Appendix 3

3-A Santa Barbara County Supply and Demand – Current Uses and Future Estimates, GEI for Santa Barbara County Water Resources Division, Public Works Department, 2013

3-B Santa Barbara County Groundwater Report, Santa Barbara County Water Resources Division, Public Works, 2011

3-C Santa Barbara County Creeks Bioassessment Report, 2008

3-D South Coastal Santa Barbara County Creeks Bioassessment Program, 2009 Report and Updated Index of Biological Integrity

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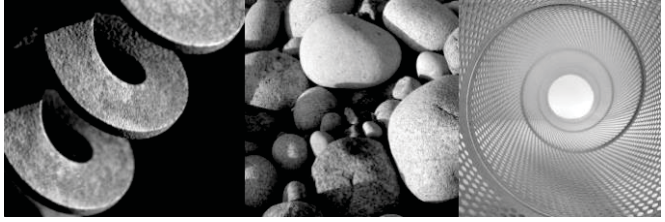
Appendix 3-A: Santa Barbara County Supply and Demand – Current Uses and Future Estimates, GEI for Santa Barbara County Water Resources Division, Public Works Department, 2013



GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Santa Barbara County Water Supply and Demand Current Uses and Future Estimates

Santa Barbara County, California

Submitted to:
Santa Barbara County Water Agency

Date: September 2013
Project No: 114970

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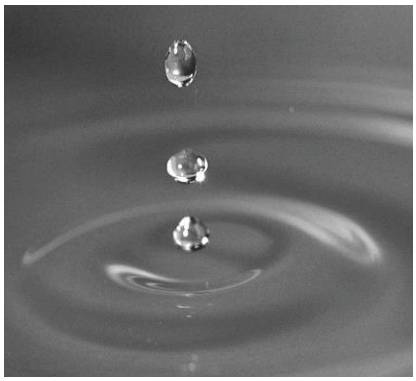

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Abbreviations and Acronyms

AB	Assembly Bill
ac	acre
AF	Acre Foot (approximately 326,000 Gallons)
AFY	Acre Feet per Year
AW	Total Applied Water
BMPs	Best Management Practices
CVWD	Carpinteria Valley Water District
CCWA	Central Coast Water Authority
CIMIS	California Irrigation Management Information System
COMB	Cachuma Operation and Maintenance Board
CUWCC	California Urban Water Conservation Council
CVWD	Carpinteria Valley Water District
DAU	Detailed Analysis Unit
DMM	Demand Management Measure
DU	Distribution Uniformity (of irrigation)
DWR	California Department of Water Resources
GCMs	Global Circulation Models
GSWC	Golden State Water Company
ID #1	Santa Ynez River Water Conservation District Improvement District #1
IRWM	Integrated Regional Water Management
LACSD	Los Alamos Community Services District
MHCSD	Mission Hills Community Services District
MOU	Memorandum of Understanding
MWD	Montecito Water District
PCM	Parallel Climate Model
SBCFCWCD	Santa Barbara County Flood Control and Water Conservation District
SBCAG	Santa Barbara County Area Governments
SBCWA	Santa Barbara County Water Agency

SMVMA	Santa Maria Valley Management Area
SYRWCD	Santa Ynez River Water Conservation District
SWP	State Water Project
USGS	United States Geological Survey
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plans
UWMPA	Urban Water Management Plan Act
VAFB	Vandenberg Air Force Base
VVCSD	Vandenberg Villiage Coummunity Services District

1 Introduction and Summary of Results

1.1 Introduction

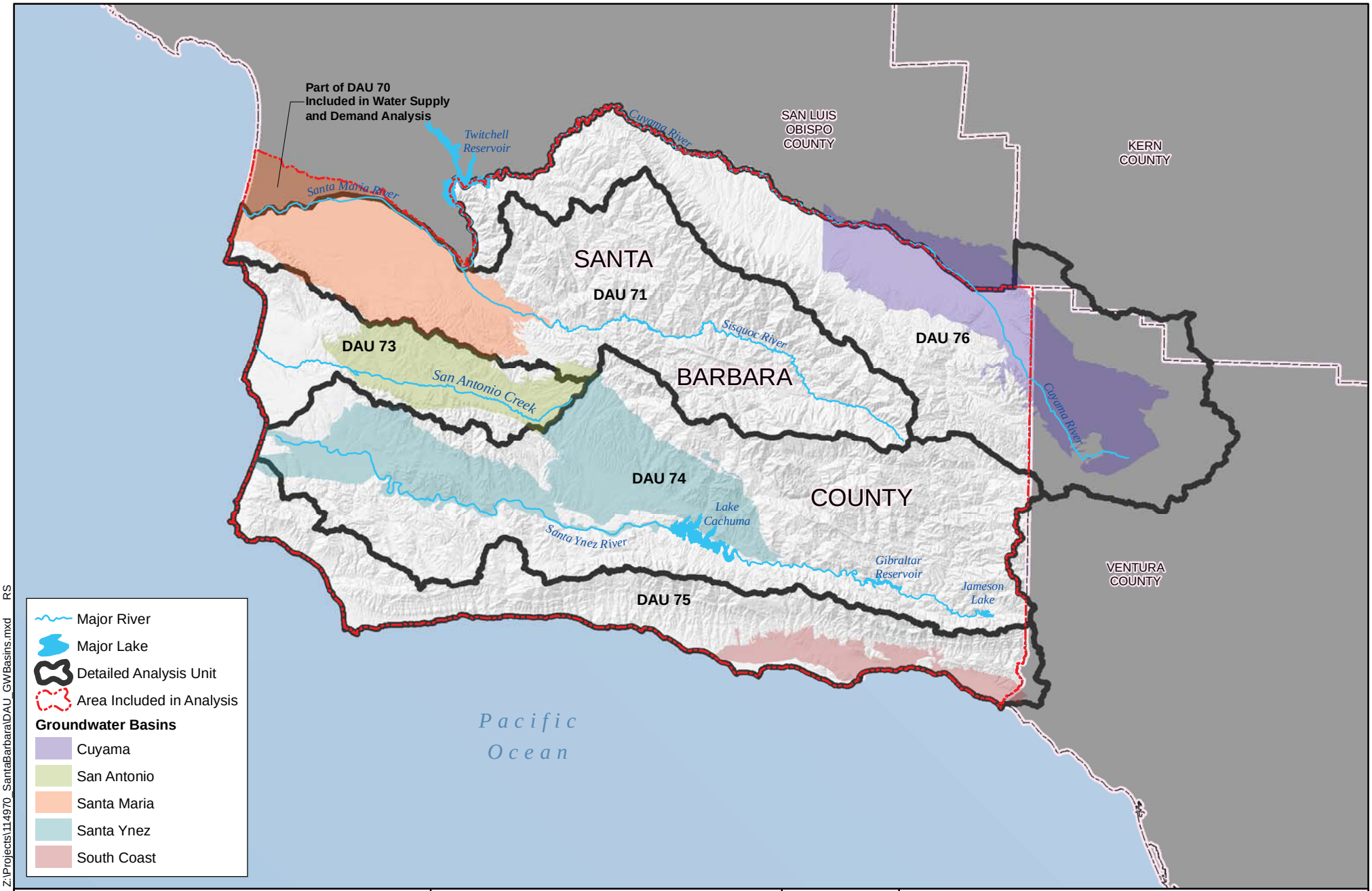
The Santa Barbara County Water Agency (SBCWA) is a dependent special district with water supply and water planning responsibilities throughout Santa Barbara County. The SBCWA was established by legislative action in 1945 and functions as part of County government. Among its responsibilities over the years the SBCWA has contracted with the United States (Bureau of Reclamation) for the Cachuma and Santa Maria (Twitchell Reservoir) Projects, provided planning and contract management services for the County share of the State Water Project (SWP), led a regional water conservation effort, coordinated the County-wide Integrated Regional Water Management Planning effort, and performed hydrologic monitoring and modeling. In 1991, and 2003 the Agency prepared water supply and demand projections for all areas of the County to provide a basis for evaluating trends in water supply and demands within planning areas.

Due to availability of 2010 census data, changes in state law regarding water conservation and other factors, SBCWA has prepared this update of the supply demand study completed in 2003. The analysis will be a basis for revision of the Santa Barbara Integrated Regional Water Management Plan and help demonstrate compliance with emerging requirements to further increase water use efficiency.

Recently available census data, updated Urban Water Management Plans (UWMP), and recent California Urban Water Conservation Council (CUWCC) reports provide current and projected water supply and use data for individual public water suppliers (purveyors). Up-to-date population and demographic trends can be used to understand current water user profiles and project the demographics of future user groups. Using this information, regional programs may find insight that will improve the delivery of their services.

1.2 Detailed Analysis Units

Because the focus of this report is regional water supply and demand trends rather than the water supply balance for individual water purveyors or basins, the supply data is aggregated for the Detailed Analysis Units (DAUs) as defined by the California Department of Water Resources (DWR) (Figure 1-1). Each DAU is watershed based and encompasses one or more rivers and their tributaries, and one or more basins. Within Santa Barbara County, there are five DAUs: the Santa Maria (DAU 71), the San Antonio (DAU 73), the Santa Ynez (DAU 74), the South Coast (DAU 75), and the Cuyama Valley (DAU 76). Only the part of each DAU within Santa Barbara County is considered. A portion of DAU 70 is located outside of Santa Barbara County and considered as part of the Santa Maria Groundwater Basin



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Santa Barbara County, California

Santa Barbara County Water Agency

GEI Consultants

LOCATION OF RIVERS, GROUNDWATER BASINS AND PRINCIPAL RESERVOIRS IN SANTA BARBARA COUNTY WITH OUTLINES OF DETAILED ANALYSIS UNITS

SEPTEMBER 2013

FIGURE 1-1

11-Sep-2013 Z:\Projects\114970_SantaBarbara\DAU_GWBasins.mxd RS

and part of the Supply and Demand analysis for consistency with yield estimates from previous studies. Portions of the area in DAU 76 (Cuyama) are within adjacent counties and not considered in this analysis. Supply and demand in these areas are the topic of other studies such as Luhdorff and Scalmanini Engineers, (2010) in DAU 74 and an ongoing investigation by SBCWA, United States Geological Survey (USGS) and DWR in DAU 76.

1.3 Use of the Analysis

This analysis is intended to provide a general overview of trends in the Santa Barbara County Region. In addition, the supply-demand projections will play an important role in the Santa Barbara Integrated Regional Water Management (IRWM) Plan by identifying areas where demand may exceed supply and by demonstrating the need for protection or augmentation of certain sources of water. In addition, understanding likely changes in user demographics will help each water purveyor better focus its efficiency programs in order to meet the State's aggressive water conservation policies.

The information provided may be used to consider general regional trends in water supply and demand projections through the year 2040. However, it should be noted that both demand and supply vary from year to year due to changes in weather patterns (climate change), water conservation practices, land use, agricultural cropping patterns, and a wide variety of other factors. Therefore, this is a general assessment of water supply and demand and it should be reevaluated from time to time as factors change.

1.4 Santa Barbara County Region Water Supply and Demand

This report focuses on long-term trends. Because annual water use and supply may fluctuate due to weather and other factors, this report evaluates water supply and demand in five-year increments. Basing the approach on average or typical use is similar to reports published by SBCWA in 1991 and 2003. This report is regional in scope; it does not attempt to evaluate short-term (seasonal) or peak demand. More detailed evaluations are the basis of individual water system design and operation.

This report relies on a number of data sources; many are the same as those used for the previous reports. In all cases data available directly from purveyors or other relevant public agencies were used. In particular water use and availability data from the County Water Agency, population data from the census coupled with urban water plans prepared by the largest water purveyors provide a reasonably complete picture of past and current urban water demand. In those cases where data were not previously developed for the needs of this report, alternative sources and estimates were relied on as documented in various footnotes.

2 Data, Approach and Assumptions

The focus of this report is regional water supply and demand trends rather than the water supply balance for individual water purveyors or basins. The input data and results are aggregated for the DAUs within Santa Barbara County. Other ongoing studies look at areas such as the Cuyama Valley and Santa Maria Valley that encompass areas outside the jurisdiction of the County Water Agency.

2.1 Data Sources

This report relies on existing publically available sources of information. Past and present population estimates were based on census data. Water use and water use projections were obtained from Urban Water Management Plans, the County Water Agency, and, for agriculture, based on cropping information from the County Agricultural Commissioner's office. The approach used in the Santa Maria Valley Management Area (SMVMA) Annual Report to the court was used as a basis for estimating agricultural water demand. Future population projections were obtained from Urban Water Management Plans and the Santa Barbara County Area Governments (SBCAG).

2.2 Population Projection Calculation Approach

Population projections are based on existing projections by public agencies as noted in Appendix A (Tables A-1 and A-2). For the unincorporated service areas of Vandenberg Village Community Services District (VVCSD) and La Cumbre Mutual Water Company, population estimates were obtained from SBCAG for 2030 and 2040, but these numbers did not fit within past and near-term trends. In those two cases estimations were developed that showed a consistent rate of growth beginning in 2015 and ending with year 2040 estimates from SBCAG.

2.3 Water Supplies and Demand Analysis Approach

Water supply descriptions were developed from reports by Santa Barbara County, individual water purveyors, and regional water management entities such as the Central Coast Water Authority (CCWA) and the SMVMA group (Table 2-1). Future changes in water supply were estimated from existing reports including UWMPs and facility management plans, modeling by the State of California (for the SWP), and adjudication results.

Demand analysis was based on the requirement of State law (AB 2020), UWMPs, existing data on per capita, and overall purveyor use and agricultural cropping. Future urban demand

was estimated based on projected changes in population and changes in per capita demand over the period of the analysis.

Crop acreages and crop types were obtained from the County Agriculture Commissioner's Office and other sources (and are shown in Appendix E). Estimates of water demand were based on the needs of each crop type and acreage of each type. Crop water use factors were obtained from the University of California Agricultural Extension Service. Except for the Cuyama area each area utilized a 5-year average unit calculation for applied crop water requirements since their climate zones were very similar for most of the DAUs. There is some potential for increased crop water requirements due to the climate of the most inland portions of the Santa Ynez DAU; however, published data were not available to support a different calculation. The Cuyama Valley climate is significantly different than the coastal DAUs; therefore, crop water requirements from a 2008 study were utilized (Gibbs 2011).

For each of the five DAUs, Total Applied Water (AW) is equal to the sum of the individual crop type category acres (ac) times the assigned Unit Water Requirement (af/ac/yr). Return flow of applied water from irrigation has a direct relationship with distribution uniformity (DU), which is a measurable characteristic of irrigation systems. Within each DAU, total AW was calculated based on the crop type and acreages obtained from the County Agriculture Commissioner's Office. For each of the five DAUs, Return Flow was based on the DU assigned for each crop category of the SMVMA study. A weighted average of irrigated crop type acres times the representative DU for the crop type (based on SMVMA) provided an estimate for return flow of AW to the supply.

This approach is widely used in California and locally in the annual report to the Court by the SMVMA prepared by the engineering consultant Luhdorff and Scalmanini (Luhdorff and Scalmanini 2011).

The formula used in this study to estimate Applied Water is AW = [(ETc-Eff.Precip.)/DU]

Given: AW = Applied Water

ETc = Evapotranspiration of Crop

Eff. Precip. = Effective Precipitation

DU = Distribution Uniformity

<u>Crop Acreage</u> was estimated by verifying crop inventories and interpreting aerial photography of crop category (acres).

<u>Total Applied Water</u> = sum of estimate of <u>Applied Water</u> times the <u>Crop Acreage</u> for each crop category.

Methods used for estimating parameters:

ETc – Based on California Irrigation Management Information Service (CIMIS) data in the Santa Maria area or DWR

Effective Precipitation – Estimated based on monthly precipitation in months with ETc

-or-

ETaw – Evapotranspiration of Applied Water; Estimated based on previous studies/DWR values

DU – Based on previous studies

Maps of crops and summaries of crop types and water use are contained in Appendix E.

2.4 Water Use Sectors

This report recognizes two major water use sectors: agriculture and urban. We have included cooling, packing, and other product processing uses in the agriculture sector. Urban water use includes municipal water use, primarily residential and limited industrial use. Industrial use is contained within the overall purveyor water demand. Where reported separately, residential water use is applied as the basis for per capita water use estimates. Residential water use was made available for most purveyors by the County Water Agency.

2.5 Current Population and Demographic Data

Current population and demographic data was obtained from the US Census and is summarized in Table 2-2 Demographic Data for Purveyor Service Areas. These data were developed as a basis for targeting water conservation messages so they may reach all elements of the water user community. Future population estimates were based on UWMPs and SBCAG projections. Estimates of future population do not include projections of changes in demographics.

2.6 Per Capita Water Demand

Per capita water demand has been compiled for most purveyors by the County Water Agency from 1999 to 2011 and is summarized in Table 2-3. These estimates were compared to information contained in 2010 UWMPs. Data from UWMPs were used in cases where there was discrepancy (such as with population forecasts). No per capita water demand (for domestic use) was estimated for rural areas outside existing service areas. The domestic water use in these areas is either relatively small (San Antonio Valley) or isolated (Gaviota coast portion of the south coast area).

2.7 Future Land Use Changes

Future land use changes were reviewed based on County General Plan and various Cities' General Plan development scenarios. Sphere of influence reports were evaluated to estimate both increase of population and potential conversion of agricultural lands. Because in most areas land use regulations are protective of agriculture, the effect of future development on crop water demand is considered negligible.

2.8 Water Use Efficiency

The larger urban areas of Santa Barbara County have participated in water use efficiency programs since the 1980s. More recent State legislation and policies have increased reporting requirements for the larger water purveyors whose previously existing water efficiency programs had already had a direct effect on per capita water use. The Demand Management Measures implemented by the larger water purveyors, as reported in their 2010 Urban Water Management Plans, are shown in Table 2-4. Although some local purveyors (such as the City of Santa Barbara and the Goleta Water District) were leaders in developing water conservation measures, the Demand Management Measures currently used by larger purveyors county-wide generally conform to descriptions developed through the California Urban Water Conservation Council (CUWCC).

Table 2-1 Agencies Involved Directly in Water Supply

Regional Agencies

Santa Barbara County Water Agency
Santa Barbara County Flood Control and Water Conservation District
Central Coast Water Authority
Santa Maria Valley Water Conservation District
Twitchell Management Authority
Santa Ynez River Water Conservation District ("Parent District")
Cachuma Operations and Maintenance Board

Participation of "retail" water suppliers (purveyors) in management programs (north to south)

Water Supplier	State Water Project	Cachuma Project	Urban Water Management Plan	Urban Water Conservation Council Member	Groundwater Management Plan or Adjudication
Cuyama CSD					
City of Santa Maria	yes		yes	yes	Yes (1)
City of Guadalupe	yes		yes		
Golden State Water Co.	yes		yes	yes	Yes (1)
Casmalia CSD					Yes (1)
Los Alamos CSD					
Vandenberg Village CSD					
Vandenberg AFB	yes				
Mission Hills CSD					
City of Lompoc			yes		In Progress
City of Buellton	yes				
City of Solvang					
Santa Ynez River CD ID#1	yes	yes	yes	yes	
Goleta Water District	yes	yes	yes	yes	yes
La Cumbre Mutual Water Co.	yes				
City of Santa Barbara	yes	yes	yes	yes	Pueblo rights
Montecito Water District	yes	yes	yes	yes	
Carpinteria Valley Water District	yes	yes	yes	yes	yes

Note: (1) Change since 2003 report.

Table 2-2 Demographic Data for Purveyor Service Area

Area	Demographic Information (1)													
	Population (2010)	Residential Units		Average Household Size (2)	Median Age	Median Household Income	Single-Family Units (3)		Multi-Family Units		Other Units (4)		Primary Languages	Ethnicity
		Total Units	Occupied Units				No. of Units	Percent of Total Units	No. of Units	Percent of Total Units	No. of Units	Percent of Total Units		
Cuyama CSD (5)	517	202	147	3.51	35.1	$45,313	202	100%	0	0	0	0	English 53% Spanish 47%	White: 268 (52%) Hispanic/Latino: 234 (45%) Other: 15 (3%)
City of Santa Maria	99,747	29,373	27,948	3.57	29	$51,450	19,340	66%	8,373	28%	1,660	6%	English 37% Spanish 58% Other 5%	White: 21,596 (22%) Hispanic/Latino: 70,409 (70%) Black: 2001 (2%) Asian: 4,946 (5%) Other: 795 (1%)
City of Guadalupe	7,080	2,007	1,888	3.75	28.2	$42,978	1,420	71%	577	29%	10	<1%	English 26% Spanish 71% Other 3%	White: 626 (9%) Hispanic/Latino: 6,103 (86%) Other: 351 (5%)
Orcutt (GSWC) (6)	28,905	11,582	10,908	2.65	42.3	$64,328	9,555	82%	687	6%	1,340	12%	English 86% Spanish 9% Other 5%	White: 19,667 (68%) Hispanic/Latino: 6,870 (24%) Black: 375 (1%) Asian: 1,012 (4%) Other: 981 (3%)
Casmalia CSD (7)	138	98	98	1.4	43	$42,692	86	88%	0	0	12	12%	English 4% Spanish 96%	White: 74 (54%) Hispanic/Latino: 58 (42%) Other: 6 (4%)
Los Alamos CSD (8)	1,890	472	449	4.2	38.2	$56,645	325	69%	40	8%	107	23%	English 55% Spanish 42% Other 3%	White: 1,057 (56%) Hispanic/Latino: 773 (41%) Other: 60 (3%)
Vandenberg AFB	3,338	1,296	1,022	3.7	22.5	$51,439	1,175	91%	121	9%	0	0	English 91% Spanish 7% Other 2%	White: 2,005 (60%) Hispanic/Latino: 616 (18%) Black: 285 (9%) Asian: 197 (6%) Other: 235 (7%)
Vandenberg Village CSD (9)	6,497	2,735	2,595	2.5	45	$77,121	2,315	85%	415	15%	5	<1%	English 87% Spanish 10% Other 3%	White: 4,385 (67%) Hispanic/Latino: 1,216 (19%) Black: 261 (4%) Asian: 304 (5%) Other: 331 (5%)

Area	Demographic Information (1)													
	Population (2010)	Residential Units		Average Household Size (2)	Median Age	Median Household Income	Single-Family Units (3)		Multi-Family Units		Other Units (4)		Primary Languages	Ethnicity
		Total Units	Occupied Units				No. of Units	Percent of Total Units	No. of Units	Percent of Total Units	No. of Units	Percent of Total Units		
Mission Hills CSD (10)	3,576	1,241	1,124	3.2	40	$68,448	1,241	100%	0	0	0	0	English 69% Spanish 28% Other 3%	White: 2,089 (59%) Hispanic/Latino: 1,137 (32%) Asian: 120 (3%) Other: 230 (6%)
City of Lompoc	42,434	14,196	13,061	3.2	33.9	$47,466	8,445	60%	4,724	33%	1,027	7%	English 58% Spanish 37% Other 5%	White: 15,424 (36%) Hispanic/Latino: 21,557 (51%) Black: 2,204 (5%) Asian: 1,505 (4%) Other: 1,744 (4%)
City of Buellton	4,828	1,551	1,507	3.2	39.1	$63,988	1,110	72%	107	7%	334	21%	English 60% Spanish 35% Other 5%	White: 3,034 (63%) Hispanic/Latino: 1,451 (30%) Asian: 132 (3%) Other: 211 (4%)
City of Solvang	5,245	2,207	2,136	2.5	45	$61,289	1,390	63%	696	32%	121	5%	English 74% Spanish 20% Other 6%	White: 3,597 (67%) Hispanic/Latino: 1,530 (29%) Other: 208 (4%)
SYRWCD ID#1	6,017	2,568	2,365	2.5	---	----	2,398	94%	110	4%	60	2%	English 88% Spanish 10% Other 2%	White: 4,847 (82%) Hispanic/Latino: 810 (13%) Other: 31 (5%)
Los Olivos	1,132	516	419	2.7	48	$81,964	516	100%	0	0	0	0.0%		
Ballard	467	195	180	2.6	45.7	$98,889	195	100%	0	0	0	0.0%		
Santa Ynez	4,418	1,857	1,766	2.5	47.8	$98,015	1,687	91%	110	6%	60	3.0%		
Goleta Water District (11)	86,946	29,645	28,193	3.1	36.5 (14)	$66,921 (14)	16,645	57%	12,019	40%	981	3%	English 68% Spanish 20% Other 12%	White: 51,558 (59%) Hispanic/Latino: 23,278 (27%) Black: 1,306 (2%) Asian: 7,796 (9%) Other: 3,008 (3%)
Hope Ranch (12)	3,653	1,626	1,452	2.5	53.1	$118,750	1,442	89%	184	11%	0	0	English 92% Spanish 3% Other 5%	White: 3,167 (87%) Hispanic/Latino: 310 (8%) Other: 176 (5%)
City of Santa Barbara	88,410	37,132	33,220	2.7	36.8	$61,937	22,360	60%	14,618	39%	154	1%	English 62% Spanish 30% Other 8%	White: 48,417 (55%) Hispanic/Latino: 33,591 (38%) Asian: 2,927 (3%) Other: 3,475 (4%)
Montecito WD (13)	10,413	4,840	4,006	2.6	---	---	3,999	83%	813	17%	28	<1%	English 91% Spanish 4% Other 5%	White: 9,061 (87%) Hispanic/Latino: 797 (8%) Other: 555 (5%)
Montecito	8,965	4,163	3,414	2.6	50	$110,375	3,626	88%	520	12%	17	<1%		
Summerland	1,448	677	592	2.4	49.2	$63,654	373	55%	293	43%	11	2%		
Carpinteria Valley WD	13,040	5,472	5,031	2.6	39.5	$63,834	2,602	48%	2,015	37%	855	15%	English 60% Spanish 36% Other 4%	White: 6,081 (47%) Hispanic/Latino:6,351 (49%) Other: 608 (4%)

(1) Source: 2010 Census Data: http://factfinder2.census.gov
(2) Average household size determined by dividing population by the number of occupied units.
(3) Includes 1-unit detached and 1-unit attached residences.
(4) Includes mobile homes, boats, recreation vehicles, vans, etc.
(5) Data reported is for the New Cuyama Census Designated Place
(6) Data reported is for the Orcutt Census Designated Place
(7) Data reported is for the Casmalia Census Designated Place
(8) Data reported is for the Los Alamos Census Designated Place
(9) Data reported is for the Vandenberg Village Census Designated Place
(10) Data reported is for the Mission Hills Census Designated Place
(11) 2010 population estimate is from the GWD 2010 Urban Water Management Plan, November, 2011. Other reported data were derived from census data for the City of Goleta and unincorporated census tracts served by the GWD.
(12) Data reported is for Census Tract 30.07
(13) Data reported is for the City of Carpinteria
(14) Data reported is for the City of Goleta only.

Table 2-3 Recent Per Capita Residential Water Demand by Service Area

Average Daily Per Capita Water Use* Based on Total Residential Use** (Gallons/Person/Day)											
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Buellton	226.7	257.5	253.5	281.9	264.7	281.2	291.3	306.0	298.4	266.7	273
Carpinteria VWD	115.1	123.3	113.9	116.6	104.3	102.4	109.0	103.9	101.4	111.1	110
Casmalia CSD						46.3	46.3	41.1	40.1	38.0	42
Cuyama CSD	198.8	224.2	193.8	209.2	191.8	183.1	121.6	187.4	180.4	158.7	185
Golden State Water	211.3	219.7	219.8	200.3	200.3	177.6	195.8	201.5	182.4	160.0	197
Goleta WD	121.0	114.8	99.8	106.4	107.1	108.1	118.0	116.7	110.2	101.8	110
Guadalupe	103.8	111.3	95.3		118.5	116.7		129.6	130.3	117.8	115
La Cumbre MWC	242.9	321.4	299.2	334.5	294.0	295.2	306.7	335.5	293.5	264.4	299
Lompoc	101.4	108.0	102.6	102.4	106.2	104.1	111.0	105.5	109.2	98.8	105
Los Alamos CSD	187.0	213.1	199.2	234.5	221.0	195.4	181.5	180.5	174.8	153.7	194
Mission Hills CSD	160.0	171.5	165.8	171.9	173.3	189.3	200.7	200.7	179.6	162.6	178
Montecito WD	209.2	263.5	241.6	270.8	322.0	344.9	414.0	391.1	352.0	305.8	311
Santa Barbara	113.3	128.0	121.5	129.8	125.4	120.8	135.2	131.3	122.2	110.7	124
Santa Maria	124.0	137.5	136.6	135.1	124.2	123.3	135.6	131.4	129.9	117.2	129
S.Ynez RWCD ID#1	311.2	295.7	273.1	270.5	262.2	272.8	308.3	296.1	284.1	256.2	283
Solvang	258.6	252.0	229.4	243.3	226.6	225.7	167.3	244.2	229.8	214.9	229
Vandenberg AFB								231.9	143.6	191.0	189
Vandenberg Village	185.0	208.0	217.0	230.5	223.8	201.7	219.8	216.7	212.5	185.1	210
Average	**179**	**197**	**185**	**203**	**192**	**182**	**191**	**197**	**182**	**167**	**182**

* Per Capita Use is total water divided by population, and rounded up or down; 1 acre-foot=325,851 gallons.
** Residential Use = Single Family Residential Use and Multifamily Residential Use divided by population.
Data was originally sourced from Public Water System Statistics Form #38, which water purveyors submit annually to California Department of Water Resources.

Table 2-4 Demand Magagement Measure Implementation Summary - 2010

DEMAND MANAGEMENT MEASURE IMPLEMENTATION SUMMARY - 2010

Jurisdiction	DMM A	DMM B	DMM C	DMM D	DMM E	DMM F	DMM G	DMM H	DMM I	DMM J	DMM K	DMM L	DMM M	DMM N
	Residential Water Surveys	Res. Plumbing Retrofits	Water Audits and Repair	Meters	Landscape Conservation	Washing Machine Rebates	Public Information	School Education	Conservation for CII Users	Wholesale Agency Prgms	Conservation Pricing	Conservation Coordinator	Water Waste Prohibition	ULFT Replacement
City of Santa Maria	✓	✓	✓	✓	E	E	✓	✓	✓	NA	✓	✓	✓	E
Central Coast Water Authority (wholesaler)	NA	NA	✓	✓	NA	NA	✓	✓	NA	NA	NA	NA	NA	NA
City of Lompoc	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA		✓	✓	✓
City of Santa Barbara	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓	✓	✓	✓
Golden State Water - Orcutt	✓	✓	✓	✓	✓	✓	✓	✓	NI	NA	✓	✓	✓	✓
Carpinteria Valley Water District	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓	NI	✓	✓
Montecito Water District	✓	?	✓	✓	✓	?	✓	✓	?	NA	✓	✓	✓	?
Goleta Water District	✓	✓	✓	✓	✓	✓	✓	✓	✓	NA	✓	✓	✓	✓

✓ Jurisdiction has implemented or partially implemented the demand management measure
E Jurisdiction is exempt
NA Not Applicable
NI Not Implemented
? Not Addressed by Plan
F Will implement in the future

3 Past and Present Water Supplies and Demand

3.1 Brief History of Water Supply Development

Initial development of water supplies in Santa Barbara County relied on diversion from streams and shallow wells in alluvium. The first dam in the region was completed on Mission Creek in 1807 and supplied water to the Santa Barbara Mission. Locally developed supplies were challenged by increasing demand as the City and surrounding areas increased in population. In the south coast area, tunnels were dug into the south flank of the Santa Ynez Mountains to intercept groundwater. As its first major supply project, the City of Santa Barbara commissioned the Cold Springs Tunnel, which began supplying water in 1897.

In the 1920s, the City of Santa Barbara completed Gibraltar Reservoir on the upper Santa Ynez River and used the Mission Tunnel (completed in 1912) to deliver supplies through the mountains. The Montecito Water District constructed Jameson Reservoir and the Doulton Tunnel in the 1920s, which began delivering supplies from the watershed upstream of Gibraltar reservoir in 1930.

In the first half of the 1900s water well construction and availability of electricity allowed development of expanded irrigation for agriculture as well as reliable supplies for growing urbanized areas of North County. Supported with improved preservation and shipping, agricultural operations expanded groundwater use through the mid-1900s. Meanwhile, urban suppliers looked also to larger reservoirs to meet future local demand and asked the Federal government to play a role in their location, design, and construction.

Two Federal projects were eventually completed: the Cachuma Project in 1956 and the Twitchell Project in 1958. The Cachuma Project comprised Cachuma Lake in the Santa Ynez River, Tecolote Tunnel, and a major distribution system along the south coast. Construction of Bradbury Dam, the South Coast Conduit, and related distribution systems was completed between 1953 and 1956. Construction of Tecolote Tunnel was completed in 1956. Twitchell Reservoir was completed in 1958 on the lower Cuyama River and serves to provide water for direct recharge to the Santa Maria basin and control of flood waters.

In anticipation of continuing growth in demand for water, and after years of controversy, in 1991 voters in several areas of the County authorized construction of local facilities to deliver water from the State Water Project (SWP). The Santa Barbara County Flood Control and Water Conservation District (SBCFCWCD) had contracted for an allocation from the State Water Project in 1963. Deliveries from the SWP are made to the urban suppliers in the Santa Maria Basin, Vandenberg Air Force Base, central Santa Ynez Valley, and south coast.

In 1990, after four years of extremely dry conditions, the City of Santa Barbara built a desalination plant as an emergency source of supply. The plant was run for a short period and has since been decommissioned and may be brought into operation in response to any future need.

Treated wastewater is used throughout Santa Barbara County either for direct reuse or for groundwater recharge. Direct reuse occurs on the south coast in the City of Santa Barbara and Goleta Water District for landscape irrigation. Both direct reuse and recharge occur in the Santa Maria Valley. Evaluation of additional use of recycled water is part of the current update of the 2007 Integrated Regional Water Management Plan.

Beginning in the early 1950's research in the Santa Barbara region demonstrated that weather modification using silver iodide could significantly increase average rainfall. Since the early 1980's the County has managed an operational weather modification program that increases rainfall an average 10-percent per year. The benefits of the weather modification program are incorporated in the estimates of local water supply.

3.2 Present Water Supplies (by area and type)

Water users in Santa Barbara County rely on regional ground- and surface-water supplies to meet the majority of their needs. Surface water is developed from reservoirs on the Santa Ynez and Cuyama Rivers, and groundwater is developed from wells in all groundwater basins (Figure 1-1). Water imported through the State Water Project is an important source to several urban water districts but is not used directly for agriculture. The following sections describe the water supplies developed within areas delineated by the State Department of Water Resources as DAUs because they correspond to major hydrologic basins and generally defined areas of use.

The County has several large basins that in total supply most of the water used in Santa Barbara County (Figure 1-1). The nature of these basins has been studied extensively by the US Geological Survey and their characteristics are well described in the Santa Barbara County Water Agency Groundwater Report prepared on a triennial basis. The basins generally comprise alluvium and consolidated alluvial materials underlain by much older rocks of lower permeability and containing water of poorer quality. Several basins provide sufficient water for all uses and most can be developed successfully through prolonged drought with recovery in subsequent wet periods. However, other basins, although containing large quantities of water, are subject to water level decline or water quality degradation if not carefully managed. Management includes provision of supplemental supply sources such as reservoirs or the SWP. Additionally, several key groundwater basins are subject to management plans or court oversight (as a result of adjudication) (Table 3-1).

Table 3-1 Adjudications and Groundwater Management ("AB 3030") Plans in Santa Barbara County

Groundwater Basin	Water Supplier Involved	Groundwater Management Plan or Adjudication
Santa Maria Groundwater Basin	City of Santa Maria	Adjudication (1)
	City of Guadalupe	Adjudication (1)
	Golden State Water Co.	Adjudication (1)
	Casmalia CSD	Adjudication (1)
Lompoc Basin within City boundary	City of Lompoc	groundwater plan In Progress (1)
Goleta and Goleta West basin	Goleta Water District	Adjudication
Carpinteria Basin within District boundary	Carpinteria Valley Water District	groundwater plan

Note: (1) Change since 2003 report.

In Santa Barbara County several rivers flow from back-country watersheds into the ocean. Due to the local climate, flow of these rivers is highly variable with more years of below average flow than years with higher flow. Four reservoirs have been built by public agencies to capture these surface flows: one on the Cuyama River (Twitchell Reservoir) and three on the Santa Ynez River (Jameson Lake, Gibraltar Reservoir and Cachuma Lake) as shown on Figure 1-1. The role each reservoir plays in supplying water is discussed in the appropriate DAU section.

In addition to local supplies, the Central Coast Water Authority (CCWA) operates the Coastal Branch of the SWP to bring treated water to a number of purveyors in the County. Table 3-2 lists the areas served SWP supplies and the amount allocated to each participating entity. Because all water delivered to Santa Barbara County passes through the Polonio Pass Treatment Plant, these potable water supplies may be introduced directly into each purveyor's distribution system. CCWA contracts with the SBCFCWCD for a SWP allocation of 45,486 Acre Feet per Year (AFY) divided among 14 allocation holders with 41,578 AFY held by individual participants and an additional 3,908 AFY is held by CCWA as a "drought buffer" to help firm up the overall entitlement of SWP participants in Santa Barbara County. Nominally equal to ten percent of the base entitlement of SWP project participants in Santa Barbara County, the drought buffer is intended for potential use by SWP project participants during years when the availability of SWP water is less than project participants' delivery requests.

Table 3-2 State Water Project Allocations in Santa Barbara County

State Water Allocations in Santa Barbara County		
Project Participant	**SWP Allocation (AFY)**	**Drought Buffer (AFY) (1)**
City of Santa Maria	16,200	1,620
Golden State Water Company	500	50
City of Guadalupe	550	55
Vandenberg Air Force Base	5,500	550
City of Buellton	578	58
City of Solvang (2)	1,500	0
Santa Ynez River Water Conservation District ID#1 (2)	500	200
Goleta Water District (3)	4,500	450
Goleta Water District additional "drought buffer"		2,500
Morehart Land Company (3)	200	20
Raytheon Infrared Operations (3)	50	5
La Cumbre Mutual Water Co. (3)	1,000	100
City of Santa Barbara	3,000	300
Montecito Water District	3,000	300
Carpinteria Valley Water District	2,000	200
Total	**41,578**	**3,908**

Notes: (1) CCWA holds additional allocation in the name of certain participants; Goleta Water District has an additional amount.
(2) The City of Solvang holds a contract with ID #1 for a 1,500 AFY allocation.
(3) Goleta Water District holds contracts for delivery of allocation held by Morehart, Raytheon and La Cumbre Mutual.

Due to variations in runoff in the SWP source area, actual deliveries in any given year may vary considerably. However, in 2011the State Department of Water Resources published an analysis that showed average annual deliveries ("reliability") of the SWP would be 78 percent of Table A allocation held by project contractors. Management measures employed by CCWA and their participants (such as the drought buffer, short-term purchases, exchanges, and groundwater banking) increase reliability of delivery in any given year to 86 percent of the SWP allocation shown in Table 3-2.

3.2.1 Santa Maria River Watershed (DAU 76 and DAU 71)

The Santa Maria River watershed includes the Cuyama, Sisquoc, and Santa Maria rivers and their tributaries. The area is divided into two Detailed Analysis Units; DAU 76 and DAU 71. DAU 76 encompasses the Cuyama watershed above Twitchell Reservoir and includes the

Cuyama Valley. DAU 71 encompasses the Sisquoc, Santa Maria, and lower Cuyama watersheds and includes the Santa Maria Valley.

3.2.1.1 Cuyama Valley (DAU 76)

The Cuyama Valley is located in a 1,140 square mile watershed area and includes northeastern Santa Barbara County, southeastern San Luis Obispo County, and relatively small portions of Ventura and Kern counties. The Cuyama River crosses the Valley and is the main source of recharge to the basins. Flow in the Cuyama River is unregulated above the Cuyama Valley and occurs only in years of above average rainfall.

The Cuyama Basin comprises unconsolidated sands and gravels that fill a 225-square-mile valley that lies between the Sierra Madre Mountains on the south and the Caliente Mountain Range on the north. The water resource in the basin underlies portions of Ventura, Kern, and San Luis Obispo counties. The basin is the sole source of water in the area, serving primarily agricultural users, but also the community of New Cuyama and small petroleum development operations. The Cuyama Community Services District delivers approximately 1 percent of the water used in DAU 76. The basin has historically contained a large volume of water: an estimated dewatered storage of 400,000 AF estimated in 1972 had increased to 1,500,000 AF in 2008 due in part to development for agriculture and in part due to limited recharge. The USGS and County of Santa Barbara are performing a major evaluation of the groundwater resource, and the study is expected to be complete in 2013.

<u>Agricultural Water Use in DAU 76</u>
The climate of the Cuyama Valley is significantly different than the coastal DAUs, therefore, crop water requirements from an ongoing study were utilized (Gibbs 2011). For the Cuyama Valley, irrigated acres are based on a comparison of information obtained from Santa Barbara County Agriculture Commissioner's office, San Luis Obispo County studies. Cuyama, unit water requirements (af/ac) are based on the ongoing study since this climate zone is much different than the other DAUs. The crop acreage and water use in the Cuyama Valley are shown in detail in Appendices E and F.

3.2.1.2 Santa Maria Valley (DAU 71)

DAU 71 receives water from both local groundwater and imported (State Water Project) sources. Groundwater is developed from the Santa Maria basin, which is recharged by rainfall, surface flow, and recycled water.

The Santa Maria Valley covers the 260 square miles of this watershed area and is crossed by the Santa Maria River and lower reaches of the Sisquoc and Cuyama rivers. The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc rivers near Fugler Point about 20 miles from the Pacific Ocean. The Santa Maria River is ephemeral, with no surface

through flows about 83 percent of the time. Much of the valley consists of a broad alluvial plain.

The Santa Maria Valley is underlain by an extensive deposit of water bearing alluvium and semi consolidated sedimentary deposits. These materials comprise a major aquifer system and virtually the sole source of groundwater supply in the area. The aquifer is unconfined east of the vicinity of Black Road (west of the City of Santa Maria) and includes an upper unconfined zone and lower confined zone west of Black Road.

The majority of water available to the Santa Maria Valley has historically derived from stream flow in the Santa Maria River originating from the Cuyama and Sisquoc rivers. This stream flow is not developed directly as a supply, but rather is the main source of groundwater recharge in the area. Releases from Twitchell Reservoir are used exclusively to augment natural recharge to the groundwater basin. Thus, quality in aquifers underlying much of the Santa Maria Valley has historically reflected the water quality of stream flow in the Cuyama and Sisquoc rivers.

Water used for agricultural purposes in the Santa Maria Valley is developed exclusively from groundwater. The three public water system operators currently deliver approximately 17 percent of the water used in DAU 71. Development of most groundwater for municipal purposes is from numerous water supply wells located in the vicinity of the Santa Maria Airport and the town of Orcutt. The City of Guadalupe and the communities of Sisquoc and Garey are served by wells within each community.

Water is imported to the Santa Maria Valley through the Coastal Branch of the State Water Project for municipal use. Municipal supplies are delivered directly to the cities of Santa Maria and Guadalupe and the Tanglewood community serviced by the Golden State Water Company (GSWC, formerly Southern California Water Company). The GSWC serves both groundwater and SWP supplies to the community of Orcutt and its immediate area. GSWC makes its SWP deliveries to the community of Orcutt through interconnections with the City of Santa Maria. (The GSWC provides solely groundwater to the small towns of Sisquoc and Garey.)

Surface Water Role

The Santa Maria River is formed by the Sisquoc and Cuyama rivers. The Sisquoc River is unregulated and drains an area that is generally undeveloped. Flow in the lower portion is intermittent, and when flowing, it recharges the eastern portion of the Santa Maria Groundwater Basin.

The Cuyama River is effectively regulated by Twitchell Reservoir located 6 miles upstream from its confluence with the Sisquoc River. Because the Cuyama River flows intermittently, water level in the reservoir is highly variable. Reservoir storage reached 190,000 AF in 1983

and has exceeded 100,000 AF eight times after periods of above average rainfall in the upper watershed. However, storage is commonly below 50,000 AF during most other years. Twitchell releases are made for recharge along the Santa Maria River between Fugler Point and the Bonita School Road crossing. Water flowing past the Boneta School Road crossing would not be able to infiltrate into the deep aquifer due to an impermeable (confining layer) in the western portion of the aquifer. Since the first recorded releases in 1967, releases from Twitchell Reservoir have ranged from zero during low rainfall years and drought periods, to a maximum of 243,660 AF in 1998 (Luhdorff and Scalmanini Engineers, 2009). Supplemental recharge to the Santa Maria Valley from Twitchell Reservoir operations has been estimated to be about 32,000 AFY (Luhdorff and Scalmanini, 2011).

State Water Supply

State Water supplies are delivered directly to users in the Santa Maria Valley through turnouts in the Coastal Branch pipeline. Since the water is treated at the Polonio Pass Treatment facility, SWP supplies are potable and are delivered directly into local distributions systems. Blending may be performed if substantial groundwater is being developed at the same time. Table 3-2 shows the allocation of SWP supplies held by interests in the Santa Maria Basin.

Treated sewage effluent from the City of Santa Maria and the Laguna Sanitary District (serving Orcutt) is reused. The City of Santa Maria recharges the groundwater basin through percolation ponds adjacent to its Black Road treatment facility. Because a substantial percentage of this recharge derives from imported water, the City's recharge increases supply within the basin. Treated water recycled from the Laguna Sanitation District is derived from a relatively small percentage of SWP deliveries (compared to the City of Santa Maria) delivered to Orcutt by the Golden State Water Company. Because a much smaller proportion of Laguna Sanitation District recycled water is derived from imported sources, only a small fraction comprises a new source of supply.

Groundwater in the Santa Maria Area

The aquifer system underlying the Santa Maria Valley occupies the upper portion of a large geological depression (syncline) that is open to the west. The aquifer system comprises alluvium and partially consolidated sands and gravel with a maximum thickness of 1200 feet. Water storage above sea level within the basin varies as a function of annual rainfall. For example storage was estimated to be about 2.5 million AF (MAF) in 1984 and 1.97 MAF in 1991. (Ahlroth, 2002). The maximum recorded storage level occurred in 1918 and was estimated to be over 3 MAF (Miller and Evenson, 1966). The portion of the basin located in San Luis Obispo County is estimated to contain storage of 45,600 AF (California Department of Water Resources, 1979).

The aquifer is unconfined in most of the basin (east of Black Road) and stream flow, rainfall, and return flows all contribute significant recharge. The westernmost portion of the aquifer

includes two zones separated by an impermeable (confining) zone. Agricultural return flows and rainfall are the main sources of recharge to the upper (unconfined) zone. The lower zone is confined and receives most of its recharge from where it is unconfined east of Black Road and may receive some recharge from cross flow in wells that develop both zones. Local water level elevations suggest that both aquifer zones discharge to the Pacific Ocean to the west. No evidence of sea water intrusion has been found in monitoring wells located along the westernmost edge of the basin.

Prior to the late 1990s, all municipal and agricultural water requirements in the Santa Maria Valley were met by local pumping. Since the beginning of SWP availability in 1997, deliveries of SWP water have replaced some of the local pumping for municipal supply. In particular, the City of Santa Maria and Golden State Water Company have reduced pumping in the vicinity of the Santa Maria Airport. The reduction since 1997 has been estimated to be 50 percent on an average annual basis (Appendix A).

Agricultural Water Use in DAU 71

DAU 71 contains one sub-area that includes the Santa Maria Valley Management Area (SMVMA). The SMVMA is subject to annual reporting on water use submitted to the Court. In the annual reports Agricultural Applied Water Use (AW) has been estimated by crop category (af/ac) (Luhdorff and Scalmanini, 2011).

The Santa Maria Valley unit water requirements (af/ac) are based on the 5-year average from the Twitchell Management Authority Annual Report (Luhdorff and Scalmanini, 2011); this DAU is in the DWR's ETo Zone 3 (Appendix E). A map showing crop distribution and a spreadsheet analysis are contained in Appendix F. A summary is provided (Table 3-3).

Table 3-3 Applied Crop Water Requirements Unit Calculation, Average for 2006-2010

Santa Maria Valley Management Area – Basis for Climate Zone 3							
Crop Category	**DU %**	**2006 AF/Ac/Yr**	**2007 AF/Ac/Yr**	**2008 AF/Ac/Yr**	**2009 AF/Ac/Yr**	**2010 AF/Ac/Yr**	**5-yr Avg. 2006-2010 AF/Ac/Yr**
Rotational Veg	80	1.88	2.52	2.7	2.19	2.06	2.27
Strawberries	85	0.88	1.57	1.66	1.49	1.28	1.38
Vineyard	95	0.9	1.3	1.3	1.3	0.6	1.08
Alfalfa	80	3.27	4.38	2.25	4.00	3.41	3.46
Grain	80	0	0.8	0.3	0.4	0	0.30
Nursery		2.0	2.0	2.1	2.0	2.0	2.02
Deciduous	85	2.5	3.1	2.7	2.8	2.1	2.64
Avocado	85	2.8	3.1	2.9	2.9	2.6	2.86
Fallow		0	0	0	0	0	0.00

3.2.2 San Antonio Valley (DAU 73)

Water supplies in the San Antonio Valley are mainly derived from groundwater; some importation of State Water Project supplies occurs and is delivered to the service area of Vandenberg Air Force Base (VAFB) within the DAU. Los Alamos Creek, which drains the valley, is intermittent. Rainfall and flow in the creek are the sources of recharge. No significant impoundments occur on Los Alamos Creek or its tributaries. The Los Alamos Community Services District (LACSD) supplies water from wells to the community of Los Alamos. Water supplied by the LACSD is approximately 1.5 percent of the water currently used in DAU 73.

The San Antonio Basin underlies approximately 70,400 acres and comprises alluvium and semi-consolidated sands and gravels (Paso Robles Formation). This basin is utilized by agriculture and the LACSD; the VAFB has back-up wells in the westernmost portion of the basin, but production from those wells have fallen over 90 percent since importation of SWP supplies (Gibbs, 2009). The SBCWA (Gibbs, 2011) reports the current safe yield estimate as approximately 15,000 AFY[1]. An extensive wetland at the western end of the basin, the Barka Slough, is formed where less permeable rocks underlying the basin brings groundwater to the surface.

[1] In that report Safe Yield is defined as the maximum amount of water which can be withdrawn from a basin (or aquifer) on an average annual basis without inducing a long-term progressive drop in water level. The report acknowledges shortcomings in the use of the term but puts the use of the term in an historical context.

Agricultural Water Use in DAU 73

For the San Antonio Creek watershed, irrigated acres were mapped based on Santa Barbara County Agriculture Commissioner's data. The estimate of unit water requirements within San Antonio Creek watershed are based on DWR climate zone 3. The crop distribution map and agricultural water demand analysis is shown in Appendices E and F.

3.2.3 Santa Ynez Valley (DAU 74)

The Santa Ynez Valley comprises several sub-areas. Since each derives its supply from a different mix of sources, each sub-basin is discussed separately in the following section. The principle water supplies developed in the Santa Ynez Valley include:

- Direct deliveries from Lake Cachuma
- Shallow ("riparian") wells along the Santa Ynez River
- State Water Project deliveries

Because of their importance to water supplies in the Santa Ynez Valley, an overview of both the Cachuma Lake and the Alluvial Groundwater Basin (sometimes referred to as the "riparian basin") are provided below. Their specific role as a water supply is discussed in the appropriate subarea section. Operation of Cachuma Lake provides both direct deliveries to a portion of the valley and releases are a major source of recharge to the riparian basin in all sub-areas. The three cities and three special districts that operate community water systems deliver approximately 23 percent of the water used in DAU 74.

Cachuma Lake Discussion

Cachuma Lake is the largest and lowermost reservoir on the Santa Ynez River. Built in the mid-1950s to supply direct deliveries to portions of the Santa Ynez Valley and south coast areas (Table 3-4), it is also the main means of managing flow in the river in the lower half of the watershed. Of the water users in the Santa Ynez Watershed, only the Santa Ynez River Water Conservation District Improvement District No. 1 (ID #1) has a direct allocation of the yield of the reservoir. (Other entities that receive direct allocation of water from the reservoir are located in the South Coast area.)

Beginning with completion of the Coastal Branch pipeline, treated State Water deliveries are provided in exchange for the ID #1 Cachuma allocation; ID #1 Cachuma allocation is delivered to the south coast service areas. (This arrangement, managed by the Central Coast Water Authority, saves operating costs of the Coastal Branch and avoided construction of an additional pipeline and treatment facility.) Cachuma Lake is also used to store and deliver water to supply downstream users along the Santa Ynez River. This is done through a system

of inflow credits and releases that are timed to maintain shallow (riparian) groundwater along the Santa Ynez River within agreed to storage conditions.

Since 1993, the maximum annual Cachuma Project delivery was 25,714 AFY for all Member Units (Reclamation, 2012). This delivery limit is based on an estimate of operational yield developed by the Member Units and documented in Reclamation's report: "Guidelines for Operations, Cachuma Project, 2012". The Member Units use 25,714 AFY as the amount of water supply that can be delivered in most years with acceptable shortages or deficiency levels in critically dry years.

3-4 Cachuma Project Allocations among Cachuma Member Units

Member Unit	Percentage of Project Yield	Annual Deliveries Based on Operational Yield of 25,714 AFY
Carpinteria Valley Water District	10.938	2,813
Montecito Water District	10.311	2,651
City of Santa Barbara	32.188	8,277
Goleta Water District	36.250	9,321
SYRWCD, ID#1	10.313	2,652
Total	**100.000**	**25,714**

Santa Ynez River Alluvial Groundwater

The Santa Ynez River Alluvial Groundwater Basin consists of the unconsolidated sand and gravel alluvial deposits of the Santa Ynez River. These deposits are up to 150-feet thick, are several hundred feet across, and extend 36 miles from Bradbury Dam (Lake Cachuma) to the Lompoc Plain. Storage within the upper 50 feet of the basin is about 90,000 AF. Groundwater in the Alluvial Groundwater Basin is in direct hydraulic communication with surface flow of the river (Gibbs 2011).

Recharge to riparian zones is from direct infiltration of river flow, and to some extent direct percolation from rainfall and underflow from adjacent groundwater basins (i.e., the Santa Ynez Uplands, Buellton Uplands, and the Santa Rita area of the Lompoc Uplands Basins). Consistent with requirements of the State Water Resources Control Board, water is released from Cachuma Lake to recharge the Alluvial Groundwater Basin based on water levels in monitoring wells and "credits" of water held in reservoir storage. In any given year the amount may range from no releases up to over 10,000 AF depending on conditions (Santa Ynez River Water Conservation District, 2011). In addition, small amounts of recharge to the Santa Ynez River Alluvial Basin occur when water is released from Cachuma Lake to enhance instream habitat pursuant to requirements of the Endangered Species Act. Thus

releases from Cachuma Lake directly influence water levels in riparian areas along the Santa Ynez River downstream through the Lompoc area.

Agricultural Water Use in DAU 74

For the Santa Ynez Valley watershed, irrigated acres were mapped based on Santa Barbara County Agriculture Commissioner's data. The estimate of unit water requirements within the Santa Ynez Valley are based on DWR climate zone 3 except for the inland areas, where an adjustment was applied based on discussion with ID#1 staff. The crop distribution map and agricultural water demand analyses are provided in Appendices E and F.

3.2.3.1 Lompoc Valley Sub-Area

The Lompoc Valley and surrounding area includes the City of Lompoc, the communities of Mission Hills and Vandenberg Village, and Vandenberg Air Force Base. Irrigated agriculture is the main land use on the valley floor. Except for VAFB, which takes SWP deliveries as its principal supply, groundwater is the main source of supply in the Lompoc Valley. Both riparian groundwater and deeper aquifers are developed. The Lompoc Basin underlies the Lompoc Valley and adjacent hills to the north. The Lompoc Basin comprises three hydrologically connected sub-basins: the Lompoc Plain, the Lompoc Uplands, and the Lompoc Terrace. Together, these basins underlie about 76 square miles. The Lompoc Terrace occurs on VAFB and is not currently used as a water supply.

The Lompoc Plain sub-basin is crossed by the lowermost reaches of Santa Ynez River, which provides limited recharge. The sub-basin is bordered on the north by the Purisima Hills, on the east by the Santa Rita Hills, on the south by the Lompoc Hills, and on the west by the Pacific Ocean. The aquifer in this sub-basin is alluvial materials that are divided into two zones with only limited points of hydrologic continuity and exchange. The aquifer supplies the City of Lompoc and extensive agriculture west of the City.

The Lompoc Uplands sub-basin is bordered on the west by the Burton Mesa, on the north by the Purisima Hills, on the east by a topographic divide, which separates it from the Buellton Uplands Basin, and on the south by the Lompoc Plain Alluvial Basin and the Santa Rita Hills. The communities of Vandenberg Village and Missions Hills develop this sub-basin as a municipal supply. The sub-basin is also developed for agriculture east and south of Mission Hills.

3.2.3.2 Buellton Sub-Area

The Buellton sub-area receives supply from the Buellton Uplands Basin, Santa Ynez River Alluvial Groundwater Basin, and SWP deliveries directly to the City of Buellton. Agriculture develops both the Alluvial Groundwater Basin and the Buellton Uplands Basin. The City relies on its SWP allocation as well as supplies from both the alluvial groundwater basin and Buellton Uplands Basin to satisfy its needs.

The Buellton Uplands Basin underlies about 29 square miles directly north of the Santa Ynez River. The basin's boundaries include the impermeable bedrock of the Purisima Hills to the north, the Santa Ynez River Fault to the south, a limited connection to the Santa Ynez Upland Basin to the east, and a topographic divide with the Lompoc Basin to the west. The Santa Ynez River Alluvial Basin sediments overlie portions of the Buellton Uplands in the south-east part of the basin. Due to the north-to-south hydrologic gradient the Buellton Uplands Basin likely discharges into the Santa Ynez River Alluvial Basin.

3.2.3.3 Solvang and Santa Ynez Uplands Sub-Area

The Solvang and Santa Ynez Uplands sub-area includes the City of Solvang, and the communities of Santa Ynez, and Ballard. Water users in the sub-area receive water from four sources: from the Santa Ynez Uplands basin, production from wells along the Santa Ynez River, deliveries from the Cachuma Project, and SWP deliveries. The City of Solvang, the two communities, and much of the more populated areas receive water from all four supplies. Less densely populated areas and agricultural users rely on groundwater from either the Alluvial Groundwater Basin or the Santa Ynez Uplands Basin.

Uplands

The Santa Ynez Uplands Basin underlies 130 square miles located about 25 miles east of Point Arguello and north of the Santa Ynez River. The basin is wedge shaped, narrowing to the east. It is bounded by a topographical divide (from the San Antonio Basin) to the northwest, faults and the impermeable rocks of the San Rafael Mountains to the north and east, and impermeable rock formations that separate it from the Santa Ynez River Alluvial Basin to the south. Rainfall and stream seepage are the primary sources of recharge to the basin. The Paso Robles Formation is the major aquifer in the basin and consists of poorly consolidated gravel, sand, silt, and clay. The Careaga Sand lies underneath the Paso Robles Formation, but due to its great depth and fine-grained nature, it is not developed in most areas.

Santa Ynez River Alluvial Groundwater

The Santa Ynez Alluvial Groundwater Basin supplies water to the City of Solvang, ID#1 and several landowners whose agricultural operations are close to the river. These supplies are developed with relatively shallow wells.

Cachuma and State Water Supplies

The Santa Ynez River Water Conservation District Improvement District No. 1 (ID # 1) has an allocation of the yield of both Cachuma Lake and the State Water Project. Based on an agreement between ID #1 and the south coast area Cachuma Member Units, treated State Water Deliveries are delivered to the ID #1 distribution system in exchange for the ID#1 Cachuma allocation. The Cachuma allocation is delivered through the Tecolote Tunnel to the south coast Member Unit service areas. This arrangement, managed by the Central Coast

Water Authority saves operating costs of the Coastal Branch and avoided construction of an additional pipeline and treatment facility.

3.2.4 South-Coast Area (DAU 75)

The South Coast area is broken into several sub-areas that correspond roughly to public agency service areas: Goleta Valley, City of Santa Barbara, Montecito, Carpinteria Valley, and Gaviota Coast.

Each has a different set of water supplies. Generally, each south coast sub-area receives supply from a mix of several sources:

- Lake Cachuma
- Gibraltar Reservoir
- Juncal Reservoir (Jameson Lake)
- SWP deliveries
- Local basins
- Recycled water
- Desalination

Except for the Gaviota Coast, all areas receive deliveries from the Cachuma Lake and from the State Water Project. These shared sources are discussed below, followed by separate discussions for each sub-area individual sources. The City of Santa Barbara, three water districts, and La Cumbre Mutual Water Company operate community water systems that deliver approximately 75 percent of the water used in DAU 75.

<u>Cachuma Lake Deliveries to the South Coast</u>
Water captured and stored by Cachuma Lake is delivered to the south coast through the Tecolote Tunnel and distributed to the four public water supplies (Cachuma Member Units) by the South Coast Conduit (Table 3-4). Distribution of water is managed by the Cachuma Operation and Maintenance Board (COMB). Cachuma Lake is managed by the Member Units to deliver water through a 6-year drought ("operational period") and thus has an average annual yield of 25,714 AFY. The yield also includes infiltration of water into the Tecolote Tunnel, estimated to be 2,000 AFY.

The lake's original storage capacity was approximately 205,000 AF, but has declined over time due to silt from erosion in the upstream watershed. Additionally, releases for fish, environment, and drought planning strategies may change over time. Both factors have caused the estimated yield to decline from the original 32,000 AFY; and continued siltation is likely to cause further reduction in the future. When Cachuma Lake fills and spills, certain South Coast Member Units take extra deliveries and inject the water into the ground through specially designed wells for use during years of reduced deliveries.

State Water Project Deliveries to the South Coast
Each of the entities on the South Coast that have an allocation from the State Water Project receives its deliveries through Cachuma Lake and Tecolote Tunnel. When ordered by project participants, State water is delivered from Cachuma through Tecolote Tunnel along with Cachuma Project water. Due to its relatively high delivery cost, other supplies are typically delivered before allocations of State water are used. All of the South Coast Member Units participate in the exchange agreement with ID #1 that allows delivery of additional SWP supplies to the Santa Ynez sub-area in exchange for Cachuma water being delivered to the South Coast.

Agricultural Water Use in DAU 75
In the South Coast region, irrigated acres were mapped based on Santa Barbara County Agriculture Commissioner's data. The estimate of unit water requirements within the south coast are based on DWR climate zone 3. The crop distribution map and water demand analyses are provided in Appendices E and F.

3.2.4.1 Gaviota Coast Sub-Area

Water supplies on the Gaviota Coast west of the Goleta Water District service area are derived exclusively from bedrock wells. Typically these wells develop sandstone of the Vaqueros Formation due to greater production rates and superior water quality. Other zones produced locally include the Sespe Formation and coastal terrace materials.

3.2.4.2 Goleta Valley Sub-Area

The Goleta Valley is an alluvial plain, defined by the Santa Ynez Mountains to the north and the Pacific Ocean to the south. The sub-area is served by the Goleta Water District, which develops and manages most of the supplies used. In addition to supplies from Cachuma Lake and the State Water Project, Goleta Valley water users rely on groundwater and recycled water. Prior to construction of the Cachuma Project in the 1950s, groundwater was the principal source of supply with some use of springs in the foothills to the north.

Groundwater Supplies
Groundwater is developed primarily from the Goleta Basin. Some minor supplies are taken from wells in bedrock zones to the north, but water quality is generally problematic. The Goleta Basin lies immediately west of the Santa Barbara Basin on the County's south coast. It is about eight miles long and three miles wide including the hydraulically connected alluvial materials extending into the drainages along the northern border.

The Goleta Basin includes two sub-basins separated by an inferred low permeability barrier that separates areas of differing water quality. The Goleta North-Central sub-basin extends from the Modoc Fault on the east to a north-west trending line marking an inferred low permeability zone on the west. Extending west from this line to outcrops of Tertiary bedrock

is the West sub-basin. Both basins are separated from the ocean on the south by the More Ranch Fault. Although originally defined as portions of a larger basin, these two hydrologic units are distinct and have been analyzed and described in planning and legal documents as separate basins. The basin is developed as a source of supply by the Goleta Water District who uses its wells to store surplus water from Cachuma Lake for use during periods of prolonged drought. These wells are constructed to allow injection of treated water during periods of high releases from the lake. Agricultural users also rely on the basin for supply.

Recycled Water

The Goleta Sanitary District supplies recycled water to a number of users for irrigation of landscaping, agricultural fields, and golf courses. Currently, the District is able to produce more recycled water than local users need.

3.2.4.3 Santa Barbara Sub-Area

The Santa Barbara sub-area comprises the City of Santa Barbara and minor areas in the foothills to the north. The sub-area receives supplies from Cachuma Lake, the State Water Project, Gibraltar Reservoir, and recycled water. In addition, the City owns a desalination plant that could supply water if re-commissioned.

Gibraltar Reservoir

Gibraltar Reservoir is owned and operated by the City of Santa Barbara; its supplies are delivered through the Santa Ynez Mountains to Santa Barbara via Mission Tunnel. Water from the reservoir is combined with a much smaller and variable diversion from Devil's Canyon before introduction to the tunnel. Gibraltar Reservoir has experienced severe sedimentation and has been raised once to recover some of its capacity. The City has set aside any future plans to increase the capacity of the reservoir, opting instead to reach an agreement with the other Cachuma member units to use Cachuma Reservoir to store and transport some of the lost yield from Gibraltar Reservoir for City use. The arrangement is called the 1989 Upper Santa Ynez River Operations Agreement (Pass Through Agreement).

Current Gibraltar Reservoir operations are based on the Pass Through Agreement by which the City agreed to defer a second enlargement of the reservoir in exchange for the right to receive a portion of its Gibraltar water through Lake Cachuma. The intent of this arrangement was to allow the City and other parties to continue to experience Santa Ynez River supplies that would reflect the Gibraltar storage volume as it was in 1988. The City continues diversions to the Mission Tunnel from Devil's Canyon and continues to use both sources as a water supply.

The Santa Barbara Basin is composed of alluvial sediments that underlie a coastal plain. The basin includes two hydrologic units: Storage Unit #I and Storage Unit #II. These hydrologic units encompass about seven square miles in and adjacent to the City of Santa Barbara. The

basin is bounded on the north and west by faults, and by the Pacific Ocean on the south. The boundary to the east is an arbitrary line that does not reflect any known hydrologic or geologic barrier, separating the Santa Barbara Basin from the Montecito Basin.

The Foothill Basin comprises unconsolidated alluvial sediments that have accumulated along the base of the Santa Ynez Mountains in the Santa Barbara and Goleta areas. This basin encompasses about 4.5 square miles and extends from the outcrops of the underlying Tertiary age bedrock formations on the north to the Modoc and Mission Ridge Faults on the south. This basin is used as a supply when the City's surface supplies are reduced.

Conjunctive Use

The City does not inject surplus surface supplies into their groundwater basins. However, by deferring use until surface supplies are reduced, the City is practicing conjunctive use.

Recycled Water

The City initiated planning for a water reclamation project in the early 1980s. Phase I was completed in 1989. It included addition of tertiary treatment with carbon filtration and disinfection at El Estero Wastewater Treatment Plant, a 600,000 gallon distribution reservoir and pumping station, and 5.1 miles of distribution main. Phase II was completed in 1992, adding an additional pumping station, a 1.5 million gallon reservoir, and 8.3 miles of distribution main. The system now provides recycled water to 80 accounts that serve 440 acres of landscaped area at parks, schools, golf courses, and other large landscaped areas.

Desalination

The City constructed a reverse osmosis seawater desalination facility as an emergency water supply during the drought of 1987 to 1992. The facility has since been incorporated into the City's long-term supply plan as a way of reducing shortages due to depleted surface supplies during drought. Two neighboring water purveyors participated in the temporary project, but have since dropped out of the project. A portion of the reverse osmosis filtration capacity was subsequently sold, leaving current capacity of 3,125 AFY. This capacity is entirely dedicated to City use, though it is currently in a long-term storage mode to reduce maintenance costs and would require approximately one year and significant cost to recommission. The time to recommission is consistent with the anticipated use of the facility during drought, a water shortage condition that develops rather slowly.

3.2.4.4 Montecito/Summerland Sub-Area

The Montecito sub-area includes the communities of Montecito and Summerland and the areas east of Montecito and north of Summerland. The subarea is served by the Montecito Water District, which manages the basin and supplies water to the majority of users in the subarea. In addition to supplies from Cachuma Lake and the State Water Project, Montecito develops water from the basin underlying its service area and Jameson Lake (Juncal Reservoir).

The Montecito Basin encompasses about 6.7 square miles between the Santa Ynez Mountains and the Pacific Ocean. The Montecito Groundwater Basin is separated from the Carpinteria Groundwater Basin to the east by faults and bedrock and from the Santa Barbara Basin to the west by an administrative boundary. The basin has been divided into three storage units on the basis of east-west tending faults that act as barriers to movement. The northernmost unit is bounded on the south by the Arroyo Parida Fault, the central unit by the Montecito Fault, and the southernmost unit by the Rincon Creek Fault. These storage units are numbered One, Two, and Three, respectively (Geotechnical Consultants, 1974). The Toro Canyon sub-basin is included in the section on the Carpinteria Basin because it is contiguous with that aquifer. However, the Toro Canyon sub-basin is within the Montecito Water District service area.

Jameson Lake (Juncal Reservoir)
Jameson Lake is the uppermost and smallest reservoir on the Santa Ynez River. The Montecito Water District owns and operates Juncal Dam and Jameson Lake. Water is diverted to the Montecito area through the Doulton Tunnel. Yield for the Reservoir is estimated to be between 1,470 and 1,571 AFY (Bachman, 2007). Inflow to Doulton Tunnel currently averages approximately 440 AFY.

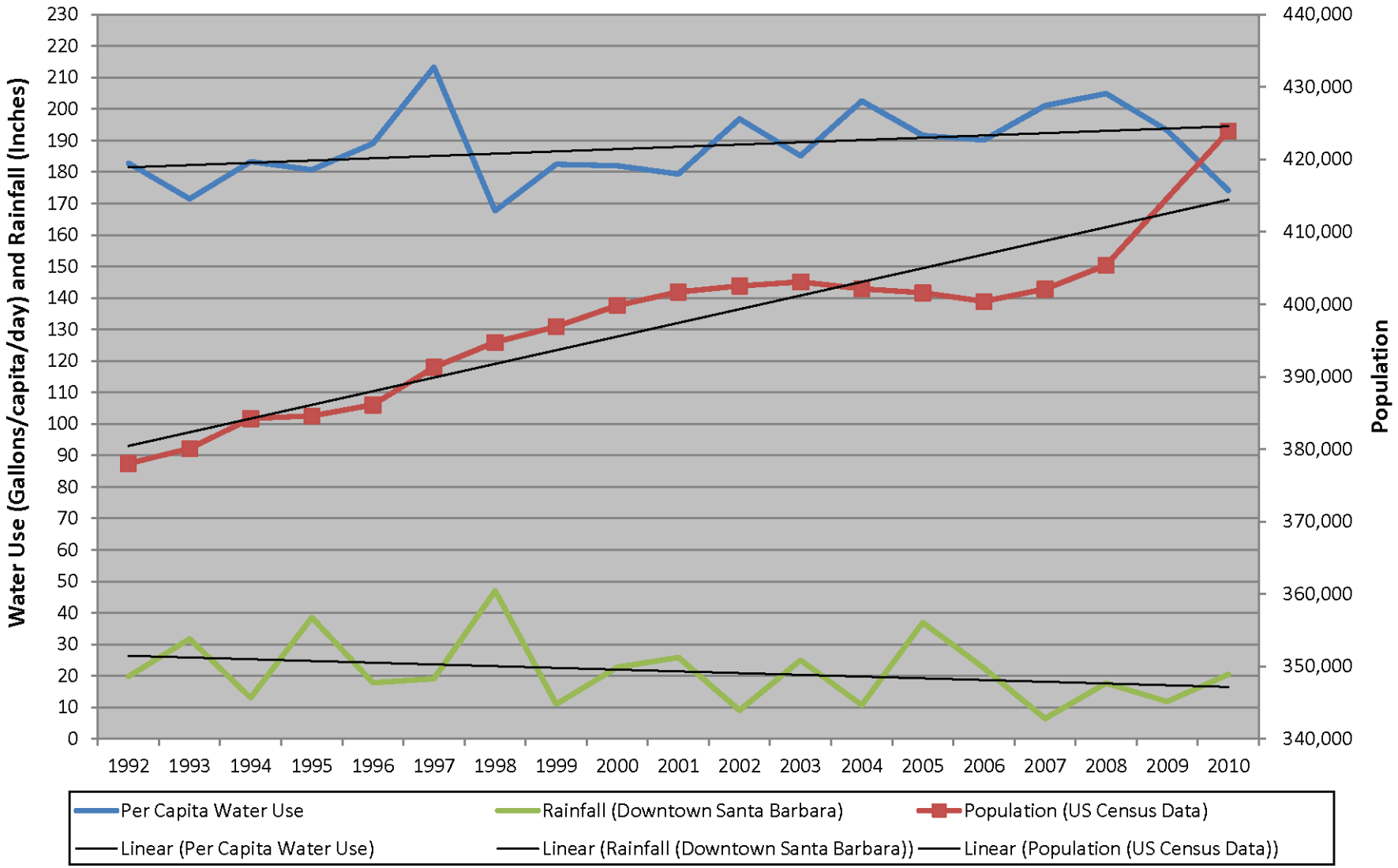
3.2.4.5 Carpinteria Valley Sub-Area

The Carpinteria Valley sub-area includes the City of Carpinteria and the coastal plain from Toro Canyon on the west to Rincon Creek on the east. The Carpinteria Valley is served by the Carpinteria Valley Water District (CVWD), which develops supply from the Cachuma Lake, State Water Project, and the Carpinteria Groundwater Basin. Not all users take delivery from CVWD; a significant number of agricultural users rely on their own wells.

The Carpinteria Groundwater Basin underlies approximately 12 square miles in the Carpinteria Valley. The Carpinteria Basin comprises two aquifers that extend from beyond the Ventura County line on the east, to Toro Canyon on the west. Total storage in the aquifer is estimated to be approximately 700,000 AF. The two aquifers are separated by the Rincon Creek Fault and are called Storage Unit 1 and Storage Unit 2. Storage Unit No. 1 exhibits both higher water quality and storage capacity. Estimated total storage capacity of Unit No. 1 is 170,000 AF. Overall pumping from the basin has not approached the estimated perennial yield since the drought in the early 1990s and the recovery of generally high water levels has corroborated this. Under the authority of State Assembly Bill 3030 the CVWD adopted a Management Plan in order to establish its role as manager for the Carpinteria Basin. This Plan provides direction for the District as the managing entity for the Carpinteria Basin. Elements of the plan include; water level and quality monitoring, sanitary seal retrofit program, abandoned well destruction program, educational goals, and a well inventory database.

3.3 Present Water Demand (By Use and Area)

Estimates of current water demand are shown in Appendix A, Table A-3. Water use estimates are based on actual reports of use from water suppliers and population estimates outside of service areas. Agricultural water use is estimated based on cropping information from the Santa Barbara County Agricultural Commissioner's office and crop water use factors from the University of California at Cal Poly Irrigation and Training Research Center or the Agricultural Extension Service. Since this report is an overview of regional supply and demand, demand estimates represent typical annual use, not peak annual demand. Historical variation in per capita water use, population and rainfall is shown in Figure 3-1.



Santa Barbara County Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Average Annual per Capita M&I Water Use, Population, and Rainfall, 1992-2010
Santa Barbara County Water Agencey		October 2012 — Figure 3-1

Agricultural Water Demand Approach

Current and future agricultural acreages and water demand for each of the agriculture areas within the DAUs are based on data from the County Agricultural Commission Office and University of California at Cal Poly Irrigation and Training Research Center or the Agricultural Extension Service. Agricultural water demand considers water use on irrigated acreage. Detailed maps are provided in Appendix E and analyses are provided in Appendix F.

Irrigated Acres

For each of the DAUs, irrigated acres by crop type were based on recent completed studies or based on the readily available information found through the Santa Barbara County Agricultural Commissioner's Office. (http://www.countyofsb.org/agcomm/) GIS Shape files obtained from the Agricultural Commissioner's Office website provided agricultural acres that were totaled by irrigated crop types within each DAU; the irrigated crop categories were the same used in the recently completed study for the SMVMA (Luhdorff and Scalmanini, 2011). Regarding DAU areas that include some areas outside of Santa Barbara County, acres were obtained by utilizing available information found in specific studies or from San Luis Obispo County.

Agricultural Applied Water Use

Agricultural Applied Water Use (AW) is an indirect estimate that contains some level of uncertainty as it varies for a given crop type, with wet and dry periods, and by climate zones. For this study, the unit AW for each crop category group in acre-feet per acre (af/ac) was based on values presented in two existing studies; one completed for the Santa Maria Valley Management Area and one underway for the Cuyama Valley. In the remaining DAU areas, the AW was estimated using knowledge of each DAU climate zone in comparison to the existing study area. Using this methodology, a representative estimate for AW was obtained for each of the DAUs.

This approach is widely used in California and locally in the annual report submitted to the Court by the SMVMA ((Luhdorff and Scalmanini, 2011).

The formula used to estimate Applied Water is AW = [(ETc-Eff.Precip.)/DU]

Given: AW = Applied Water

ETc = Evapotranspiration of Crop

Eff. Precip. = Effective Precipitation

DU = Distribution Uniformity

Crop Acreage was estimated by verifying crop inventories and interpreting aerial photography of crop category (acres).

Total Applied Water = sum of estimate of Applied Water times the Crop Acreage for each crop category.

Methods used for estimating parameters:

ETc – Based on CIMIS data in SM Area or DWR

Effective Precipitation – Estimated based on monthly precipitation in months with ETc

-or-

ETaw – Estimated based on previous studies/DWR values

DU – Based on previous studies

This methodology accounts for return flows and is similar to the method used in the 1991 and 2003 supply and demand evaluations by the County Water Agency.

3.4 Effects of Adjudication and Other Sub-Regional Agreements

Several adjudications and legal agreements affect water availability and demand. As shown in Table 3-1, adjudications have occurred in the Goleta Basins and the Santa Maria Basin. Other agreements affect water management in the Santa Ynez River watershed (including the Upper Santa Ynez River Operations Agreement and the 2002 Cachuma Project Settlement Agreement). These agreements define specific conditions relating to the nature and use of water supplies for each area addressed. These agreements add to predictability of key water supplies and are factored into the estimates provided in this report.

3.5 Key Legislative Changes to the Water Code since the 2003 Report

The major legislation actions since the preparation of the 2003 Report include the Governor's Plan of "20 percent water use reduction target by 2020," which led to major water conservation legislation in 2009. Also of significance is the updating of best management practices (BMPs). These and other major developments are described below:

- Governor's 20 percent Reduction Target by 2020
- Water Conservation Legislation in 2009 (SBX7-7)
- AB 1420 (2007) — Water Demand Management Measures
- AB 1465 (2009) — Urban Water Management Planning

In 1983, State Assembly Bill (AB) 797 modified the CWC Division 6, by creating the Urban Water Management Planning Act (UWMPA). Several amendments to the original UWMPA, which were introduced since 1983, have increased the data requirements and planning elements to be included in the 2010 Plans.

Initial amendments to the UWMPA required that the total projected water use be compared to water supply sources over the next 20 years, in 5-year increments. Recent DWR guidelines also suggest projecting through a 25-year planning horizon to maintain a 20-year timeframe until the next UWMP update has been completed.

Other amendments require that plans include provisions for recycled water use, demand management measures (DMMs), and a water shortage contingency plan. The UWMPA requires inclusion of a Water Shortage Contingency Plan, which meets the specifications set forth therein. Recycled water was added in the reporting requirements for water usage and figures prominently in the requirements for evaluation of alternative water supplies, when future projections predict the need for additional water supplies. Each urban water purveyor must coordinate the preparation of the Water Shortage Contingency Plan with other urban water purveyors in the area, to the extent practicable. Each water supplier must also describe their water demand management measures to the extent that they are being implemented in each of the respective service areas. Any DMMs that are scheduled to be implemented should also be discussed.

The most recent amendment includes Santa Barbara 318 (Alpert, 2004), which requires the plan to describe the opportunities for development of desalinated water, including but not limited to brackish ocean water, and as a long-term water supply alternative. AB 105 (Wiggins, 2004) requires urban water suppliers to submit their UWMPs to the California State Library.

3.5.1 Key Requirements

Key requirements from the UWMPA (AB 797), Sections 10631, 10632, and 10633 are summarized as follows:

<u>Section 10631</u>
This section requires an evaluation of the methods related to the conservation of water, as well as describing the local water demand and supply. Originally 16 BMPs were suggested for cost effectiveness evaluations. In 1997, the California Urban Water Conservation Council (CUWCC), who administers the Memorandum of Understanding (MOU), revised the list of BMPs. Four BMPs were eliminated, two new ones were added, and others were revised resulting in a new list of 14 BMPs. Recent state legislation revised section 10631 to make it consistent with the current MOU and the 14 BMPs.

AB 1420

AB 1420 (Stats. 2007, Ch. 628) amended the UWMPA, Water Code Section 10610 et seq., to require, effective January 1, 2009, that the terms of, and eligibility for, any water management grant or loan made to an urban water supplier and awarded or administered by the DWR, State Water Resources Control Board (SWRCB), or California Bay-Delta Authority or its successor agency (collectively referred to as "Funding Agencies"), be conditioned on the implementation of the water DMMs, previously known as BMPs as defined in Section 10631 above and in Water Code Section 10631(f). BMP Implementation under AB 1420 specifies that:

1. The urban water supplier is currently implementing all BMPs at a coverage level determined by the CUWCC MOU.
2. The urban water supplier has submitted a schedule, budget, and finance plan commencing within the first year of the agreement for which grant funds are requested to implement all BMPs at the coverage level determined by the CUWCC MOU.
3. The urban water supplier has demonstrated by providing supporting documentation that certain BMPs are "not locally cost effective," which means that the present value of the local benefits of implementing a BMP is less than the present value of the local costs of implementing that BMP.

AB 1465

AB 1465 states that water suppliers who are members of the CUWCC and comply with the MOU regarding urban water conservation in California are required to describe their water DMMs in their UWMP to be in compliance.

SBx7-7

SBx7-7 enacted in 2009 (Chapter 4, Statutes of 2009 Seventh Extraordinary Session) requires the state to achieve a 20 percent reduction in urban per capita water use by December 31, 2020. The law establishes that the measure of increased efficiency is on a per capita basis. The law also requires the State to make incremental progress towards this goal by reducing per capita water use by at least 10 percent on or before December 31, 2015.

Urban water purveyors serving over 3,000 AFY to urban customers, or serving over 3,000 urban customers are required to develop a plan by the year 2020 to reduce per-capita water use by 20 percent from a selected base year. This is implemented through the Urban Water Management Plans and demonstrated compliance is a requirement for State grant funding.

SBx7-6

The Legislature amended the Water Code with SBx7-6, to mandate a statewide groundwater elevation monitoring program. Its purpose is to track seasonal and long-term trends in groundwater elevations in California's groundwater basins. The law requires collaboration

between local monitoring entities and Department of Water Resources (DWR) to collect groundwater elevation data. The County Water Agency already had an extensive water level monitoring program with the means to share data with other agencies.

20x2020 Water Conservation Plan (20x2020Plan)

The 20x2020 Water Conservation Plan is a plan developed by Governor Schwarzenegger to reduce statewide per capita urban water use by 20 percent by the year 2020. The 20x2020 Plan sets forth a statewide road map to maximize the State's urban water efficiency and conservation opportunities between 2009 and 2020, and beyond. It aims to set in motion a range of activities designed to achieve the 20 percent per capita reduction in urban water demand by 2020. These activities include improving an understanding of the variation in water use across California, promoting legislative initiatives that incentivize water agencies to promote water conservation, and creating evaluation and enforcement mechanisms to ensure regional and statewide goals are met.

AB 2572 Water Meter Compliance Requirements

Water Code Sections 525-529.7 limit the ability of water purveyors, both agricultural and urban, from receiving State grant and loan funds if metering requirements are not met. These laws apply to SWP contractors, Central Valley Project contractors, local, community, and private water suppliers. These sections of law are in addition to requirements contained in AB 1420 and SB X7-7.

Section 10632

This section requires the preparation of an urban water shortage contingency plan. Shortages of up to 50 percent are to be planned. To comply with this section, the purveyor must adopt a water shortage contingency ordinance.

Section 10633

This plan is to provide information on the availability of reclaimed water and its potential for use as a water source in the purveyors' service area. Methods to increase the use of reclaimed water in areas where potable water is not required should be identified along with financial incentives to encourage its use for agricultural irrigation, landscape irrigation, wildlife enhancement, wetlands, and industrial use.

Changes to the California Urban Water Conservation Council Memorandum of Understanding

The CUWCC MOU was modified and there are new options for implementation of the MOU that provide more flexibility for water purveyors to choose which BMPs are most effective for their service areas. There remain some BMPs that all Group 1 (water providers) signatories to the MOU must implement (foundational BMPs), but implementation of the remaining BMPs is flexible although a water provider using the "Flex Track" approach must

demonstrate that this alternate approach will be at least as effective as implementing the BMPs.

4 Future Water Supplies

This section discusses changes that were considered in the estimates of future supply. The factors affecting supply are in some instances well demonstrated (reservoir siltation), while in others more speculative (climate change). Their level of definition and likely impact are discussed below.

4.1 Changes to Municipal Water Supplies

Siltation of reservoirs in Santa Barbara County is well established. For example, the Gibraltar Reservoir was raised in 1949 to restore capacity, and the Upper Santa Ynez River Operating Agreement provides for managing the loss of capacity through a change in management of the Cachuma Reservoir. The Department of Water Resources has developed a model to simulate operation of the State Water Project under a range of climate conditions and environmental constraints. The latest results of this evaluation are reflected in estimates of average SWP supply availability incorporated into supply estimates by CCWA and its members. These estimates, which indicate a slow reduction of SWP availability with time, are incorporated into this report.

Other factors, such as increased conjunctive use could increase reliability of surface water supplies. However, since additional conjunctive use projects are not in development, there is no basis for reflecting the effect of such projects in this report.

4.2 Effects of Climate Change

According to the California Climate Action Adoption Strategy, 2009, climate change impacts are already affecting the State and will continue to do so into the future. Given the complexity of the factors affecting climate and precipitation, detailed quantitative assessment of impacts and evaluation of impacts at a local scale is difficult. However, much of the work produced to date for California cites some likely impacts. Impacts that are particularly relevant to Santa Barbara County include higher temperatures, more extreme storm events, longer and more frequent drought, sea level rise and increased incidents of wild fire (California Climate Adaptation Strategy, 2009).

The long term qualitative effect of such changes can be considered relative to the County's geography, water supply sources, infrastructure and economy. For example, larger storms could result in more frequent and destructive flooding. Depending on the timing and distribution of such storms, greater recharge of ground and surface water storage may also result. Higher temperatures could increase water demand and exacerbate wildfire which could increase sedimentation rates in reservoirs resulting in reduced water storage capacities.

Longer and more frequent droughts could threaten the reliability of surface and groundwater supplies and impact agricultural production and our regional economy. Sea level rise could place water infrastructure at risk and cause salt water intrusion of coastal groundwater basins.

The State government has enacted legislation requiring the reduction of greenhouse gas emissions (Executive Order S-3-5). Numerous State and local programs are targeted to monitor climate change effects and prepare for its impacts. The Santa Barbara County Planning and Development Department has completed a Climate Action Study (September, 2011) and included in the Santa Barbara County Integrated Regional Water Management Plan now under revision will be a section discussing the vulnerabilities and adaptation strategies unique to Santa Barbara County's water resources.

Given the difficulty of quantifying the extent and timing of short and long term climate change impacts and the effectiveness of programs and measures to reduce or adapt to its impacts, quantitative climate change calculations in regard to water supply and demand have not been included in this report. If such calculations are feasible in the future, this supply-demand report will be updated to account for those impacts. It is recommended that climate change legislation and data relating to Santa Barbara County be monitored and evaluated as they progress.

4.3 Effects of Regulations

New and emerging regulations have affected water supply in several ways:

- Increased allocation for habitat purposes reduces supplies for some human uses.
- More efficient use is mandated for medium and large public suppliers.
- Clarifications to regulations encourage increased water recycling.
- Initiatives have been initiated to control degradation of water quality due to recycling.

The effect of each of these is briefly described below:

Competing water needs among municipal, agricultural, and environmental interests has changed assumptions made about allocation of water through past water rights decisions and project design, particularly in the Santa Ynez River Watershed. In particular, the listing of *O. Mykiss* (steelhead trout) has led to changes in reservoir operation to meet new requirements for release of water downstream to maintain fish habitat. Additional changes may occur as the recovery plan for *O. Mykiss* may be incorporated into water rights permits. However, due to uncertainty about the outcome of this process, no changes in availability of future supply were ascribed to allocation for habitat purposes except as included in State Water Project estimates.

Water recycling increases overall supply, particularly when recycled wastewater was discharged to the ocean prior to recycling. Water recycling currently occurs in the service areas of the City of Santa Barbara and the Goleta Water District. Opportunities for increased water recycling are being evaluated on the entire south coast as part of the update to the Integrated Regional Water Management Plan. However, due to uncertainty about the outcome of this process, no changes in availability of future supply are reflected for south coast supply. Water recycling also occurs in the Santa Maria Valley through the direct use of treated sewage effluent (in the Orcutt area) and recharge to the groundwater basin with treated effluent (City of Santa Maria). Current recycling in the Santa Maria Valley captures virtually all sewage from the communities of Orcutt and Santa Maria so little or no opportunity is assumed for any increase.

Regulations to increase water use efficiency currently are intended to establish target reduction levels below a calculated baseline. The baseline considers past water use and likely use given local climate conditions. Because the region has been a leader in water conservation, particularly in installation of water efficient indoor plumbing fixtures, per capita use is generally well below the State average. More importantly, in some cases the current water use is well below future mandated levels calculated using the State methodology. However opportunities exist to complete implementation of all applicable Best Management Practices (management measures) and in particular to implement landscaping guidelines consistent with existing State law.

Control of water quality, particularly salt and nutrients, is the formal policy of the State Water Resources Control Board. The control of salts and nutrients in the Santa Barbara County region will enhance sustainability of existing water supplies. Except for the City of Santa Barbara desalination plant, no proposals have been put forward to remove salts or nutrients as a means of increasing existing supply.

4.4 Estimates of Future Municipal Water Supplies

The estimate of future water supplies available to municipal users depends on the specific nature of sources available to the entity developing and delivering the supply (the purveyor). Groundwater resources are assumed constant. Ongoing sedimentation has been demonstrated to reduce local reservoir capacity thus available supply. The report assumes that reduction of supply will continue at the same average annual rate. Changes to supply from the State Water Project are based on the most recent modeling of reliability performed by DWR. That analysis takes into consideration a number of changes, including effects of climate change on the timing of snow melt in the projects source areas. No effects of climate change were factored into locally developed supplies for two reasons: timing of snowmelt does not significantly affect local supplies and no clear relationship between climate change and change in precipitation has been quantitatively demonstrated.

4.5 Estimates of Future Agricultural Supply

Agriculture in Santa Barbara County relied overwhelmingly on groundwater for its supply. With two exceptions, supplies of water to agriculture are expected to remain constant based on existing adjudication and the condition of the groundwater resources. In the Cuyama Valley, long-term monitoring and the recent study by the County Water Agency and USGS suggest that continued water level decline will occur in areas relying on groundwater for irrigated crops. In the Cuyama Valley agricultural water use could be affected by increasing pumping costs if water levels drop in the future. Increased pumping costs could cause a reduction in pumping.

Supplies for irrigated agriculture in the San Antonio Valley are currently adequate, but the basin appears to be in overdraft. However, insufficient information is available to estimate the effect on irrigated agriculture.

4.6 Effect of Future Environmental Issues on Water Supply

Several environmental factors may affect water supply in the future including:

- Control of invasive species such as Arundo donax.
- Santa Ynez River fish passage/habitat expansion.
- Santa Maria River fish passage flows.

These factors are discussed briefly below, but no changes in any of these factors are certain to affect estimates of future supply in this report.

Invasive species such as *Arundo Donax* are found in streams within the Santa Ynez and south coast watershed areas. *A. Donax* can crowd out other riparian species and develop dense and extensive infestations that respirate significant amounts of water and choke off natural flow. Although infestations occur in south coast watersheds, they are not reported to affect groundwater recharge thus these infestations are not reported to reduce supply. In the Santa Ynez watershed limited occurrences are reported, but the level of infestation has not yet resulted in reports of reduced water availability.

Studies and regulatory pressures have resulted in management of water to enhance habitat for anadramous fish in the Santa Ynez River. Releases from Cachuma Lake are managed to provide both passage and residence habitat for *O. Mykiss* (steelhead trout) in the main stem of the river. Additional storage has been provided at Cachuma Lake to minimize the potential reduction in supply to existing users due to the additional water released to enhance fish habitat. The issue of whether additional water should be allocated for fish habitat is before the State Water Resources Control Board. No changes in water supply availability were

included in the estimates for Cachuma Lake due to uncertainty regarding the outcome of this process.

A recent study of hydrology of the Santa Maria River suggests that releases to increase flow in the lower Santa Maria River be made to provide for passage of steelhead trout to the Sisquoc River (Stillwater Sciences 2012). The process by which this controversial suggestion would receive further evaluation is not clear. Therefore no changes in water supply availability were included in the estimates for yield of the Santa Maria Basin due to uncertainty regarding the outcome of this process.

5 Future Water Demand

5.1 Municipal Water Deliveries

Future water availability for some municipal suppliers will be reduced by lost reservoir capacity and reduced reliability of SWP deliveries. This reduction in supplies will likely be balanced by improved water efficiency and possibly increased water recycling on the south coast.

Reservoirs on the Santa Ynez River (Gibraltar and Cachuma) will continue to experience reduction in capacity. Sediment in Gibraltar has reduced capacity such that City of Santa Barbara has begun "Pass Through" operations pursuant to the 1989 "Upper Santa Ynez River Operations Agreement." That agreement allows use of Cachuma Project facilities for transport of lost Gibraltar Reservoir capacity in part because silt trapped by Gibraltar reduces the rate of sedimentation in Cachuma Lake.

State Water Project deliveries are affected each year by weather conditions within the source areas and measures to protect habitat in key water transport facilities, particularly within the Sacramento/San Joaquin River Delta. The Department of Water Resources performs a detailed evaluation of SWP reliability every five years. The results from the latest (2007) analysis are reflected in the estimates of future SWP deliveries.

Future average yield from groundwater supplies are not expected to change significantly through the analysis period. This is based on the existing use and condition of the groundwater resource, past development of groundwater management plans, effect of existing adjudications, and information on future groundwater use contained in Urban Water Management Plans.

5.2 Future Municipal Water Demand Summary

The estimate of average municipal demands in this report are based on projections of population increases/projected per capita use (Appendix A). To the extent available, projections were taken from Urban Water Management Plans prepared by larger suppliers in the County. For smaller service area, other areas estimate of per capita use were derived from data made available by the County Water Agency and population estimates developed by the Santa Barbara County Area Governments' staff.

Based on an evaluation of the existing data, per capita water use is affected by household size and lot size (and landscaping type). The projections of water use were based on the following factors:

- Population is expected to increase in virtually all areas.
- Increasing efficiency decreases *per capita* use.
- Increased recycling on the south coast would divert water from ocean outfall, thus effectively increasing supply and decreasing demand from other sources.
- Increased recycling would be less effective in reducing demand in other areas because the discharge to surface streams or infiltration facilities does not effectively capture water that would be otherwise lost to the system.
- Increased cost (energy) will drive up costs; however, historical data suggest that marginal cost increases to end users will not reduce per capita demand (Appendix G).

As Shown in Figure 5-1, overall, water demand was found to increase in most areas, driven by population increase (Appendix A). This is consistent with past projections (Cosby and Ahlroth 1991, 2003)

5.3 Municipal Conservation Estimates

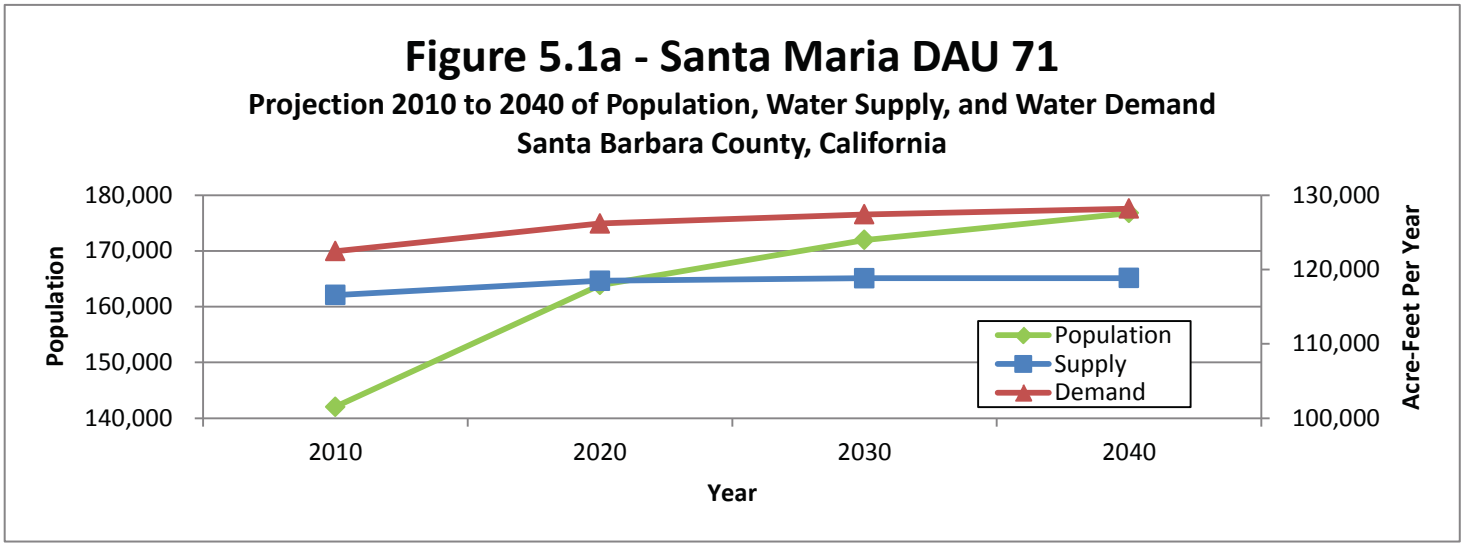
Per-capita water use data have been collected in several areas in Santa Barbara County since the 1990's. Appendix G presents graphs comparing per-capita water use against price and against annual rainfall. An analysis of per capita water use versus price in Santa Barbara County suggests that price increases in some areas apparently cause an initial reduction in per capita use, but that per capita use tends to increase in the following years. Other studies demonstrate that increasing "block rate" pricing does have a longer term effect on reducing per capita water use (Arbues et.al, 2004).

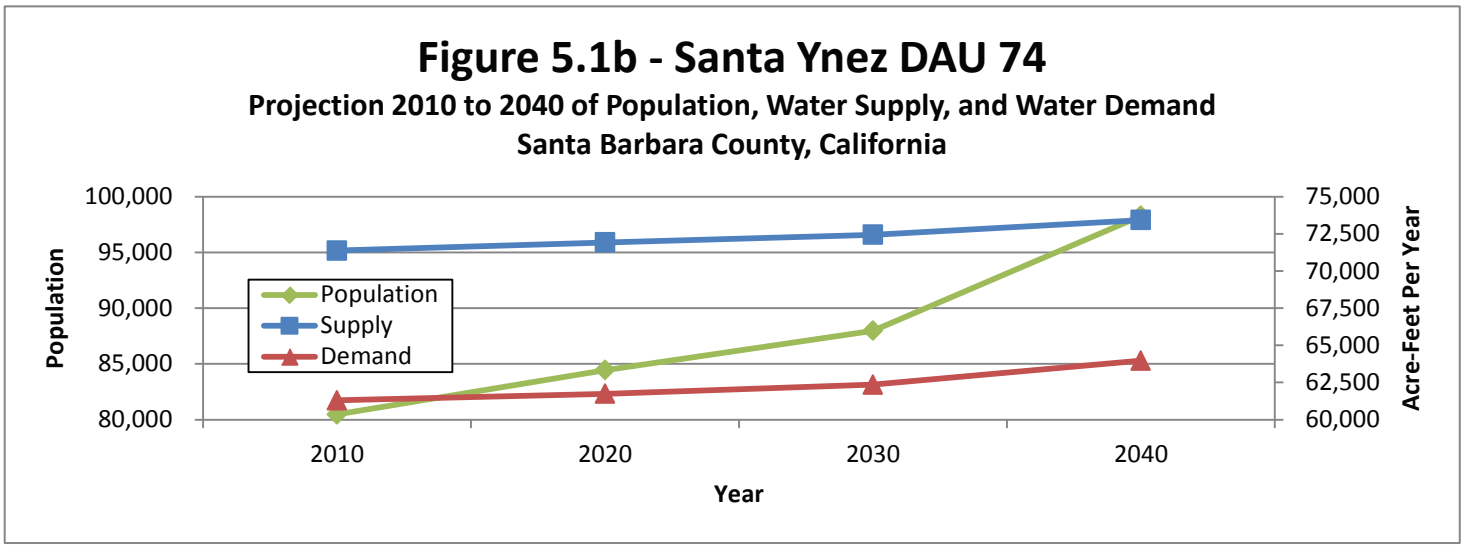
Local water use data suggest a weak correlation between annual rainfall and per capita water use. This relationship, along with higher reported usage in areas of larger lot size (Montecito, La Cumbre, and Santa Ynez ID #1) suggest the potential to reduce per capita by focusing on improved landscaping irrigation efficiency. Work on behalf of the CUWCC suggests that while higher than normal temperature and rainfall do affect per-capita water use, the effects also depend on the time of year and the actual ETo (CUWCC, 2011). A detailed analysis of per-capita water use using the CUWAA 2011 methodology was beyond the scope of this study.

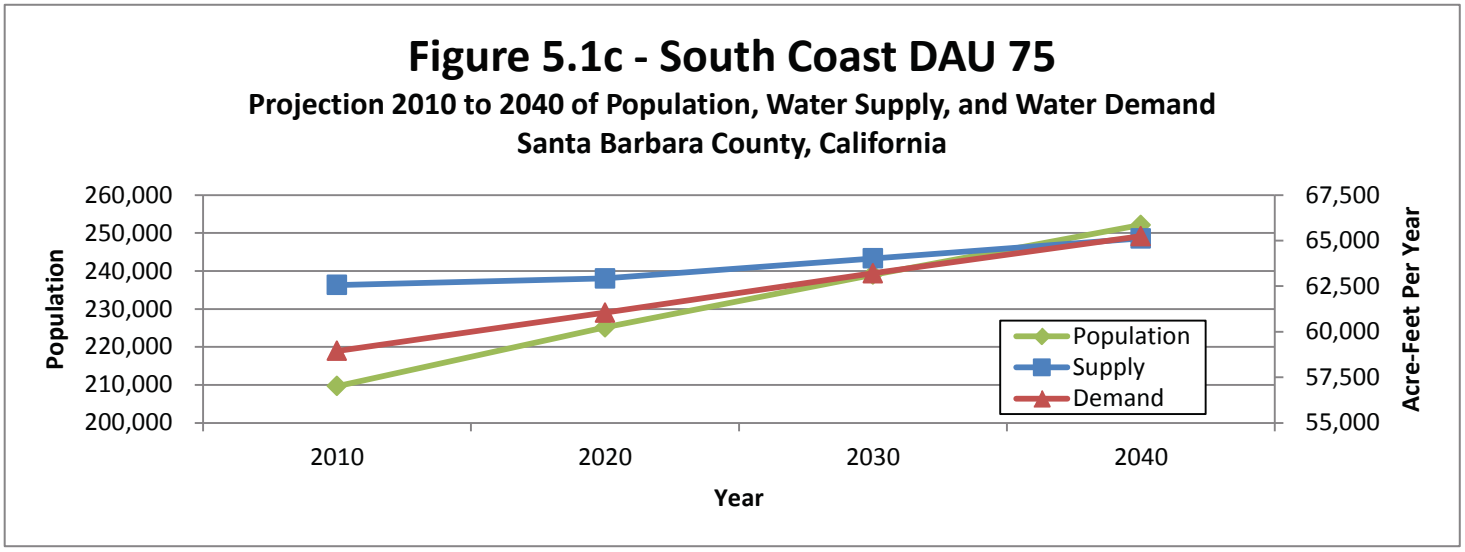
5.4 Future Industrial Water Demand

Santa Barbara County's industrial base is mainly oil/gas production and processing of agricultural products. Currently oil and gas production, processing and support facilities are provided water from onsite sources. The nature of existing development does not require significant fresh water supplies. Although the industry is experiencing an increase in production due to new technology and stronger prices, the actual demand for water is not expected to increase significantly.

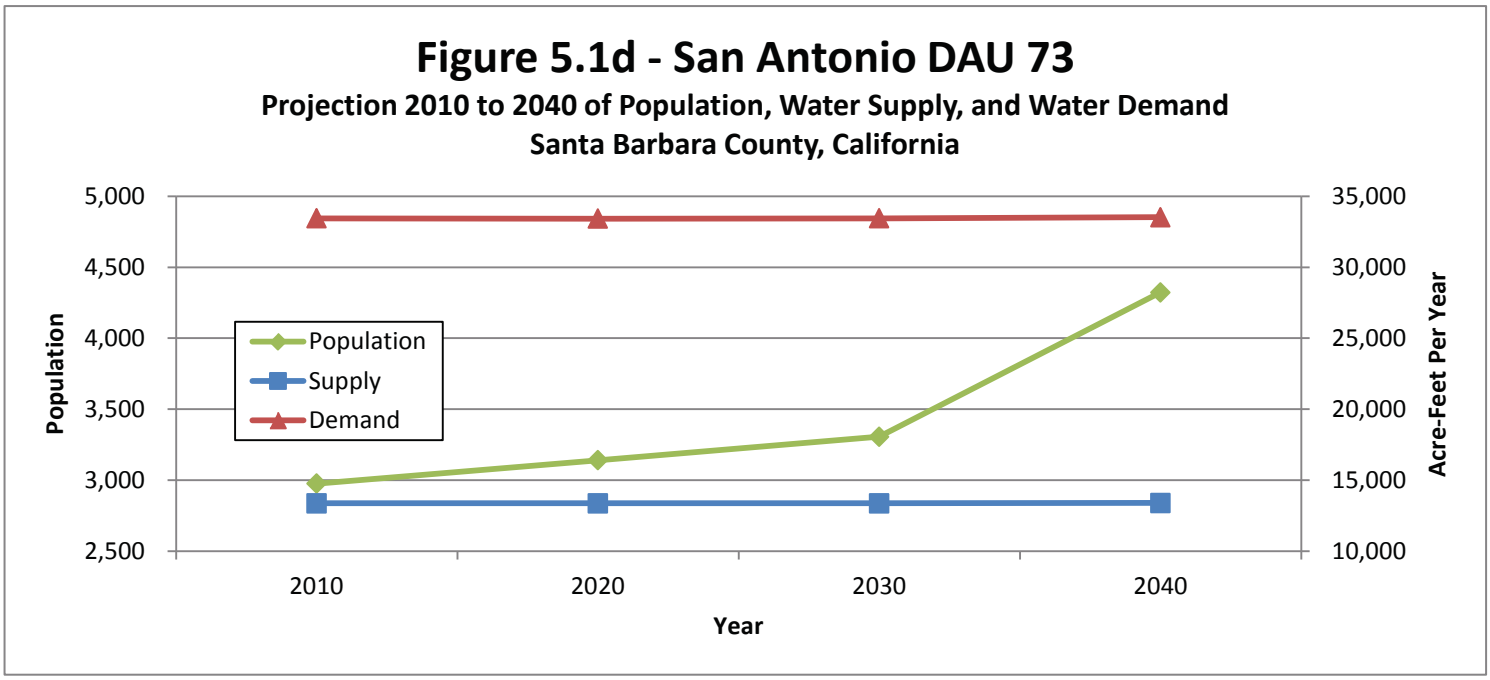
Water demand for agricultural product processing depends on the scope and nature of products produced. Since no significant change in acreage or the nature of products produced is expected, no significant change is expected in industrial water demand is expected.

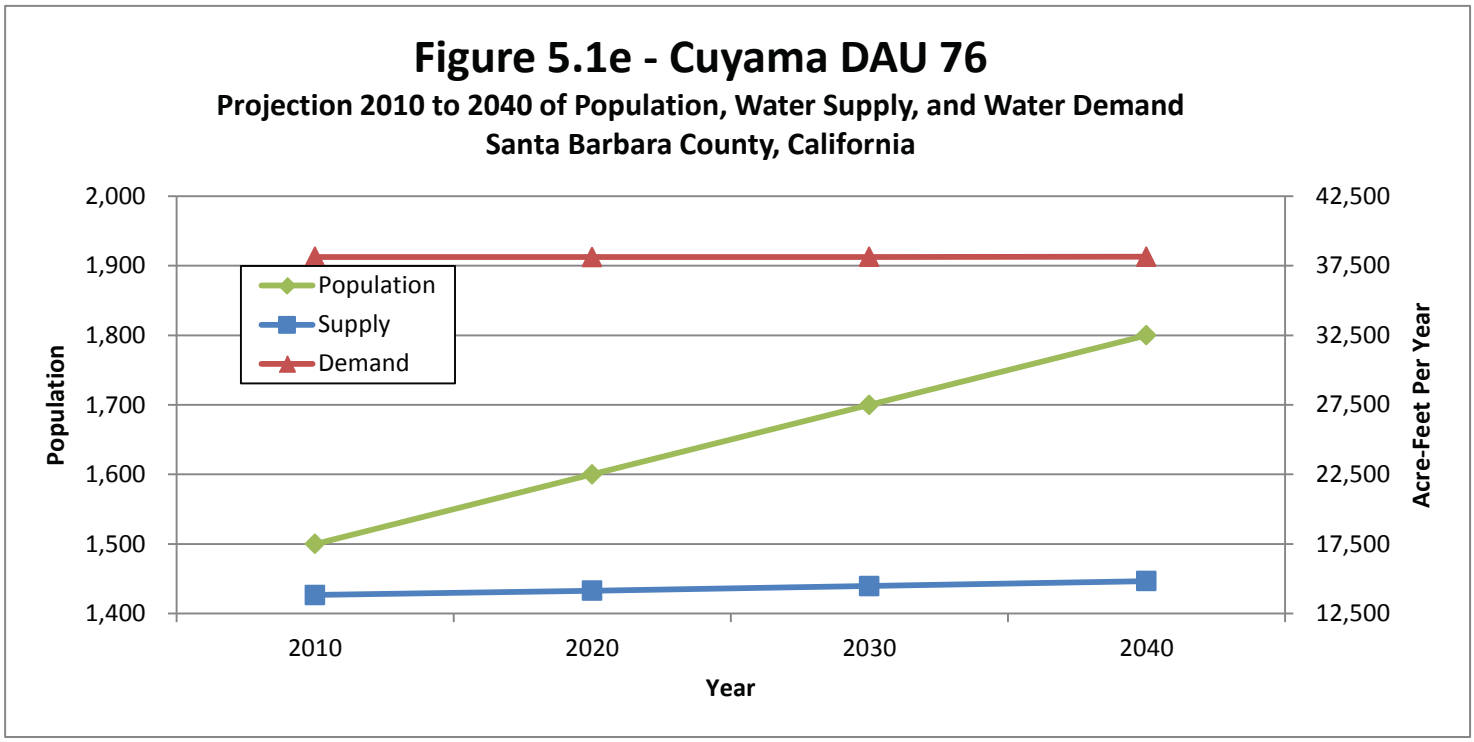






Population Projections are based on information from Table A-2
Supply and Demand Projections are based on information from Table A-8





Population Projections are based on information from Table A-2
Supply and Demand Projections are based on information from Table A-8

5.5 Future Agricultural Water Demand

Santa Barbara County enjoys a well-developed and valuable agricultural industry. Most areas with good soils and adequate water supplies have been put into production. During preparation of this report, no plans for significant conversion of agriculture to urban land use were provided by the land use agencies for the cities or the County. In addition, conversion of agricultural areas to urban land uses is otherwise controlled by land use policies. Therefore limited changes in acreage or in cropping patterns are expected except in the Cuyama Valley. Thus, average annual water demand for agriculture is not expected to change in the future except in the Cuyama Valley.

In the Cuyama Valley agricultural water use is expected to be affected by increasing pumping costs that may reduce pumpage with time. The rate of this change is presently being evaluated by the County and other agencies through their ongoing evaluation. The results of that study may be incorporated into future evaluations of supply and demand. For the purposes of this evaluation an assumption of a 10 percent reduction in agricultural demand per decade was assumed for the Cuyama Valley.

5.6 Effects of Climate Change

Although climate change is predicted to increase average annual temperatures, the seasonal nature of those changes and the effect on water demand have not been evaluated. Thus there is no basis to estimate the potential effect on water demand for either urban or agricultural users.

5.7 Estimated Future Water Demand and Supply Balance

The analysis summarized in Appendix A indicates increased water demand due to increasing population primarily in urbanized areas served by public water suppliers, increased agricultural use in the San Antonio Valley, and continued agricultural use in the Cuyama Valley. This evaluation was conducted at the DAU scale, based on available studies and information, and was not conducted at the groundwater basin or sub-basin scale or to the level of detail sufficient for a basin safe yield evaluation. Furthermore, the adjudicated Santa Maria groundwater basin submits an annual report to the court, which contains a more detailed evaluation by groundwater basin within the Santa Maria DAU. Within an acceptable level of uncertainty, this evaluation conducted at the DAU scale indicates that the expected increased demand will not exceed estimated future supplies in three of the five DAU areas with the exception of the Cuyama and San Antonio valleys. The evaluation conducted for this study was at a scale for the entire DAU and not at the spatial detail to identify the inequity of supply and demand within a groundwater basin or sub-basin boundary that occur within each of the DAU boundaries. In the Cuyama and San Antonio valleys, it is noted that demand in excess of supply will continue to be met by over producing in portions of relatively large groundwater basins underlying each area. The County of Santa Barbara in

cooperation with the USGS conducted a detailed evaluation of the Cuyama Valley groundwater basin and is considering a similar detailed evaluation for the San Antonio groundwater basin.

A discussion of the estimated water supply and demand balance for the county and for each of the DAUs within in county follows:

Countywide water supply estimates generated for this report (Tables 7 and 8) indicate that countywide water supplies do not meet all of the present demand. However, the shortfall in supply is mainly identified within two of the five DAUs. This report provides water supply and demand estimates aggregated by DAU; it does not provide a safe yield or detailed balance calculation or each groundwater basin or sub-basin within each of the DAUs, the cost to conduct a detailed evaluation was beyond the project budget. Within each DAU, some water purveyors may need to develop additional water supplies in order to provide sufficient and reliable water supplies for their current and/or future service area populations. The detailed analysis necessary to make the groundwater allocations and water supply and demand assessments and evaluate each water purveyor's water supply balance individually is beyond the scope of this regional water supply report.

- DAU 71 - Santa Maria: Estimated projections for Santa Maria DAU 71, based on the available information used in this report, indicate that water supplies for this area are sufficient to meet current or projected demands within a reasonable uncertainty using the assigned values from available information in comparison to the level of accuracy required for the calculation of a safe yield. The estimated shortfall is approximately five percent of the total annual demand, which is within a reasonable range of uncertainty and does not definitively define the groundwater basin within the DAU out of balance. This evaluation estimated the shortfall for the DAU may continue to increase through 2040 to seven percent of total demand. Importing State Water Project water has significantly reduced the overall DAU water supply shortfall; however, uncertainty remains on the need for additional water supplies. Notably, the groundwater basin within the DAU submits an annual report to the courts each year that provides a more detailed water supply and demands evaluation over a representative hydrologic period; the annual supply and demand does vary by water year type and the balance may change from positive to negative by water year type, therefore, it is imperative to recognize the limits of this study and make use of the more detailed annual report.

- DAU 73 - San Antonio: Estimated projections for San Antonio DAU 73 indicate that water supplies for this area are not sufficient to meet current or projected demand. The estimated shortfall for the DAU stated in this report is approximately 20,000 acre-feet per year is for the entire DAU area which includes a defined groundwater basin area and additional area in the northwest portion of the DAU; thus, the estimate for the DAU includes a groundwater basin that has an estimated safe yield and additional area outside the defined

groundwater basin. The rate of use is anticipated to continue at the similar rate over time. The agricultural land use information provided for this report indicates a substantial amount of vineyard acres in the central portion of DAU 73 and a substantial amount of rotational vegetables in the in northwest portion of DAU 73, adjoining DAU 71. Importing State Water Project water has significantly reduced the overall DAU water supply shortfall; however, additional water supplies are still needed. The County of Santa Barbara is considering undertaking a more detailed study for this area. Some of the shortfall will be reduced over time due to expected water conservation efforts to reduce the per capita water demand by Los Alamos CSD, Vandenberg AFB and the private M&I and agricultural water pumpers.

- DAU 74 - Santa Ynez: Projections for Santa Ynez DAU 74 indicate that the current water supplies for this area are sufficient to meet current demand and there will be sufficient supply into the future. This condition of sufficient supply to meet demand is anticipated to remain through 2040.

- DAU 75 - South Coast: Projections for the South Coast DAU 75 indicate that this area has sufficient water supplies up to the year 2040. This is due to the variety of potential supplies available to South Coast purveyors including State Water Project water, groundwater, desalination, recycled water, and Cachuma, Gibraltar, and Jameson Reservoirs, along with the active conservation programs conducted by these purveyors. Important spatial differences may exist in the water supply and demand balance within specific groundwater basins and subbasins.

- DAU 76 - Cuyama Valley: Water supply projections for the Cuyama Valley DAU 76 indicate that this area is already experiencing a severe water supply shortfall with respect to meeting current demands. The current shortfall is approximately 23,000 acre-feet per year or more and is expected to continue.

5.8 Uncertainty

This report provides a long-term forecast of the regional water supply and demand balance for Santa Barbara County, aggregated by DAUs. A certain amount of uncertainty exists in the estimates for current and future water supply and demand. Regarding uncertainty within the DAUs, this report utilizes available information regarding the supplies and demands of water uses within groundwater basins and sub-basins within each DAU, however, it does not compute a safe yield level of balance for each of these groundwater basins or sub-basins within each DAU. Therefore, the report does contain some spatial uncertainty for long-term balance within each DAU. This uncertainty is based on the difficulty of accurately predicting changes in numerous factors including:

- Population growth rates
- Land use changes
- Level of participation in residential, commercial, industrial and agricultural water efficiency programs
- Weather changes year-to-year and long-term trends
- Environmental regulatory changes, including requirements that reduce the assumed yield of surface and groundwater water supplies
- Groundwater basin and surface water model revisions to reflect improved geotechnical data, assumed rainfall or other factors
- DAU boundaries containing one or more groundwater basin or sub-basin boundaries
- Changes in irrigated agricultural acreage and types of crops planted
- Indirect estimation of agricultural water use
- Estimation of return flow from irrigation applied water
- Outcome of water rights litigation
- Development of new water supplies and drought year contingency supplies by water purveyors
- Future development and reliability of the State Water Project

Furthermore, the level of uncertainty is compounded as the forecast time horizon extends from 10 years to 40. To minimize the uncertainty that will always exist, this report is based on the most recently available current and future population estimates, land use plans, water supply master plans, water models and agricultural data. Nevertheless, significant changes may occur that cannot be anticipated at this time. Consequently, the water supply and demand forecasts should be considered as trends within the DAU spatial areas rather exacting forecasts of groundwater basins. In addition, the water supply and demand forecasts should be reevaluated periodically to reflect new baseline conditions that arise.

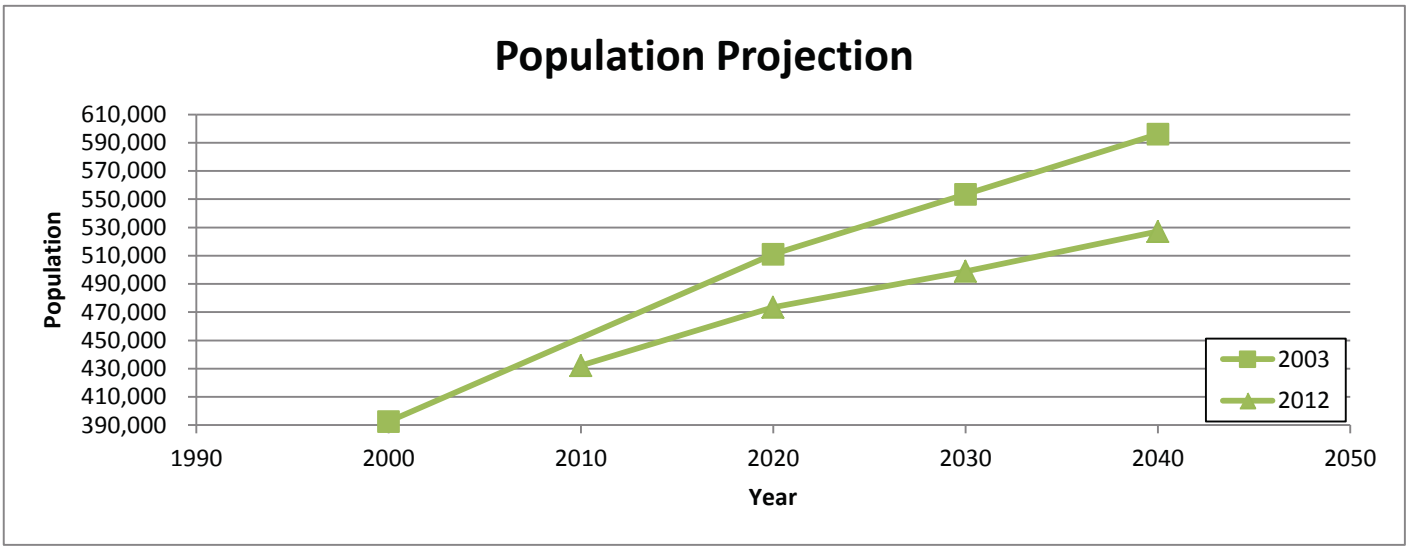
6 Conclusions: Future Water Demand and Supply

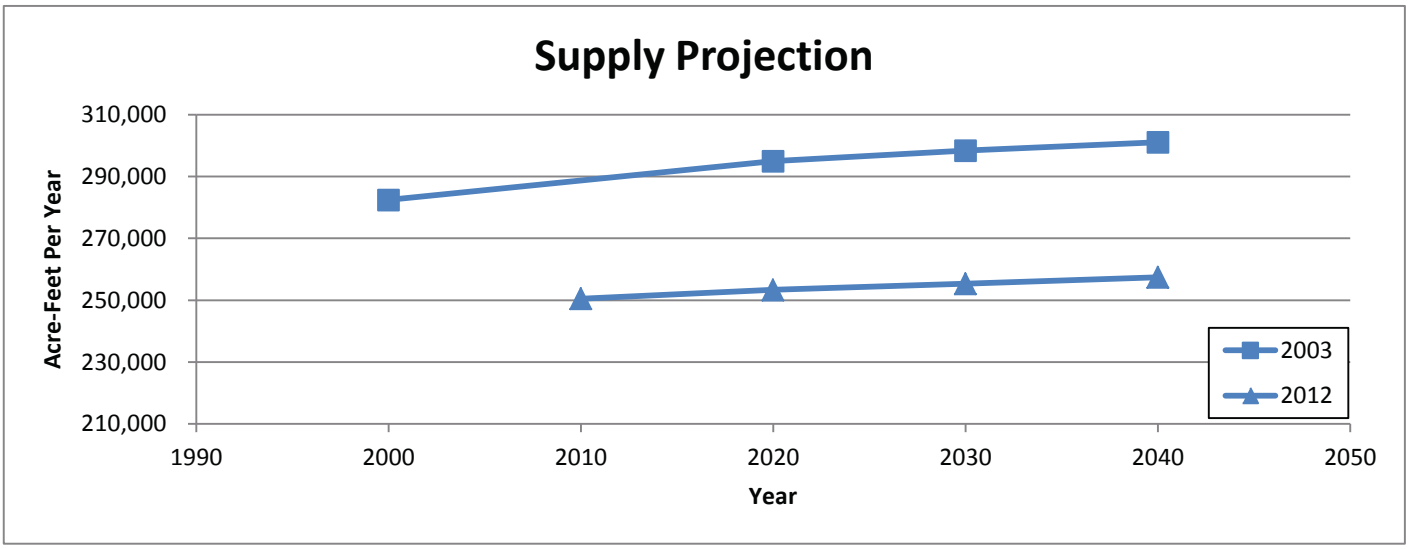
- Current and future supply is less than current and future demand in the Cuyama and San Antonio DAU areas.
- The Santa Maria Valley, Santa Ynez Watershed and South Coast DAU areas have sufficient supplies to meet current demand. The Santa Ynez watershed has sufficient supplies to meet estimated future demand.
- Since future benefits of ongoing and potential conjunctive use were not evaluated for individual groundwater basins, this report likely underestimates projections of supply in the Santa Maria DAU and South Coast DAU. Without conjunctive use measures, projected demand in the Santa Maria DAU and the south coast DAU may exceed supply.
- Available supplies for some areas (e.g., south coast communities) are reduced by siltation of reservoirs and may be affected by increased allocation of water for environmental protection and habitat enhancement purposes. Some areas downstream from reservoirs may benefit from releases for habitat protection.
- Reliability of water supplies provided by public agencies is improved by infrastructure that allows trades, exchanges, and purchases. The service areas that benefit from this infrastructure are in the Santa Maria Valley, Santa Ynez River Watershed, and south coast areas.
- Water purveyors in Santa Barbara County have been successful in helping their customers use water more efficiently. However, more aggressive efforts by water purveyors, including regulatory actions, better targeting of user populations, and subsidizing residents' costs for new water-efficient equipment could result in 10 to 20 percent reduction in per-capita water use over the next 20 years.
- Further study is warranted to better understand the connection between climate factors (rainfall, temperature) and water use, and also the connection between water pricing and demand.

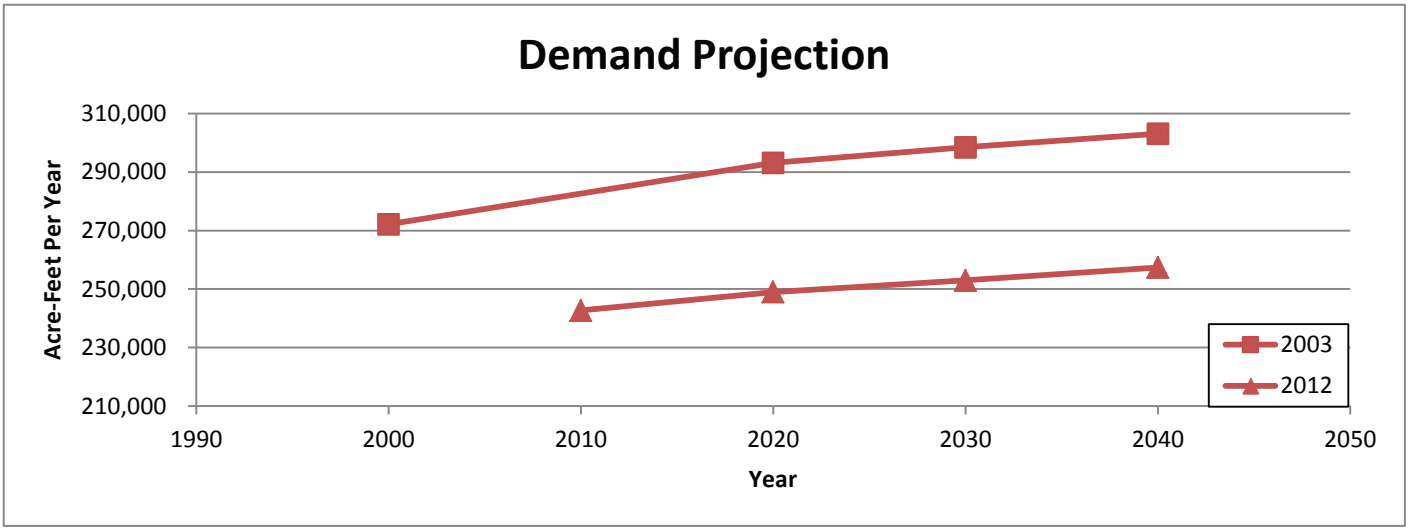
Shown in Figure 6-1 is a comparison of the water supply and demand projections found in the 2003 and 2012 reports.

Figure 6-1 - Comparison of Projections Made in 2003 and 2012

Cuyama DAU and San Antonio DAU Not Included







2003 Population, Supply, and Demand Projections are based on info from the Santa Barbara County Water Supply and Demand Update, February 2003

2010 Population Projections are based on info from Table A-2

2010 Supply and Demand Projections are based on info from Table A-7

References

Arbue´s, F., R. Barbera´n, and I. Villanu´a (2004), Price impact on urban residential water demand: A dynamic panel data approach, Water Resource. Res., 40, W11402, doi:10.1029/2004WR003092.

Bachman, S. (2007). Montecito Water District, Future Water Supply and Water Supply Options

California Urban Water Conservation Council (2011) GPCD Weather Normalization Methodology, Final Report Submitted to the California Urban Water Conservation Council, By Anil Bamezai, Ph.D,

CH2MHill. (2011). 2010 Urban Water Management Plan – City of Santa Maria, prepared for City of Santa Maria.

City of Santa Barbara, Water Resources Division. (2011). City of Santa Barbara Urban Water Management Plan – 2010 Update.

Cosby, P .G and Ahlroth, J. A. (1991). Santa Barbara County Growth Inducement Potential of State Water Importation, Santa Barbara County Water Agency.

Cosby, P .G and Ahlroth, J. A. (2003). Santa Barbara County Water Supply and Demand Update, Santa Barbara County Water Agency.

Geotechnical Consultants, Inc. (1974) Hydrogeologic Investigation of the Montecito Ground Water Basins. Prepared for the Montecito Water District.

Gibbs, Dennis. (2009). 2008 Santa Barbara County Groundwater Report. Santa Barbara County Public Works Department, Water Resources Division, Water Agency.

Gibbs et al. (2011). 2011 Santa Barbara County Groundwater Report, Santa Barbara County Public Works Department, Water Resources Division, Water Agency.

Hendrickson, Dean and McGaugh, Suzanne. (2005). Arundo donax (Carrizo Grande / Giant Cane) in Cuatro Ciénegas. at http://desertfishes.org/cuatroc/organisms/non-native/arundo/Arundo.html.

Kennedy/Jenks Consultants. (2011). 2010 Urban Water Management Plan – Orcutt, prepared for Golden State Water Company – A Subsidiary of American State Water Company.

Kennedy/Jenks Consultants. (2011). 2010 Urban Water Management Plan Update, prepared for Goleta Water District.

Luhdorff and Scalmanini Engineers. (2008). Monitoring Program for the Santa Maria Valley Management Area, prepared for Superior Court of California, County of Santa Clara, and Twitchell Management Authority.

Luhdorff & Scalmanini Engineers. (2009). 2008 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies and Disposition, Santa Maria Valley Management Area. Prepared for Superior Court of California, County of Santa Clara, and Twitchell Management Authority.

Luhdorff & Scalmanini Engineers. (2010). 2009 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies and Disposition, Santa Maria Valley. Prepared for Superior Court of California, County of Santa Clara, and Twitchell Management Authority.

Luhdorff & Scalmanini Engineers. (2011). 2010 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies and Disposition, Santa Maria Valley Management Area. Prepared for Superior Court of California, County of Santa Clara, and Twitchell Management Authority.

Martin, Northart, & Spencer. (2000). Cachuma Bathymetric Survey. Prepared for the Cachuma Operation and Maintenance Board.

Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy. (2007). Fine-resolution climate projections enhance regional climate change impact studies, Eos Trans. AGU, 88(47), 504.

Miller, G.A. and Evenson, R.E., (1966) Utilization of Ground Water in the Santa Maria Valley Area, California. United States Geological Survey Water Supply Paper 1819-A

Milner-Villa Consulting. (2011). 2010 Urban Water Management Plan Update, prepared for Carpinteria Valley Water District.

Nakicenovic, N. et al. (eds.). (2000). Special Report on Emissions Scenarios (SRES): a special report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Santa Ynez River Water Conservation District. 2011. Thirty Third Twenty Eighth Annual Engineering and Survey Report on Water Supply Conditions 2010-2011.

Stetson Engineers. (2011). City of Lompoc 2010 Urban Water Management Plan, prepared for City of Lompoc.

Stetson Engineers. (2011). Draft Hydrologic analyses of the Pass Through Operations at Gibraltar Reservoir. Prepared for the City of Santa Barbara.

Stillwater Sciences. (2012). Final Report, Santa Maria River Instream Flow Study: Flow Recommendations for Steelhead Passage. Prepared for California Ocean Protection Council.

State of California. (2011). The State Water Project Final Delivery Reliability Report. The Resources Agency, Department of Water Resources.

USBR. (2011). West-Wide Climate Risk Assessments: Bias-Corrected and Spatially Downscaled Surface Water Projections, Technical Memorandum No. 88-68210-2011-01. USBR Technical Services Center, Denver, Colorado. 138pp.

USBR. (2012). Cachuma Project, California: Guidelines for Operation – Draft Report. USBR, Mid-Pacific Region, South-Central California Area Office, Fresno, CA.

Ventura County Watershed Protection District. (2011). Arundo donax – Invasive and Noxious Weed. http://www.vcwma.org/noxious-weeds/arundo-donax-invaisive-and-noxious-weeds-vc-wma.

Washington, W. M. et al. (2000). Parallel Climate Model (PCM) control and transient simulations, Earth and Environmental Science, Climate Dynamics, Vol. 16, No. 10-11, 755-774.

Worts, G.F., (1951) Geology and Groundwater Resources of the Santa Maria Valley Area, California, U.S. Geological Survey Water Supply Paper 1000.

Appendix C

Area Specific Data of Population, Water Use, and Water Supply

A number of organizations supply water to customers within Santa Barbara County. The agencies below are the larger suppliers for which information is readily available. A number of smaller privately operated suppliers exist but records of their production are not made available to the public. Estimates of water use by smaller systems are based on evaluation of population and land use information.

Cuyama Community Service District

The Cuyama Community Services District is an independent special district formed in December 1977. The District's service area is the community of New Cuyama. The District relies on groundwater for its supply and treats its water to meet drinking water standards. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Population served - 820 (from 2010 Census)

Connections – (2010)

- Single Family – 217
- Multi-family – 0
- Commercial – 15
- Industrial – 0
- Institutional/Gov – 0
- Landscape – 22
- Ag – 0
- Other – 0
- **Total – 254**

Sources – (2010, in af/yr)

- Groundwater – 146
- **Total – 146**

Distribution system – The District provides water distribution and wastewater collection, treatment, and disposal services. (No details; miles of pipeline, pumps, wells, etc.)

Storage system – The District relies on groundwater basin resources for storage.

Water Conservation-- The District is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

City of Santa Maria

The City of Santa Maria is an incorporated city in Santa Barbara County. The City is a signatory to the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU) administered by the California Urban Water Conservation Council (Council). The City is a member of the Central Coast Water Authority and the Twitchell Management Authority.

Service Area - The City of Santa Maria is located in the Santa Maria Valley of Santa Barbara County, about 180 miles north of Los Angeles. The City is bounded on the north by the Santa Maria River and San Luis Obispo County line. The service area is primarily characterized by residential and commercial land use. The service area boundary also includes developed and underdeveloped land area to the west, south, and east of the City's center. A portion of the City's service area lies outside the city limits, within unincorporated areas of Santa Barbara County. Since 2003 the City has annexed several areas including roughly 800 acres along its western side and 100 acres along the west side of Hwy 101 (See map in Appendix D).

Population served - 108,489 (from 2010 Census)

Connections – (2010)

- Single Family – 18,436
- Multi-family – 787
- Commercial – 1,337
- Industrial – 89
- Institutional/Gov – 557
- Landscape – 355
- Ag – 0
- Other – 275
- **Total – 21,836**

Sources – (2010, in af/yr)

- State Water Project – 13,366
- Groundwater – 12,795
- Twitchell Yield/Comingled Groundwater – 14,300
- Return flows from SWP Water – 8,688

- Exchanged water – 0
- **Total – 49,149**

Distribution system – The City provides water distribution and wastewater collection, treatment, and disposal services. (No details; miles of pipeline, pumps, wells, etc.)

Storage system – The City relies on groundwater basin resources for storage.

Water Conservation- In association with the changes in legislation, the City has formalized its reporting procedures and submits biannual reports to the CUWCC. Since the 2003 report the City has:

- Implemented rebate programs in cooperation with the County for high efficiency washing machines
- Established rebates for toilet replacement for CII customers
- Adopted conservation water rebates

City of Guadalupe

The City of Guadalupe was incorporated as a city in 1946. The City is located in the northwestern portion of Santa Barbara County. The City is a member of the Central Coast Water Authority and the Twitchell Management Authority. The City serves primarily residential and commercial customers. No significant changes in the boundaries of the area served by the City have occurred since the 2003 Supply and Demand Report. Minor changes are shown on the Map in Appendix D.

Service Area--1.4 Sq. Mi.

Population served – 7,345 (2010 Census)

Connections

- Single Family – 1,771
- Multi-family – 12
- Commercial – 102
- Industrial – 0
- Institutional/Gov – N/A
- Landscape – 26
- Ag – 0
- Other – N/A
- **Total – 1,911**

Sources – (2010, in af/yr)

- SWP – 382
- Groundwater-- 552

Distribution system— No information made available.

Storage system-- The City relies on groundwater basin resources for storage.

Water Conservation-- The City is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

Golden State Water Company
Political Description - Supply Sources, Delivery systems, Other Responsibilities
Private water Company serving unincorporated communities of Orcutt, Sisquoc and Garey.

Service Area - The Orcutt System is located in Santa Barbara County and serves an unincorporated portion of the county south of the City of Santa Maria. Separate systems serve the communities of Sisquoc and Garey. The service area is primarily characterized by residential and commercial land use. No changes in the boundaries of the area served by the Company in the Santa Maria Valley have occurred since the 2003 Supply and Demand Report.

Population served – 28,761 (2010 Census)

Connections – (2010)

- Single Family – 10,587
- Multi-family – 117
- Commercial – 166
- Industrial – 11
- Institutional/Gov – 70
- Landscape – 137
- Ag – 1
- Other – 71
- **Total – 11,160**

Sources – (2010, in af/yr)

- Purchased/Assigned water from Santa Maria (SWP water via CCWA) – 92
- Groundwater (Santa Maria Basin) – 7,207
- **Total – 7,299**

Distribution system – 125.4 Miles

Storage system – The Company makes use of the groundwater basin for storage.

Water Conservation- In association with the changes in legislation, the Company has formalized its reporting procedures and submits biannual reports to the CUWCC. Because any costs associated with implementing measures associates with SBX7-7 must be approved by the Public Utilities Commission, the Company is waiting for the outcome of a pending rate increase request before implementing new water efficiency measures.

Los Alamos Community Services District

The Los Alamos Community Services District was formed on October 29, 1956 under Division 4 of the Streets and Highways Code for the purposes of providing water for the Los Alamos area. Service began in July 1958. It is an independent special district functioning as an Enterprise District. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area – 1 square mile

Population served – 1,890 (2010 Census)

Connections

- Residential – 469
- Commercial – 21
- Multi-family – 27
- Industrial – 0
- Landscape – 14
- Other – 12
- **Total - 543**

Sources

- Groundwater – 96,675,000 gal (~296.8 AF)

Distribution system - The Districts water system consists of 3-groundwater wells, 1-square mile of distribution system, consisting of pipes ranging in size from 6 to 12 inches. The District has 3-storage tanks, a 1-million gallon above-ground tank, a 500,000 gallon partially buried reservoir, and a 200,000 gallon above ground tank for a total storage volume of 1.7 MG. The District is responsible for the operation and maintenance of the water wells and entire distribution system, including all fire hydrants, air vacs, blow offs, and storage tanks.

Storage system – See above

Water Conservation-- The District is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

Vandenberg Air Force Base

Vandenberg Air Force Base consists of 86,000 acres of federally owned open lands in the Lompoc-Guadalupe-Santa Maria triangle. Today, the base is operated by Air Force Space Command's 30th Space Wing. Population is variable and is typically between 12,500 and 15,000 people. Currently, Vandenberg Air Force Base relies on two sources of supply to meet water demand in its service area and they are as follows:

- State Water Project: Vandenberg Air Force Base has a SWP allotment of 5,500 AF per year with an additional 550 AF per year of drought buffer.
- Groundwater. Vandenberg Air Force Base has four active groundwater production wells that are permitted by the California Department of Public Health. These groundwater wells draw water from the San Antonio Groundwater Basin. These wells are generally used only when SWP deliveries are not available.

No changes in the area served by the Base system have occurred since the 2003 Supply and Demand Report.

Water Conservation-- The base is not required to prepare and Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

Vandenberg Village Community Services

The Vandenberg Village Community Services is an independent special district serving the unincorporated community of Vandenberg Village. The District was formed in 1983 and acquired its facilities in 1988 from the Park Water Company. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area – 5.25 square miles

Population served – 6,497 (2010 Census)

Connections

- Residential – 2,350
- Commercial – 68

- Bulk-metered Residential – 44
- Irrigation – 16
- Temporary Fire Hydrant Meter – 5
- Non-metered fire hydrant/detector check – 8
- **Total – 2,491**

Sources

- Groundwater (Lompoc uplands groundwater basin)

Distribution system – 28.5 miles of water distribution system, three booster stations and a pressure filter treatment system. The District also operates one natural gas engine booster pump as a standby pump and has two standby diesel generators.

Storage system – three 500,000 gallon tank reservoirs, two 1,000,000 gallon steel tank reservoirs.

Water Conservation -- The District is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The VVCSD has several active water conservation programs, including a "cash for grass" landscape rebate program that has been implemented since preparation of the 2003 Report.

<u>Mission Hills Community Services District</u>
Mission Hills Community Services District was established in 1979 as an independent special district serving the unincorporated community of Mission Hills. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area – N/A

Population served – 3,576 (2010 Census)

Connections (2010)

- Single Family – 1,132
- Multi-family – 0
- Commercial – 2
- Industrial – 0
- Institutional/Gov – 0
- Landscape – 2
- **Total – 1,136**

Sources (2010, in af/yr)

- Groundwater – 601 (Lompoc uplands groundwater basin)
- **Total – 601**

Distribution system – 27.5 miles

Storage system – N/A

Water Conservation-- The District is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

City of Lompoc

The City of Lompoc was incorporated as a city 1888. It is located in the lower Santa Ynez River Valley in the western portion of Santa Barbara County. The City has annexed two areas to its service area since 2003: an area north of the City along Highway 1 and an area on the east side of the city. These annexations are shown on the Map in Appendix D.

Service Area – 11.7 Sq. Mi.

Population served – 44,988 including prison; 41,389 excluding prison (2010 UWMP)

Connections (2010)

- Single Family – 7,804
- Multi-family – 1,138
- Commercial – 448
- Industrial – 19
- Institutional/Gov – 151
- Landscape – 112
- **Total – 9,674**

Sources (2010, in af/yr)

- Groundwater – 5,750
- Surface Water (Frick Springs) – 12
- Recycled Water – 5
- **Total – 5,767**

Distribution system – The City of Lompoc has 132 miles of water mains in its underground water distribution system and 3.4 miles of water main in its surface water treatment system. The City's distribution system maintenance program includes record keeping, valve exercise,

hydrant inspection and exercise, and leak repair. The City also has a meter maintenance program to replace old meters and identify and replace broken, stopped, and inaccurate meters. All water customers are billed for their water usage from their meters and charged a monthly service rate.

Storage system – The City relies on groundwater basin resources for storage, as well as four distribution reservoirs that have a total usable storage capacity of 12 million gallons. These reservoirs are connected to a gravity delivery grid.

Water Conservation- In association with the changes in legislation, the City has formalized its reporting conservation procedures and incorporates information in its UWMP. Since the 2003 report the City has:

- Adopted and will implement a "low water using landscape rebate program"
- Adopted a rebate program for replacement of high water use dishwashers
- Implemented a rebate program for high efficiency washing machines

<u>City of Buellton</u>
The City of Buellton was incorporated in 1992 and is located in the central Santa Ynez River Valley. The City of Buellton's service area is approximately 1,025 acres and potable water is provided to residential, commercial, and industrial customers. There are no agricultural irrigated lands within city limits. Currently, the City of Buellton relies upon two sources of water for domestic supply: groundwater from wells along the Santa Ynez River and deliveries from the State Water Project. No changes in the boundaries of the area served by the City have occurred since the 2003 Supply and Demand Report.

Service Area – 1,025 acres

Population served – 4,828 (2010 Census)

Connections

- Single Family – 1,235
- Multi-family – 108
- Commercial – 155
- Industrial – 21
- Institutional/Gov – N/A
- Landscape – 10
- Ag – 0
- Other – N/A
- **Total – 1,529**

Sources (2010, in af/yr)

- SWP – 578
- Groundwater – 616

Distribution system—N/A

Storage system—N/A

Water Conservation-- The City is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

City of Solvang

The City of Solvang was incorporated in 1985. It is located in the central Santa Ynez River Valley. SWP supplies are provided through the Santa Ynez River Water Conservation District, ID#1 SWP allocation. As shown in the map in Appendix D, the City has made one minor annexation since the 2003 Report.

Service Area 2.4 Sq. Mi.

Population served – 5,245 (2010 Census)

Connections

- Single Family – 1,591
- Multi-family – 84
- Commercial – 230
- Industrial – 20
- Institutional/Gov – N/A
- Landscape – 26
- Ag – 0
- Other – N/A
- **Total – 1,951**

Sources (2010, in af/yr) 1,308

- Riparian Wells, N/A
- State Water Supplies (through SYRWCD ID #1 N/A

Distribution system-- The City's water system is made up of nearly 32 miles of water mains, four water wells, two connections to Santa Ynez River Water Conservation District Improvement District #1, and a State Project Water pump station.

Storage system—Groundwater and three reservoirs

Water Conservation -- The City is not required to prepare an Urban Water Management Plan and is not a signatory of the CUWCC MOU and therefore no detailed information regarding water conservation efforts is available. The County Water Agency implements a regional water conservation program that includes an extensive website with information for all residents regarding water conservation opportunities.

SYRWCD ID #1

Santa Ynez River Water Conservation District Improvement District #1 is an independent special district formed in 1956. The district serves both retail customers and provides "wholesale" supplies to the City of Solvang. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area: 10,850 acres

(Including the communities of Santa Ynez, Los Olivos, Ballard, and the City of Solvang)

Population Served: 8,920 – not inclusive of the City of Solvang

Connections

- Single Family – 2,373
- Multi-family – 0
- Commercial – 0
- Industrial – 0
- Institutional/Gov – N/A
- Landscape – 0
- Ag – N/A
- Other – N/A
- **Total – 2,553**

Sources (2010, in af/yr) 2382

- Santa Ynez Uplands Groundwater Basin
- Santa Ynez River Alluvium
- State Water Project
- The United States of America Bureau of Reclamation – Cachuma Project

Distribution system-- 86.7 miles of water lines and five (5) booster stations

Storage system—Two Reservoirs and two tanks, with a combined capacity 16.75 Million Gallons

Water Conservation - In association with the changes in legislation, the District has formalized its reporting of conservation procedures and incorporates information in its UWMP.

Goleta Water District

The Goleta Water District was formed in 1944 as an independent special district that now serves the City of Goleta and the surrounding unincorporated area. The Goleta Water District service area includes the Santa Barbara County South Coast area from Santa Barbara City limits west to the El Capitan State Park area. The District operates the Corona del Mar Water Treatment Plant and delivers potable water to the South Coast Conduit for its customers as well as the City of Santa Barbara, Montecito Water District, and Carpinteria Valley Water District. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area – 29,000 acres

Population served – 86,946 (2010 Census)

Connections

- Single Family – 13,342
- Multi-family – 1,578
- Commercial – 1,017
- Industrial – 0
- Institutional/Gov – N/A
- Landscape – 207
- Ag – 164
- Other – N/A
- **Total – 16,308**

Sources (2010, in af/yr)

- SWP – 4,500
- Cachuma Project – 9,321
- Groundwater – 2,350 plus surplus water in storage (6 wells)
- Recycled Water – N/A

Distribution system-- approximately 270 miles of pipeline

Storage system—steel tank, West Coast Conduit regulating reservoirs, groundwater basin

Water Conservation- In association with the changes in legislation, the District has formalized its reporting procedures and submits biannual reports to the CUWCC. Since the 2003 report the District has:

- Developed and adopted a detailed water efficiency program implementation plan
- Landscaping water audits
- Established rebates for toilet replacement for residential and commercial/ industrial/ institutional customers
- Adopted a landscape conversion rebate program

City of Santa Barbara

The City of Santa Barbara is an incorporated city on the south coast of Santa Barbara County. The City was founded prior to California statehood and thus is a charter city with "pueblo" water rights. The City operates the water supply system that serves most of the properties within the City limits (except for the City airport), and selected areas located outside the City limits. The City operates the Cater Water Treatment Plant, which serves water to City customers and to the Montecito and Carpinteria Valley Water Districts through the South Coast Conduit. Since the 2003 Report the City has annexed several parcels as shown on the Map in Appendix D. Generally speaking, these annexations are either of open space or parcels already served water by the City.

Service Area –41.97 sq. mi.

Population served – 91,416 (2010 Census)

Connections – (2010)

- Single Family – 16,920
- Multi-family – 6,126
- Commercial – 2,530
- Industrial – 56
- Institutional/Gov – 0
- Landscape – 729
- Ag – 59
- **Total – 26,420**

Sources (2010, in af/yr)

- SWP via CCWA – 2,084
- Cachuma Project – 8,277 (less 640 af/yr to Local Carryover Storage)
- Gibraltar Reservoir/Devils Canyon – 2,933
- Mission Tunnel – 1,220
- Groundwater – 1,164

- Recycled Water—800 (system capacity 1,200)
- Desalination—3,125
- **Total – 15,038**

Distribution system – The City maintains approximately 320 miles of potable water distribution lines and 14 miles of recycled water distribution lines. There are 13 balancing reservoirs, 12 pumping stations, and 9 production wells for potable water. There are 2 balancing reservoirs and 2 pumping stations for recycled water. The City also maintains 277 miles of sewer pipe, 9 sewer lift stations, and a wastewater treatment plant capable of treating 11 MGD.

Storage system – See distribution system for balancing reservoirs. The City also makes use of the groundwater basin for storage.

Water Conservation - In association with the changes in legislation, the City has formalized its reporting procedures and submits biannual reports to the CUWCC. Since the 2003 report the City has continued to implement an aggressive water efficiency program compliant with State mandates. In 2010, the City commissioned a report to identify cost effective measures that may be incorporated into the City program. Generally, the report identified existing rebate programs and audits as cost effective.

Montecito Water District

The Montecito Water District is an independent special district serving the unincorporated communities of Montecito and Summerland. The District was incorporate in 1921 and operates Jameson Lake Reservoir (dedicated in 1930), the Doulton Tunnel, and Bella Vista Water Treatment Plant.

The Montecito Water District encompasses an area of 9,888 acres, of which approximately 6,883 acres are developed (about 98 percent as residential and 2 percent as commercial) and approximately 849 acres are currently used for agriculture. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Service Area – 9,888 acres

Population served—10,413 (2010 Census)

Connections

- Single Family – 4,204
- Multi-family – 74
- Commercial – 242
- Industrial – 0
- Institutional/Gov – N/A

- Landscape – 0
- Ag – 45
- Other – N/A
- **Total – 4,565**

Sources

- SWP – 3,000
- Cachuma Project – 2,651
- Jameson Lake, Fox, and Alder Creeks – N/A
- Groundwater – 700

Distribution system—Gravity mains

Storage system—ten storage reservoirs

Water Conservation- In association with the changes in legislation, the District has formalized its reporting procedures and submits biannual reports to the CUWCC. Since the 2003 report the District has:

- Adopted increasing block water rates
- Implemented landscaping water audits

Carpinteria Valley Water District

The Carpinteria Valley Water District is an independent special district formed in 1941 as the Carpinteria County Water District. The District serves the City of Carpinteria and surrounding unincorporated area in the southeastern portion of Santa Barbara County. The District prepares an annual report on its AB 3030 Groundwater Management Plan. Since the 2003 Report the District has annexed approximately 2,327 acres located north of Foothill Road (see District map in Appendix D)

Service Area-17 sq. mi.

Population served – 13,040 (2010 Census)

Connections (2010)

- Single Family – 3,078
- Multi family – 314
- Commercial – 211
- Industrial – 57
- Institutional/Gov – 35
- Landscape – 53

- Ag – 398
- Other – 15
- **Total – 4,161**

Sources (2010, in af/yr)

- Cachuma – 2,813
- SWP – 1,200 (total allocation is 2,000)
- Groundwater – 1,500 (up to 2,200)
- **Total – 6,073**

Distribution system – 75 miles of pipeline

Storage system – The District utilizes the groundwater basin, Lake Cachuma, two covered local "regulating reservoirs," and two "out of District" storage programs for water storage. One 'out of District' program involves storing SWP water in the groundwater basins managed by Rosedale-Rio Bravo Water Storage District. The other 'out of District' program involves temporarily storing SWP carryover water in the San Luis Reservoir.

Water Conservation - In association with the changes in legislation, the District has formalized its reporting procedures and submits biannual reports to the CUWCC. Since the 2003 report the District has:

- Adopted increasing block water rates
- Exterior residential water audits
- Implemented rebate programs in cooperation with the county for high efficiency washing machines
- Established rebates for toilet replacement for commercial/ industrial/ institutional customers, and implemented a smart landscape rebate program.

Appendix B

Water Supply Agencies in Santa Barbara County

B.1 Agencies Responsible for Water Supply

In general, the water-related agencies and their service areas have remained unchanged since the 2003 Supply and Demand Study. Four key exceptions include formation of the Twitchell Project Authority and expansion of service areas in the Cities of Santa Maria and Lompoc as well as the Carpinteria Valley Water District. The agencies responsible for water resources within Santa Barbara County are listed in Table B-1. The service areas of retail water suppliers, "purveyors," are shown on maps contained in Appendix D.

Table B-1 Agencies Involved Directly in Water Supply

Regional Agencies
Santa Barbara County Water Agency
Santa Barbara County Flood Control and Water Conservation District
Central Coast Water Authority
Santa Maria Valley Water Conservation District
Twitchell Management Authority
Santa Ynez River Water Conservation District ("Parent District")
Cachuma Operations and Maintenance Board

Participation of "Retail" Water Suppliers (Purveyors) In Management Programs (North To South)

Water Supplier	State Water Project	Cachuma Project	Urban Water Management Plan	Urban Water Conservation Council Member	Groundwater Management Plan or Adjudication
Cuyama CSD					
City of Santa Maria	Yes		yes	yes	Yes (1)
City of Guadalupe	Yes		yes		
Golden State Water Co.	Yes		yes	yes	Yes (1)
Casmalia CSD					Yes (1)
Los Alamos CSD					
Vandenberg Village CSD					
Vandenberg AFB	Yes				
Mission Hills CSD					
City of Lompoc			yes		In Progress
City of Buellton	Yes				
City of Solvang					
Santa Ynez River CD ID#1	Yes	yes	yes	yes	
Goleta Water District	Yes	yes	yes	yes	yes
La Cumbre Mutual Water Co.	Yes				
City of Santa Barbara	Yes	yes	yes	yes	Pueblo rights
Montecito Water District	Yes	yes	yes	yes	
Carpinteria Valley Water District	Yes	yes	yes	yes	yes

Note: (1) Change since 2003 report.

Table B-2 Other Relevant Local Agencies

Santa Barbara County Area Governments
Santa Barbara County Agricultural Commissioner
Santa Barbara County Public Health Department, Environmental Health Division
Santa Barbara County Planning and Development, Long Range Planning Division
Cachuma Resource Conservation District
City of Carpinteria
City of Goleta
Goleta Sanitary District
Laguna County Sanitary District
Carpinteria Sanitary District
Montecito Sanitary District
Santa Ynez Community Services District
Embarcadero Municipal Improvement District

Description of Regional Agencies

Several agencies have county-wide or other regional responsibilities. These agencies are listed under "Regional Agencies" in Table B-1 and are briefly discussed below. Only two of these agencies, CCWA and COMB, operate delivery systems. The others provide various water management services.

Santa Barbara County Water Agency

The Santa Barbara County Water Agency (SBCWA) is a dependent special district formed in 1945. SBCWA is signatory on the Twitchell Reservoir and Cachuma Project contracts with the US Bureau of Reclamation on behalf of local water users (Table B-1). The SBCWA does not directly manage any water supplies and operates no delivery systems. The SBCWA provides water supply planning, manages a regional water use efficiency program, collects and compiles surface and groundwater information, and implements a supply augmentation (weather modification) program. The regional water efficiency program brings together agencies throughout the County in a collaborative to share information and implement conservation program elements of mutual benefit. The SBCWA has also led development of drought response plans. No changes in the boundaries of the area served by the Agency have occurred since the 2003 Supply and Demand Report.

Santa Barbara County Flood Control and Water Conservation District

The Santa Barbara County Flood Control and Water Conservation District is a dependent special district formed in 1945. The District is signatory on the State Water Project contract with the California Department of Water Resources on behalf of local water users.

Responsibility for operation and finances for the Coastal Branch portion of the State Water Project (SWP) has been transferred to the Central Coast Water Authority. The District collaborates with the Water Agency on SWP water supply issues and collects and disseminates climate and surface hydrologic information. No changes in the boundaries of the area served by the Agency have occurred since the 2003 Supply and Demand Report.

Central Coast Water Authority

The Central Coast Water Authority (CCWA) is a joint exercise of powers agency comprising the public water agencies with an allocation of State Water Project (SWP) supplies. The Authority was formed in 1991 and has water supply agreements with other interests including the Vandenberg Air Force Base, La Cumbre Mutual Water Company, and private interests. The CCWA receives water from the State Water Project through the Coastal Branch, Phase II, which it constructed and operates. CCWA delivers water to the agencies listed in Table B-1 as well as several areas in San Luis Obispo County. CCWA represents the interests of its participants with respect to SWP operation, planning, and contractual issues. Changes in the area served by the Authority include annexations by its member cities of Santa Maria and Guadalupe and the Carpinteria Valley Water District. Details of changes due to annexation are shown on purveyor service area maps in Appendix D.

The CCWA operates the Phase II Coastal Branch segment of the State Water Project including pumping stations to lift water to a water treatment plant in the Polonio Pass area and a treated water pipeline to turnouts to the purveyors served (Figure B-2). *The distribution system consists of an approximate 130 mile long pipeline, treated water tanks at the water treatment plant, three interim storage facilities, one energy dissipation facility, nine turnouts, four isolation valve facilities, a chloramines removal and water pumping facility, and Lake Cachuma inlet monitoring facility (CCWA website)*

Santa Maria Valley Conservation District

The Santa Maria Valley Water Conservation District is an independent special district established in 1937 to represent the interests of Santa Maria area water users and eventually the beneficiaries of the Twitchell Reservoir. Under contract with the Santa Barbara County Water Agency, the District provides operation and maintenance of the reservoir. Except for the reservoir, the District operates no facilities; water is released directly from the dam for downstream benefit, primarily groundwater recharge. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Twitchell Management Authority

Since the 2003 Report the Santa Maria Basin adjudication resulted in creation of the Twitchell Management Authority. The Twitchell Management Authority manages and administers new projects to maintain the Twitchell Project yield. (The Santa Maria Valley Water Conservation District maintains their responsibility for day-to-day operation of the

Twitchell Project pursuant to the operations and maintenance manual.) The Twitchell Management Authority has no formal service area defined through incorporation or annexation, but has an area of interest that coincides with the Santa Maria Management Area as defined through court action.

The Twitchell Management Authority administers a monitoring program to determine land and water uses in the basin, sources of supply to meet those uses, groundwater conditions including groundwater levels and quality, the amount and disposition of developed water supplies, and the amount and disposition of any other sources of water supply in the basin. Each year, the Twitchell Management Authority accepts public comments on and considers for adoption an annual report prepared by a management area engineer and submits the adopted annual report along with its recommendations to the court.

Santa Ynez River Water Conservation District

Formed in 1939, the District protects water rights and supplies within the Santa Ynez River watershed, manages releases of water from Bradbury Dam to replenish downstream basins along the River and on the Lompoc Plain, and provides water management throughout the area. No changes in the boundaries of the area served by the District have occurred since the 2003 Supply and Demand Report.

Cachuma Operation and Management Board

The Cachuma Operation and Maintenance Board (COMB) is a California Joint Powers Agency formed in 1956 pursuant to an agreement with the Bureau of Reclamation. The agreement transferred to the Cachuma Member Units the responsibility to operate, repair, and maintain all Cachuma Project facilities, except Bradbury Dam, which the Bureau of Reclamation has continued to operate. Its Cachuma Member Units include Carpinteria Valley Water District, City of Santa Barbara, Goleta Water District, Montecito Water District, and Santa Ynez River Water Conservation District-Improvement District No. 1. With the exception of Santa Ynez River Water Conservation District-Improvement District No. 1, the Member Units are located in the South Coast area and receive water through the Tecolote Tunnel and the South Coast Conduit pipeline.

COMB is responsible for diversion of water to the South Coast through the Tecolote Tunnel, and operation and maintenance of the South Coast Conduit pipeline, flow control valves, meters, and instrumentation at control stations, and turnouts along the South Coast Conduit and at four regulating reservoirs.

Bradbury Dam forms Cachuma Lake, which has a storage capacity of about 188,000 AF. The facility is operated to provide approximately 27,000 AFY to the Member Units as well as releases for fish habitat and to satisfy water users holding downstream water rights.

Tecolote Tunnel extends 6.4 miles through the Santa Ynez Mountains from Cachuma Lake to the headworks of the South Coast Conduit. The horseshoe-shaped tunnel is 7 feet in diameter and has a capacity of 100 cubic feet per second. Infiltration averages approximately 1,200 AFY.

The South Coast Conduit conveys Santa Ynez River water from the Tecolote Tunnel to the South Coast water districts. It is a high-pressure concrete pipeline. The conduit extends 26 miles from the Tecolote Tunnel to its terminus at the Carpinteria Reservoir in the Carpinteria Valley Water District's service area. The conduit includes four regulating reservoirs.

The Lauro (Santa Barbara), Ortega (Summerland), and Carpinteria Regulating Reservoirs were constructed along and integrated with the South Coast Conduit to gravitate or "float along the line."

No changes in the area served by COMB have occurred since the 2003 Supply and Demand Report with the exception of an area annexed by the Carpinteria Valley Water District.

Appendix A

Supply and Demand Analysis Tables

Table A-1
Santa Barbara County Population Data and Forecasts for Cities

City	From Census				Projections [1]					
	1980	1990	2000 [6]	2010	2015	2020	2025	2030	2035	2040
City of Carpinteria [2]	10,835	13,747	14,194	13,040	15,512	15,904	16,306	16,718	17,140	17,537
City of Santa Barbara [3]	74,414	85,571	92,325	91,416	93,091	94,766	96,441	98,116	99,791	101,466
City of Solvang	3,106	4,741	5,332	5,245	5,800	5,900	6,000	6,200	6,400	6,600
City of Buellton	2,242	3,688	3,828	4,828	5,300	5,700	6,100	6,500	6,900	7,200
City of Lompoc [3]	26,267	37,649	41,103	43,300	44,400	45,700	46,900	48,200	49,450	50,710
City of Santa Maria [4]	39,685	61,284	77,423	99,553	108,489	117,425	121,191	121,512	121,833	122,154
City of Guadelupe	3,629	5,479	5,659	7,345	8,000	8,800	9,600	10,400	11,200	12,000
City of Goleta [2]	[5]	[5]	[5]	86,946	90,480	94,157	97,984	101,967	106,111	109,861
Unincorporated [5]	138,738	157,449	159,483	138,300	140,700	143,000	144,900	146,800	148,900	151,200
Santa Barbara County Total [6]	298,916	369,608	399,347	489,973	511,772	531,352	545,422	556,413	567,725	578,728

[1] SBCAG, Regional Growth Forecast, 8-2007

[2] Projection for 2040 based on 2015 to 2035 population trend

[3] Projection for 2035 and 2040 based on 2015 to 2030 population trend

[4] Projection for 2040 based on 2025 to 2035 population trend

[5] City of Goleta was incorporated in 2002, prior population included in unincorporated area

[6] Population of Unincorporated area in 2000 calculated from known 2000 Santa Barbara County Population, minus Population of Cities

Table A-2
Population Forecasts by Water Purveyor Service Areas and Detailed Analysis Units

DAU and Subareas	From Census [1]				Projections [1]					
	1980	1990	2000	2010	2015	2020	2025	2030	2035	2040
DAU 71:										
City of Santa Maria	39,685	60,229	75,667	99,553	108,489	117,425	121,191	121,512	121,833	122,154
Golden State Water Co. [2]	23,215	31,469	31,670	28,761	29,739	30,839	31,826	32,813	33,797	34,830
City of Guadalupe	3,700	5,695	5,659	7,345	8,000	8,800	9,600	10,400	11,200	12,000
S.M. Valley Industrial	-	-	-	-	-	-	-	-	-	-
Private SMV, M&I and Ag [3]	836	984	3,323	6,239	6,461	6,661	6,874	7,087	7,303	7,670
Casmalia CSD [4]	226	164	151	138	140	140	140	140	140	140
Santa Maria Totals	67,662	98,541	116,470	142,036	152,829	163,865	169,631	171,952	174,273	176,794
DAU 73:										
Los Alamos CSD [5]	734	890	1,372	1,890	1,943	1,995	2,048	2,100	2,423	2,746
Private San Ant. M&I, Ag [11]	460	543	788	1,086	1,116	1,146	1,176	1,206	1,392	1,577
San Antonio Totals	1,194	1,433	2,160	2,976	3,058	3,141	3,223	3,306	3,815	4,323
DAU 74:										
City of Lompoc	26,270	35,711	41,208	43,300	44,400	45,700	46,900	48,200	49,450	50,710
Vandenberg Village CSD [5]	5,839	6,793	5,802	6,497	6,090	5,684	5,277	4,870	6,026	7,181
Mission Hills CSD [5]	2,755	3,121	3,142	3,576	3,496	3,416	3,336	3,256	4,316	5,376
Vandenberg AFB [6,7]	8,136	9,821	7,801	6,763	6,800	6,800	6,800	6,800	6,800	6,800
City of Buellton	2,242	3,688	3,828	4,828	5,300	5,700	6,100	6,500	6,900	7,200
City of Solvang	2,899	4,755	5,332	5,245	5,800	5,900	6,000	6,200	6,400	6,600
Santa Ynez RWCD ID #1 [5]	7,712	8,298	6,952	6,017	6,418	6,819	7,220	7,621	8,280	8,939
Private SY-Lompoc M&I, Ag [12]	1,824	2,192	4,070	4,236	4,367	4,426	4,475	4,527	5,024	5,467
Santa Ynez Totals	57,677	74,379	78,135	80,462	82,671	84,445	86,108	87,974	93,196	98,273

Table A-2
Population Forecasts by Water Purveyor Service Areas and Detailed Analysis Units

DAU and Subareas	From Census [1]				Projections [1]					
	1980	1990	2000	2010	2015	2020	2025	2030	2035	2040
DAU 75:										
Carpinteria VWD	13,410	17,102	15,943	13,040	15,512	15,904	16,306	16,718	17,140	17,537
Montecito WD [5]	11,209	13,161	11,545	10,413	10,789	11,165	11,540	11,916	12,787	13,658
City of Santa Barbara	76,705	84,170	91,648	91,416	93,091	94,766	96,441	98,116	99,791	101,466
La Cumbre MWC [5]	4,000	4,141	3,157	3,653	4,043	4,433	4,822	5,212	4,783	4,353
Goleta WD [8]	64,503	70,348	74,903	86,946	90,480	94,157	97,984	101,967	106,111	109,861
Private South Coast M&I, Ag [13]	1,330	4,951	4,162	4,191	4,519	4,714	4,907	5,100	5,175	5,231
South Coast Totals	171,157	193,873	201,358	209,659	218,434	225,138	232,001	239,029	245,787	252,106
DAU 76:										
Cuyama CSD [9]	625	662	653	671	689	707	725	743	761	779
Private Cuyama Valley M&I, Ag [10]	601	718	747	829	861	893	925	957	989	1,021
Cuyama Valley Totals	1,226	1,380	1,400	1,500	1,550	1,600	1,650	1,700	1,750	1,800
Santa Barbara County Total	298,916	369,606	399,523	436,633	458,542	478,188	492,613	503,961	518,820	533,297

[1] Population projections for 2010-2040 for SB County Incorporated Cities are from Table A-1

[2] Population projection for 2040 based on trend of 2015 to 2035 projections

[3] Population projection for 2010-2040 are from Table 2.4 of CCWA UWMP - Santa Maria-Uninc. population minus GSWC population

[4] Population projection for 2015-2040 based on 2010 population

[5] Population projection for 2015-2025 and 2035 have been interpolated based on 2010 Census and 2030 and 2040 Transportation Analysis Zone Projections from the Santa Barbara County Association of Governments

[6] Population projection for 2015-2040 includes Lompoc Federal Correction Complex, and is based on current VAFB and LFCC populations

[7] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[8] Population projection for Goleta WD includes Raytheon Infrared Operations

[9] Population projection for 2015-2040 based on trend of 2000-2010 Census populations

[10] Population projection for 2015-2040 based on Cuyama Valley Total population projection minus CCSD population projection

[11] Population projection for 2010-2040 based on percentage increase of Los Alamos CSD over 2010-2040

[12] Population projection for 2010-2040 based on average percentage increase of all purveyors in DAU 74

[13] Population projection for 2010-2040 based on average percentage increase of all purveyors in DAU 75

Table A-3
Historic M&I Water Production and Demand

DAU and Subareas	1980			1990			2000			2010		
	Population[1]	Gross Water (AF)	M&I GPCD[5]	Population[1]	Gross Water (AF)	M&I GPCD[5]	Population[1]	Gross Water (AF)	M&I GPCD[5]	Population[1]	Gross Water (AF)	M&I GPCD[5]
DAU 71:												
City of Santa Maria	39,685	8,739	197	60,229	12,058	179	75,667	12,713	150	99,553	13,072	117
Golden State Water Co.	23,215	5,608	216	31,469	8,691	247	31,670	9,341	263	28,761	6,594	205
City of Guadalupe	3,700	762	184	5,695	723	113	5,659	735	116	7,345	930	113
S.M. Valley Industrial	0	7,120		0	6,000		0	2,000		0	0	
Private SMV, M&I and Ag[6]	836	89,739		984	122,379		3,323	113,895		6,239	101,852	
Casmalia CSD	226	16	65	164	13	72	151	25	148	138	9	58
Santa Maria Totals [7]	67,662	111,984	202	98,541	149,864	197	116,470	138,709	180	142,036	122,457	135
DAU 73:												
Los Alamos CSD	734	230	280	890	251	252	1,372	304	198	1,890	275	130
Private San Ant. M&I, Ag[6]	460	16,260		543	17,405		788	18,850		1,086	33,168	
San Antonio Totals [7]	1,194	16,490	280	1,433	17,656	252	2,160	19,154	198	2,976	33,443	130
DAU 74:												
City of Lompoc	26,270	3,753	128	35,711	4,930	123	41,208	5,249	114	43,300	4,500	93
Vandenberg Village CSD	5,839	1,527	233	6,793	1,438	189	5,802	1,511	232	6,497	1,203	165
Mission Hills CSD	2,755	583	189	3,121	633	181	3,142	804	228	3,576	601	150
Vandenberg AFB [2]	8,136	1,886	207	9,821	1,730	157	7,801	2,252	258	6,763	1,515	200
City of Buellton	2,242	752	299	3,688	1,083	262	3,828	975	227	4,828	1,183	219
City of Solvang	2,899	1,231	379	4,755	1,963	369	5,332	1,556	261	5,245	1,306	222
Santa Ynez RWCD ID #1	7,712	6,527	756	8,298	6,337	200	6,952	5,892	200	6,017	2,382	353
Private SY-Lompoc M&I, Ag[6]	1,824	55,120		2,192	56,334		4,070	61,358		4,236	48,603	
Santa Ynez Totals [7]	57,677	71,379	260	74,379	74,448	224	78,135	79,597	220	80,462	61,293	149
DAU 75:												
Carpinteria VWD	13,410	5,129	341	17,102	5,362	280	15,943	4,379	245	13,040	2,136	146
Montecito WD	11,209	4,075	325	13,161	4,411	299	11,545	5,357	414	10,413	5,475	469
City of Santa Barbara	76,705	14,543	169	84,170	9,849	104	91,648	14,968	146	91,416	11,616	113
La Cumbra MWC	4,000	1,533	342	4,141	1,297	280	3,157	1,813	513	3,653	1,451	355
Goleta WD [3,4]	64,503	16,034	222	70,348	10,013	127	74,903	13,806	165	86,946	10,294	106
Private South Coast M&I, Ag[6]	1,330	10,125		4,951	20,315		4,162	13,546		4,191	27,974	
South Coast Totals [7]	171,157	51,439	217	193,873	51,247	146	201,358	53,869	183	209,659	58,946	135
DAU 76:												
Cuyama CSD	625	292	417	662	189	255	653	195	267	671	146	194
Private Cuyama Valley M&I, Ag[6]	601	28,604		718	20,925		747	20,479		829	37,987	
Cuyama Valley Totals [7]	1,226	28,896	417	1,380	21,114	255	1,400	20,674	267	1,500	38,133	194
Santa Barbara County Totals [7]	298,916	280,188	244	369,606	314,329	191	399,523	312,003	194	436,633	314,272	137

[1] Historical population data is from Table A-2

[2] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[3] Goleta 2010 Numbers do not include system losses; 2010 Gross Water value is from UWMP Table 2-11: Total Water Use minus Ag Use

[4] Raytheon Infrared Operations are carried in Goleta WD totals

[5] Formula used to calculate GPCD is as follows: GPCD = (Gross Water (AFY) * 325,851.429 (Gal/AF))/(365 Day/Yr)/(Population)

[6] Private M&I and Ag includes all water use outside public agency service areas: Ag, Industrial, and the small number of private homes in the DAU. No estimate of was made of GPCD for three reasons: A large range of private water use driven by "yard" size; it was a small percentage of domestic use compared to the public supplies, and no regulatory or policy reason to derive the number.

[7] DAU GPCD calculations do not include Industrial or Private DAU M&I and Ag, population and gross water use numbers

Table A-4
Municipal and Industrial Conservation Estimates

DAU and Subareas	GPCD	GPCD	M&I Projected 2015		M&I Projected 2020		M&I Projected 2025		M&I Projected 2030		M&I Projected 2035		M&I Projected 2040	
	2000 [1]	2010 [1]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]
			GPCD[1]	(AF)	GPCD[1]	(AF)	GPCD[8]	(AF)	GPCD[8]	(AF)	GPCD[8]	(AF)	GPCD[8]	(AF)
DAU 71:														
City of Santa Maria [2]	150	117	134	16,223	119	15,600	119	16,100	119	16,143	119	16,185	119	16,228
Golden State Water Co. [2]	263	205	249	8,295	221	7,634	221	7,879	221	8,123	221	8,366	221	8,622
City of Guadalupe [2]	116	113	112	1,004	111	1,094	111	1,194	111	1,293	111	1,393	111	1,492
S.M. Valley Industrial														
Private SMV, M&I and Ag														
Casmalia CSD [2]	148	58	60	9	60	9	60	9	60	9	60	9	60	9
Santa Maria Totals	180	135		25,531		24,337		25,182		25,568		25,953		26,351
DAU 73:														
Los Alamos CSD [3]	198	130	124	270	117	261	117	268	117	275	117	318	117	360
Private San Ant. M&I, Ag														
San Antonio Totals	198	130		270		261		268		275		318		360
DAU 74:														
City of Lompoc [2]	114	93	121	6,018	117	5,989	117	6,147	117	6,317	117	6,481	117	6,646
Vandenberg Village CSD [3]	232	165	157	1,071	149	949	149	881	149	813	149	1,006	149	1,199
Mission Hills CSD [3]	228	150	143	560	135	517	135	504	135	492	135	653	135	813
Vandenberg AFB [3,4]	258	200	190	1,447	180	1,371	180	1,371	180	1,371	180	1,371	180	1,371
City of Buellton [3]	227	219	208	1,235	197	1,258	197	1,346	197	1,434	197	1,523	197	1,589
City of Solvang [3]	261	222	211	1,371	200	1,322	200	1,344	200	1,389	200	1,434	200	1,479
Santa Ynez RWCD ID #1 [5]	200	353	255	1,833	226	1,726	226	1,828	226	1,929	226	2,096	226	2,263
Private SYV M&I, Ag														
Santa Ynez Totals	220	149		13,535		13,132		13,421		13,745		14,564		15,360

Table A-4
Municipal and Industrial Conservation Estimates

DAU and Subareas	GPCD	GPCD	M&I Projected 2015		M&I Projected 2020		M&I Projected 2025		M&I Projected 2030		M&I Projected 2035		M&I Projected 2040	
	2000 [1]	2010 [1]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]	Target	Target Dmd [7]
DAU 75:														
Carpinteria VWD [2]	245	146	124	2,155	117	2,084	117	2,137	117	2,191	117	2,246	117	2,298
Montecito WD [3]	414	469	446	5,390	422	5,277	422	5,455	422	5,633	422	6,044	422	6,456
City of Santa Barbara [2]	146	113	121	12,617	117	12,420	117	12,639	117	12,859	117	13,078	117	13,298
La Cumbre MWC [3]	513	355	337	1,526	320	1,589	320	1,729	320	1,868	320	1,714	320	1,560
Goleta WD [2,6]	165	106	115	11,655	111	11,707	111	12,183	111	12,678	111	13,193	111	13,660
Private SC M&I, Ag														
South Coast Totals	183	135		33,343		33,077		34,143		35,229		36,275		37,272
DAU 76:														
Cuyama CSD [3]	267	194	184	142	175	139	175	142	175	146	175	149	175	153
Private CV M&I, Ag														
Cuyama Valley Totals	267	194		142		139		142		146		149		153
Santa Barbara County Totals	194	137		72,821		70,946		73,156		74,963		77,259		79,496

[1] 2000 and 2010 GPCD from Table A-3

[2] 2015 and 2020 Targets from respective UWMPs; based on DWR Formula

[3] Assumed a 5% reduction for 2015 Target GPCD and an additional 5% reduction for 2020 Target GPCD

[4] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[5] Estimated 2015 and 2020 target GPCD based on 10-yr average and DWR Formula

[6] Raytheon Infrared Operations are carried in Goleta WD totals

[7] Formula used to calculate Target Demand is as follows: (Target GPCD * Projected Population from Table A-2)/(325851.429 Gal/AF)*(365 Day/Yr)

[8] No further reduction of GPCD required for 2025 through 2040. Assumed Target GPCD for 2025 through 2040 to be equal to 2020.

Table A-5
Municipal and Industrial and Ag Return Flow Estimates in Acre-Feet Per Year [1]

DAU and Subareas	2010 M&I Water [5]	Percent to WWTP	2010 WWTP Effluent	Total 2010 Return Flow	Total 2015 M&I Return Flow [6]	Total 2020 Return Flow	Total 2025 M&I Return Flow [6]	Total 2030 Return Flow	Total 2035 M&I Return Flow [6]	Total 2040 Return Flow
DAU 71:										
City of Santa Maria	13,072	67%	8,758	72.1%	72.2%	72.3%	72.3%	72.3%	72.3%	72.3%
Golden State Water Co.	6,594	30%	1,978	24.7%	24.7%	24.8%	24.9%	25.0%	25.0%	25.1%
City of Guadalupe	930	65%	605	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
S.M. Valley Industrial										
Private SMV, M&I and Ag [2]				18.0%	18.0%	18.0%	18.0%	18.0%	18.0%	18.0%
Casmalia CSD										
Santa Maria Totals	20,596		11,341							
DAU 73:										
Los Alamos CSD	275	37%	102	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
Private San Ant. M&I, Ag [2]				13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
San Antonio Totals	275		102							
DAU 74:										
City of Lompoc	4,500	57%	2,565	46.0%	46.0%	46.0%	46.0%	46.1%	46.1%	46.1%
Vandenberg Village CSD	1,203	57%	686	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
Mission Hills CSD	601	30%	180	40.3%	40.3%	40.3%	40.3%	40.3%	40.3%	40.3%
Vandenberg AFB [3]	1,515	49%	742	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%	48.4%
City of Buellton	1,183	43%	509	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%	11.7%
City of Solvang	1,306	41%	535	49.0%	49.0%	49.0%	49.0%	49.0%	49.0%	49.0%
Santa Ynez RWCD ID #1	2,382	11%	262	33.8%	33.8%	33.8%	33.8%	33.8%	33.8%	33.8%
Private SY-Lompoc M&I, Ag [2]				16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%
Santa Ynez Totals	12,690		5,479							
DAU 75:										
Carpinteria VWD	2,136	37%	790	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%	13.3%
Montecito WD	5,475	28%	1,533	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%	15.6%
City of Santa Barbara	11,616	59%	6,853	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%	7.7%
La Cumbra MWC	1,451	14%	203	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Goleta WD [4]	10,294	44%	4,529	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%
Private South Coast M&I, Ag [2]				15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
South Coast Totals	30,972		13,909							
DAU 76:										
Cuyama CSD	146	25%	37	38.6%	38.6%	38.6%	38.6%	38.6%	38.6%	38.6%
Private Cuyama Valley M&I, Ag [2]				18.0%	18.0%	18.0%	18.0%	18.0%	18.0%	18.0%
Cuyama Valley Totals	146		37							
Santa Barbara County Totals	64,679		30,868							

[1] Domestic return flows are considered not significant compared to agriculture water demand

[2] Private DAU M&I and Ag return flow values are accounted for in Total Demand values on Table A-7

[3] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[4] Raytheon Infrared Operations are carried in Goleta WD totals

[5] 2010 M&I Water from Table A-3

[6] Average of previous M&I Return Flow percentage and subsequent M&I Return Flow percentage

Table A-6
Water Supply in Acre-Feet Per Year

DAU and Subareas	Estimated GWB Perennial Yield Shares [12]							Riparian Sources							Jameson Lake Yield Shares						
	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040
DAU 71:																					
City of Santa Maria [11]	5,100	5,100	5,100	5,100	5,100	5,100	5,100														
Golden State Water Co. [1, 11]	1,900	1,900	1,900	1,900	1,900	1,900	1,900														
City of Guadalupe [1]																					
Private SMV, M&I and Ag																					
Casmalia CSD																					
Santa Maria Totals [12]	75,000	75,000	75,000	75,000	75,000	75,000	75,000														
DAU 73:																					
Los Alamos CSD																					
Private San Ant. M&I, Ag																					
San Antonio Totals [12]	9,000	9,000	9,000	9,000	9,000	9,000	9,000														
DAU 74:																					
City of Lompoc																					
Vandenberg Village CSD																					
Mission Hills CSD																					
Vandenberg AFB [1,2]																					
City of Buellton [1,6,8]								468	502	535	573	611	654	698							
City of Solvang [3,6]								699	750	801	860	918	985	1,052							
Santa Ynez RWCD ID #1 [1,6,8]								1,000	1,000	1,000	1,000	1,000	1,000	1,000							
Private SY-Lompoc M&I, Ag																					
Santa Ynez Totals [5,12]	48,009	48,127	48,244	48,362	48,480	48,599	48,717	2,167	2,252	2,336	2,433	2,529	2,639	2,750							
DAU 75:																					
Carpinteria VWD																					
Montecito WD															1,500	1,500	1,500	1,500	1,500	1,500	1,500
City of Santa Barbara [7,9,10]	1,164	1,083	1,083	1,083	1,083	1,083	1,083								300	300	300	300	300	300	300
La Cumbre MWC [1]																					
Goleta WD [4]	2,350	2,350	2,350	2,350	2,350	2,350	2,350														
Private South Coast M&I, Ag [1]																					
South Coast Totals [5,12]	14,607	14,955	15,303	15,668	16,032	16,414	16,796								1,800	1,800	1,800	1,800	1,800	1,800	1,800
DAU 76:																					
Cuyama CSD																					
Private Cuyama Valley M&I, Ag																					
Cuyama Valley Totals [5,12]	6,944	7,102	7,260	7,425	7,590	7,763	7,935														
Santa Barbara County Totals	153,561	154,184	154,807	155,455	156,102	156,775	157,448	2,167	2,252	2,336	2,433	2,529	2,639	2,750	1,800	1,800	1,800	1,800	1,800	1,800	1,800

[1] SWP Data from CCWA Table UWMP Table 3-4

[2] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[3] SWP deliveries included in ID#1

[4] Raytheon Infrared Operations included in Goleta WD values

[5] Estimated GWB Perennial Yield Shares in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[6] Riparian Sources in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[7] Cachuma in 2035 and 2040 were extrapolated based on 2010-2030 trend

[8] SWP Water in 2040 was extrapolated based on 2010-2035 trend

[9] SWP Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[10] Recycled Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[11] Pursuant to Judgement after trial, 2008

[12] The Estimated GWB Perennial Yield Shares Total for each DAU is not the sum of all subareas within the DAU, but rather the safe yield estimated by the SBCWA model.

Table A-6
Water Supply in Acre-Feet Per Year

DAU and Subareas	Gibraltar Project Yield							Cachuma							SWP Water							Desal
	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040	Plant
DAU 71:																						
City of Santa Maria [11]															11,254	11,143	11,032	10,922	10,811	10,700	10,593	
Golden State Water Co. [1, 11]															347	344	341	337	334	330	327	
City of Guadalupe [1]															382	378	375	371	367	363	359	
Private SMV, M&I and Ag															-	-	-	-	-	-	-	
Casmalia CSD															-	-	-	-	-	-	-	
Santa Maria Totals [12]															11,983	11,865	11,748	11,630	11,512	11,393	11,279	
DAU 73:																						
Los Alamos CSD															-	-	-	-	-	-	-	
Private San Ant. M&I, Ag															-	-	-	-	-	-	-	
San Antonio Totals [12]															-	-	-	-	-	-	-	
DAU 74:																						
City of Lompoc															-	-	-	-	-	-	-	
Vandenberg Village CSD															-	-	-	-	-	-	-	
Mission Hills CSD															-	-	-	-	-	-	-	
Vandenberg AFB [1,2]															3,821	3,783	3,746	3,708	3,670	3,633	3,597	
City of Buellton [1,6,8]															402	398	394	390	386	382	378	
City of Solvang [3,6]																						
Santa Ynez RWCD ID #1 [1,6,8]								2,619	2,619	2,619	2,619	2,619	2,619	2,619	1,389	1,376	1,362	1,348	1,335	1,321	1,308	
Private SY-Lompoc M&I, Ag															-	-	-	-	-	-	-	
Santa Ynez Totals [5,12]								2,619	2,619	2,619	2,619	2,619	2,619	2,619	5,612	5,557	5,502	5,446	5,391	5,336	5,282	
DAU 75:																						
Carpinteria VWD								2,813	2,813	2,813	2,813	2,813	2,813	2,813	1,389	1,376	1,362	1,348	1,335	1,321	1,308	
Montecito WD								2,777	2,777	2,777	2,777	2,777	2,777	2,777	2,084	2,064	2,043	2,023	2,002	1,982	1,962	
City of Santa Barbara [7,9,10]	4,153	4,331	4,331	4,331	4,331	4,331	4,331	7,637	6,872	6,787	6,654	6,566	6,327	6,097	2,084	1,914	1,793	1,723	1,802	1,740	1,680	-
La Cumbre MWC [1]															695	688	681	674	667	661	654	
Goleta WD [4]								9,322	9,322	9,322	9,322	9,322	9,322	9,322	3,800	3,800	3,800	3,800	3,800	3,800	3,800	
Private South Coast M&I, Ag [1]															139	138	136	135	133	132	131	
South Coast Totals [5,12]	4,153	4,331	4,331	4,331	4,331	4,331	4,331	22,549	21,784	21,699	21,566	21,478	21,239	21,009	10,191	9,980	9,815	9,703	9,739	9,636	9,535	-
DAU 76:																						
Cuyama CSD															-	-	-	-	-	-	-	
Private Cuyama Valley M&I, Ag															-	-	-	-	-	-	-	
Cuyama Valley Totals [5,12]															-	-	-	-	-	-	-	
Santa Barbara County Totals	4,153	4,331	4,331	4,331	4,331	4,331	4,331	25,168	24,403	24,318	24,185	24,097	23,858	23,628	27,786	27,402	27,065	26,779	26,642	26,365	26,096	-

[1] SWP Data from CCWA Table UWMP Table 3-4

[2] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[3] SWP deliveries included in ID#1

[4] Raytheon Infrared Operations included in Goleta WD values

[5] Estimated GWB Perennial Yield Shares in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[6] Riparian Sources in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[7] Cachuma in 2035 and 2040 were extrapolated based on 2010-2030 trend

[8] SWP Water in 2040 was extrapolated based on 2010-2035 trend

[9] SWP Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[10] Recycled Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[11] Pursuant to Judgement after trial, 2008

[12] The Estimated GWB Perennial Yield Shares Total for each DAU is not the sum of all subareas within the DAU, but rather the safe yield estimated by the SBCWA model.

Table A-6
Water Supply in Acre-Feet Per Year

DAU and Subareas	Recycled Water							Total Available w/o GW							Total Available With GW						
	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040
DAU 71:																					
City of Santa Maria [11]								11,254	11,143	11,032	10,922	10,811	10,700	10,593	16,354	16,243	16,132	16,022	15,911	15,800	15,693
Golden State Water Co. [1, 11]								347	344	341	337	334	330	327	2,247	2,244	2,241	2,237	2,234	2,230	2,227
City of Guadalupe [1]								382	378	375	371	367	363	359	382	378	375	371	367	363	359
Private SMV, M&I and Ag								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Casmalia CSD								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Maria Totals [12]	-	-	-	-	-	-	-	11,983	11,865	11,748	11,630	11,512	11,393	11,279	86,983	86,865	86,748	86,630	86,512	86,393	86,279
DAU 73:																					
Los Alamos CSD								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Private San Ant. M&I, Ag								-	-	-	-	-	-	-	-	-	-	-	-	-	-
San Antonio Totals [12]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,000	9,000	9,000	9,000	9,000	9,000	9,000
DAU 74:																					
City of Lompoc								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vandenberg Village CSD								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mission Hills CSD								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vandenberg AFB [1,2]								3,821	3,783	3,746	3,708	3,670	3,633	3,597	3,821	3,783	3,746	3,708	3,670	3,633	3,597
City of Buellton [1,6,8]								870	900	929	963	997	1,036	1,076	870	900	929	963	997	1,036	1,076
City of Solvang [3,6]								699	750	801	860	918	985	1,052	699	750	801	860	918	985	1,052
Santa Ynez RWCD ID #1 [1,6,8]								5,008	4,995	4,981	4,967	4,954	4,940	4,927	5,008	4,995	4,981	4,967	4,954	4,940	4,927
Private SY-Lompoc M&I, Ag								-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Ynez Totals [5,12]	-	-	-	-	-	-	-	10,398	10,428	10,457	10,498	10,539	10,594	10,651	58,408	58,554	58,701	58,860	59,019	59,193	59,368
DAU 75:															-	-	-	-	-	-	-
Carpinteria VWD	-	-	-	-	-	-	-	4,202	4,189	4,175	4,161	4,148	4,134	4,121	4,202	4,189	4,175	4,161	4,148	4,134	4,121
Montecito WD								6,361	6,341	6,320	6,300	6,279	6,259	6,239	6,361	6,341	6,320	6,300	6,279	6,259	6,239
City of Santa Barbara [7,9,10]	696	950	1,025	1,125	1,250	1,454	1,691	14,870	14,367	14,236	14,133	14,249	14,152	14,099	16,034	15,450	15,319	15,216	15,332	15,235	15,182
La Cumbre MWC [1]								695	688	681	674	667	661	654	695	688	681	674	667	661	654
Goleta WD [4]	1,150	1,225	1,350	1,450	1,575	1,704	1,843	14,272	14,347	14,472	14,572	14,697	14,826	14,965	16,622	16,697	16,822	16,922	17,047	17,176	17,315
Private South Coast M&I, Ag [1]								139	138	136	135	133	132	131	139	138	136	135	133	132	131
South Coast Totals [5,12]	1,846	2,175	2,375	2,575	2,825	3,158	3,535	40,539	40,070	40,020	39,975	40,173	40,164	40,210	55,146	55,025	55,323	55,643	56,205	56,578	57,006
DAU 76:																					
Cuyama CSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Private Cuyama Valley M&I, Ag	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuyama Valley Totals [5,12]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,944	7,102	7,260	7,425	7,590	7,763	7,935
Santa Barbara County Totals	1,846	2,175	2,375	2,575	2,825	3,158	3,535	62,920	62,363	62,225	62,103	62,224	62,152	62,140	216,481	216,547	217,032	217,557	218,326	218,927	219,588

[1] SWP Data from CCWA Table UWMP Table 3-4

[2] Vandenberg AFB is partially located in DAU 73, however all population projections have been rolled into DAU 74

[3] SWP deliveries included in ID#1

[4] Raytheon Infrared Operations included in Goleta WD values

[5] Estimated GWB Perennial Yield Shares in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[6] Riparian Sources in 2015, 2025, and 2035 were interpolated, while 2010 and 2040 were extrapolated based on 2015-2035 trend

[7] Cachuma in 2035 and 2040 were extrapolated based on 2010-2030 trend

[8] SWP Water in 2040 was extrapolated based on 2010-2035 trend

[9] SWP Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[10] Recycled Water in 2035 and 2040 were extrapolated based on 2010-2030 trend

[11] Pursuant to Judgement after trial, 2008

[12] The Estimated GWB Perennial Yield Shares Total for each DAU is not the sum of all subareas within the DAU, but rather the safe yield estimated by the SBCWA model.

Table A-7
Additional Water Required To Meet Projected Demand

DAU and Subareas	2010				2015				2020				2025			
	Total Available[2]	Total Demand[3]	Total Return Flows[5]	Net Water Needed[6]	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]
DAU 71:																
City of Santa Maria	16,354	13,072	9,422		16,243	16,223	11,708		16,132	15,600	11,273		16,022	16,100	11,637	
Golden State Water Co.	2,247	6,594	1,627		2,244	8,295	2,051		2,241	7,634	1,891		2,237	7,879	1,961	
City of Guadalupe [1]	382	930	209		378	1,004	226		375	1,094	246		371	1,194	269	
Private SMV, M&I and Ag [1,3]	-	101,852	18,333		-	101,852	18,333		-	101,852	18,333		-	101,852	18,333	
Casmalia CSD [1]	-	9	-		-	9	-		-	9	-		-	9	-	
Santa Maria Totals	86,983	122,457	29,592	5,882	86,865	127,383	32,318	8,200	86,748	126,189	31,743	7,698	86,630	127,034	32,200	8,204
DAU 73:																
Los Alamos CSD [1]	-	275	62		-	270	61		-	261	59		-	268	60	
Private San Ant. M&I, Ag [1,3]	-	33,168	4,312		-	33,168	4,312		-	33,168	4,312		-	33,168	4,312	
San Antonio Totals	9,000	33,443	4,374	20,069	9,000	33,438	4,373	20,065	9,000	33,429	4,371	20,058	9,000	33,436	4,372	20,064
DAU 74:																
City of Lompoc [1]	-	4,500	2,071		-	6,018	2,769		-	5,989	2,756		-	6,147	2,830	
Vandenberg Village CSD [1]	-	1,203	554		-	1,071	493		-	949	437		-	881	406	
Mission Hills CSD [1]	-	601	242		-	560	226		-	517	209		-	504	203	
Vandenberg AFB [1]	3,821	1,515	733		3,783	1,447	700		3,746	1,371	664		3,708	1,371	664	
City of Buellton [1]	870	1,183	139		900	1,235	145		929	1,258	147		963	1,346	158	
City of Solvang [1]	699	1,306	640		750	1,371	672		801	1,322	648		860	1,344	659	
Santa Ynez RWCD ID #1 [1]	5,008	2,382	806		4,995	1,833	620		4,981	1,726	584		4,967	1,828	619	
Private SY-Lompoc M&I, Ag [1,3]	-	48,603	7,776		-	48,603	7,776		-	48,603	7,776		-	48,603	7,776	
Santa Ynez Totals	58,408	61,293	12,962	-	58,554	62,138	13,402	-	58,701	61,735	13,221	-	58,860	62,024	13,314	-
DAU 75:																
Carpinteria VWD [1]	4,202	2,136	284		4,189	2,155	287		4,175	2,084	277		4,161	2,137	284	
Montecito WD [1]	6,361	5,475	852		6,341	5,390	839		6,320	5,277	822		6,300	5,455	849	
City of Santa Barbara	14,870	11,616	899		15,450	12,617	977		15,319	12,420	961		15,216	12,639	978	
La Cumbra MWC [1]	695	1,451	-		688	1,526	-		681	1,589	-		674	1,729	-	
Goleta WD	14,272	10,294	1,187		16,697	11,655	1,344		16,822	11,707	1,350		16,922	12,183	1,405	
Private South Coast M&I, Ag [1,3]	139	27,974	4,196		138	27,974	4,196		136	27,974	4,196		135	27,974	4,196	
South Coast Totals	55,146	58,946	7,419	-	55,025	61,317	7,643	-	55,323	61,051	7,606	-	55,643	62,117	7,713	-
DAU 76:																
Cuyama CSD [1]	-	146	56		-	142	55		-	139	54		-	142	55	
Private Cuyama Valley M&I, Ag [1,3]	-	37,987	6,838		-	37,987	6,838		-	37,987	6,838		-	37,987	6,838	
Cuyama Valley Totals	6,944	38,133	6,894	24,295	7,102	38,129	6,892	24,134	7,260	38,126	6,891	23,975	7,425	38,129	6,892	23,812
Santa Barbara County Totals	216,481	314,272	61,241	36,550	216,547	322,405	64,628	41,230	217,032	320,530	63,832	39,666	217,557	322,740	64,491	40,692

[1] Groundwater resource not allocated to individual producer

[2] Total Available values obtained from Table A-6

[3] Total Demand values for 2010 were obtained from Table A-3. Private DAU M&I and Ag Total Demand values for 2015 through 2040 are assumed to be the same as the 2010 values

[4] Total Demand values for 2015 through 2040 were obtained from Table A-4

[5] Total Return Flows calculated based on Total Demand multiplied by M&I Return Flow percentage from Table A-5

[6] Net Water Needed is calculated for a DAU using the following equation: Total Demand - (Total Available + Total Return Flows). If the Net Water Needed value is < 0, then available supplies are sufficient to meet the projected demand for a given DAU.

Table A-7
Additional Water Required To Meet Projected Demand

DAU and Subareas	2030				2035				2040			
	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]	Total Available[2]	Total Demand[4]	Total Return Flows[5]	Net Water Needed[6]
DAU 71:												
City of Santa Maria	15,911	16,143	11,671		15,800	16,185	11,705		15,693	16,228	11,739	
Golden State Water Co.	2,234	8,123	2,031		2,230	8,366	2,094		2,227	8,622	2,160	
City of Guadalupe [1]	367	1,293	291		363	1,393	313		359	1,492	336	
Private SMV, M&I and Ag [1,3]	-	101,852	18,333		-	101,852	18,333		-	101,852	18,333	
Casmalia CSD [1]	-	9	-		-	9	-		-	9	-	
Santa Maria Totals	86,512	127,420	32,326	8,582	86,393	127,805	32,445	8,967	86,279	128,203	32,568	9,356
DAU 73:												
Los Alamos CSD [1]	-	275	62		-	318	72		-	360	81	
Private San Ant. M&I, Ag [1,3]	-	33,168	4,312		-	33,168	4,312		-	33,168	4,312	
San Antonio Totals	9,000	33,443	4,374	20,069	9,000	33,486	4,383	20,103	9,000	33,528	4,393	20,135
DAU 74:												
City of Lompoc [1]	-	6,317	2,910		-	6,481	2,985		-	6,646	3,061	
Vandenberg Village CSD [1]	-	813	375		-	1,006	463		-	1,199	552	
Mission Hills CSD [1]	-	492	198		-	653	263		-	813	328	
Vandenberg AFB [1]	3,670	1,371	664		3,633	1,371	664		3,597	1,371	664	
City of Buellton [1]	997	1,434	168		1,036	1,523	178		1,076	1,589	186	
City of Solvang [1]	918	1,389	681		985	1,434	703		1,052	1,479	725	
Santa Ynez RWCD ID #1 [1]	4,954	1,929	653		4,940	2,096	709	-	4,927	2,263	766	
Private SY-Lompoc M&I, Ag [1,3]	-	48,603	7,776		-	48,603	7,776		-	48,603	7,776	
Santa Ynez Totals	59,019	62,348	13,424	-	59,193	63,167	13,742	-	59,368	63,963	14,058	-
DAU 75:												
Carpinteria VWD [1]	4,148	2,191	292		4,134	2,246	299		4,121	2,298	306	
Montecito WD [1]	6,279	5,633	877		6,259	6,044	941		6,239	6,456	1,005	
City of Santa Barbara	15,332	12,859	995		15,235	13,078	1,012		15,182	13,298	1,029	
La Cumbra MWC [1]	667	1,868	-		661	1,714	-		654	1,560	-	
Goleta WD	17,047	12,678	1,462		17,176	13,193	1,521		17,315	13,660	1,575	
Private South Coast M&I, Ag [1,3]	133	27,974	4,196		132	27,974	4,196		131	27,974	4,196	
South Coast Totals	56,205	63,203	7,822	-	56,578	64,249	7,969	-	57,006	65,246	8,111	129
DAU 76:												
Cuyama CSD [1]	-	146	56		-	149	58		-	153	59	
Private Cuyama Valley M&I, Ag [1,3]	-	37,987	6,838		-	37,987	6,838		-	37,987	6,838	
Cuyama Valley Totals	7,590	38,133	6,894	23,649	7,763	38,136	6,895	23,478	7,935	38,140	6,897	23,308
Santa Barbara County Totals	218,326	324,547	64,840	41,381	218,927	326,843	65,436	42,481	219,588	329,080	66,027	43,465

[1] Groundwater resource not allocated to individu[1] Groundwater resource not allocated to individual producer

[2] Total Available values obtained from Table A-6 [2] Total Available values obtained from Table A-6

[3] Total Demand values for 2010 were obtained fi[3] Total Demand values for 2010 were obtained from Table A-3. Private DAU M&I and Ag Total Demand values for 2015 through 2040 are assumed to be the same as th through 2040 are assumed to be the same as the 2010 values

[4] Total Demand values for 2015 through 2040 w[4] Total Demand values for 2015 through 2040 were obtained from Table A-4

[5] Total Return Flows calculated based on Total D[5] Total Return Flows calculated based on Total Demand multiplied by M&I and Ag Return Flow percentage from Table A-5

[6] Net Water Needed is calculated for a DAU usin[6] Net Water Needed is calculated for a DAU using the following equation: Total Demand - (Total Available + Total Return Flows). If the Net Water Needed value is < 0, then availalf the Net Water Needed value is < 0, then available supplies are sufficient to meet the projected demand for a given DAU.

Table A-8
Water Supply Outlook

Detailed Analysis Units	Average Available Annual Water Supply (No Return Flows) [1]							Total Return Flows [2]							Average Available Total Water Supply with Return Flows [3]						
	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040
DAU 71: Santa Maria	86,983	86,865	86,748	86,630	86,512	86,393	86,279	29,592	32,318	31,743	32,200	32,326	32,445	32,568	116,575	119,183	118,491	118,830	118,838	118,838	118,847
DAU 73: San Antonio	9,000	9,000	9,000	9,000	9,000	9,000	9,000	4,374	4,373	4,371	4,372	4,374	4,383	4,393	13,374	13,373	13,371	13,372	13,374	13,383	13,393
DAU 74: Santa Ynez	58,408	58,554	58,701	58,860	59,019	59,193	59,368	12,962	13,402	13,221	13,314	13,424	13,742	14,058	71,370	71,957	71,922	72,173	72,443	72,935	73,427
DAU 75: South Coast	55,146	55,025	55,323	55,643	56,205	56,578	57,006	7,419	7,643	7,606	7,713	7,822	7,969	8,111	62,565	62,668	62,929	63,355	64,027	64,547	65,117
DAU 76: Cuyama Valley	6,944	7,102	7,260	7,425	7,590	7,763	7,935	6,894	6,892	6,891	6,892	6,894	6,895	6,897	13,838	13,995	14,151	14,317	14,484	14,658	14,832
SB County	216,481	216,547	217,032	217,557	218,326	218,927	219,588	61,241	64,628	63,832	64,491	64,840	65,436	66,027	277,722	281,175	280,864	282,048	283,166	284,362	285,615

[1] Average Available Annual Water Supply (No Return Flows) was obtained from Table 7 - Total Available

[2] Total Return Flows was obtained from Table 7 - Total Return Flows

[3] Sum of Average Available Annual Water Supply and Total Return Flows

[4] Average Estimated Gross Water Demand was obtained from Table 7 (and likewise, Table 3) - Total Demand

[5] New Water Supply Needs was obtained from Table 7 - Net Water Needed

Table A-8
Water Supply Outlook

Detailed Analysis Units	Average Estimated Gross Water Demand [4]							New Water Supply Needs [5]						
	2010	2015	2020	2025	2030	2035	2040	2010	2015	2020	2025	2030	2035	2040
DAU 71: Santa Maria	122,457	127,383	126,189	127,034	127,420	127,805	128,203	5,882	8,200	7,698	8,204	8,582	8,967	9,356
DAU 73: San Antonio	33,443	33,438	33,429	33,436	33,443	33,486	33,528	20,069	20,065	20,058	20,064	20,069	20,103	20,135
DAU 74: Santa Ynez	61,293	62,138	61,735	62,024	62,348	63,167	63,963	-	-	-	-	-	-	-
DAU 75: South Coast	58,946	61,317	61,051	62,117	63,203	64,249	65,246	-	-	-	-	-	-	129
DAU 76: Cuyama Valley	38,133	38,129	38,126	38,129	38,133	38,136	38,140	24,295	24,134	23,975	23,812	23,649	23,478	23,308
SB County	314,272	322,405	320,530	322,740	324,547	326,843	329,080	36,550	41,230	39,666	40,692	41,381	42,481	43,465

[1] Average Available Annual [1] Average Available Annual Water Supply (No Return Flows) was obtained from Table 7 - Total Available

[2] Total Return Flows was ob[2] Total Return Flows was obtained from Table 7 - Total Return Flows

[3] Sum of Average Available [3] Sum of Average Available Annual Water Supply and Total Return Flows

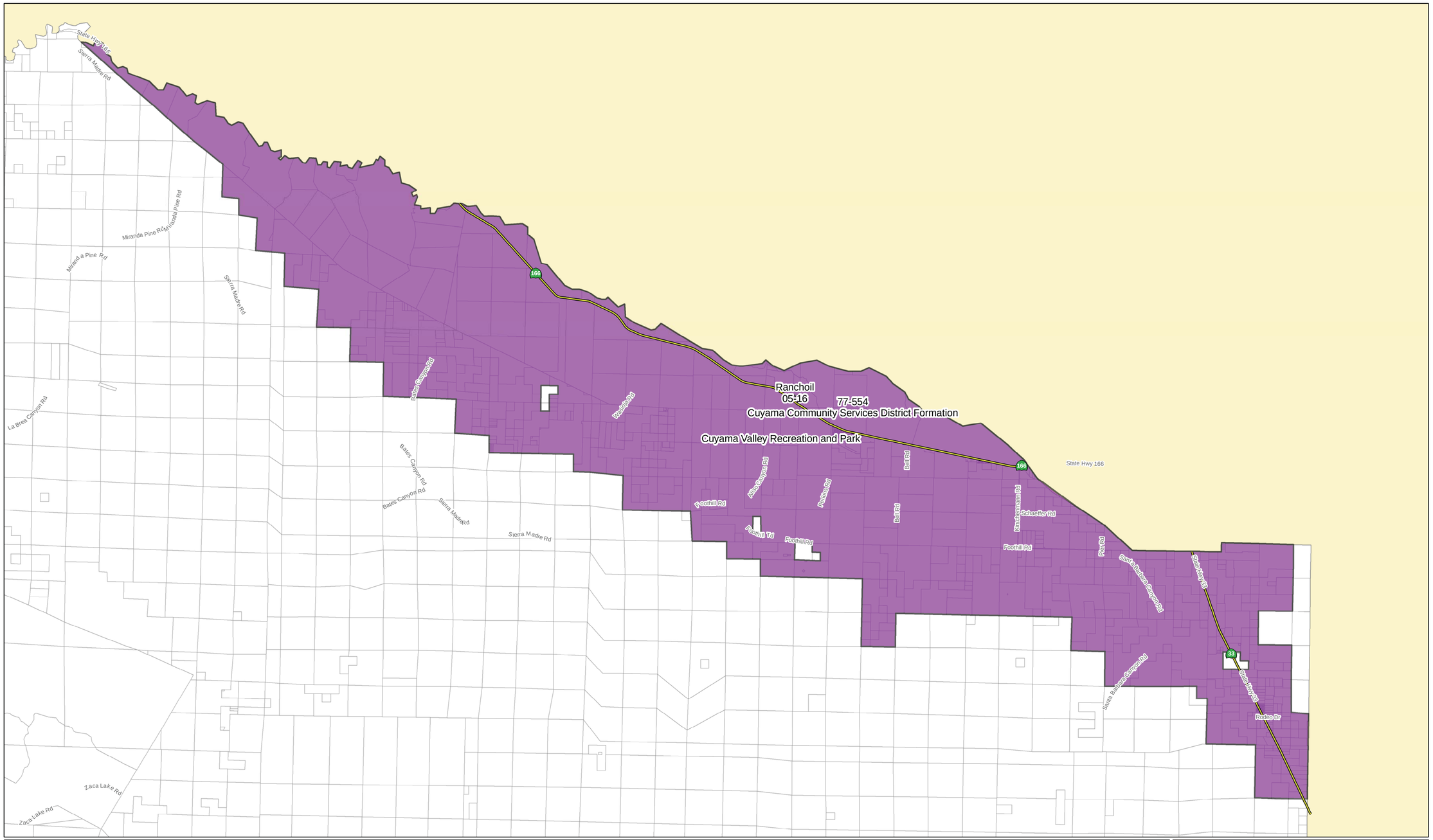
[4] Average Estimated Gross [4] Average Estimated Gross Water Demand was obtained from Table 7 (and likewise, Table 3) - Total Demand

[5] New Water Supply Needs [5] New Water Supply Needs was obtained from Table 7 - Net Water Needed

Appendix D

Service Area Boundaries, Public Water Supplier

(Provided in Digital Form on CD)



Cuyama Community Services District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Annexation
- Detachment
- Formation
- Parcel Boundary

N
W E
S

GRAPHIC SCALE

0 1.25 2.5 5 7.5 10

Miles

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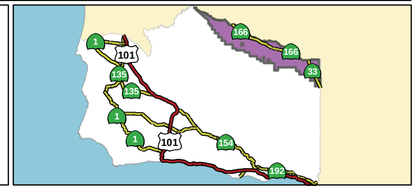

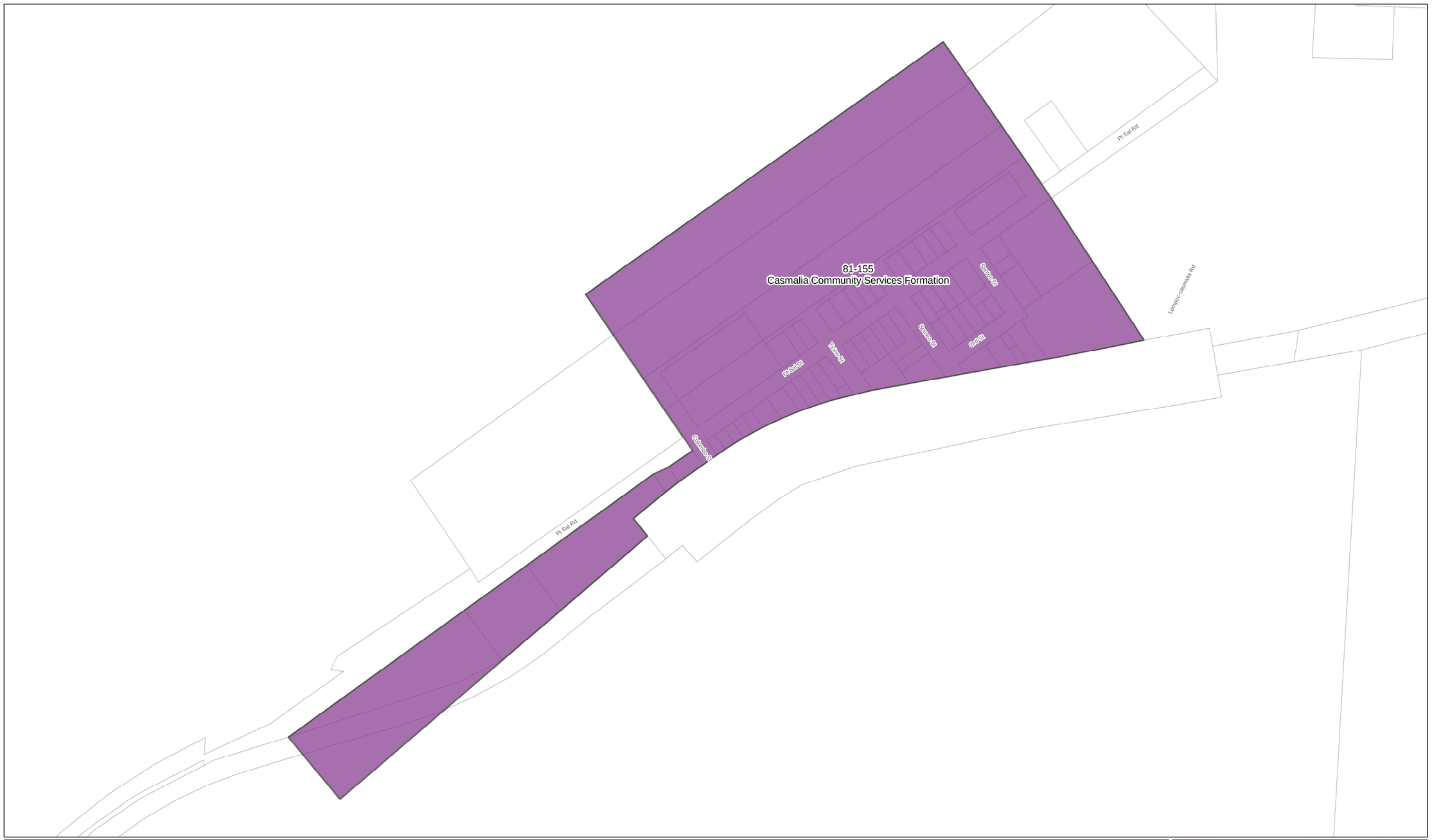

Casmalia Community Services District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Parcel Boundary
- Annexation
- Detachment
- Formation

N
W E
S

GRAPHIC SCALE

0 0.04 0.08 0.16 0.24 0.32

Miles

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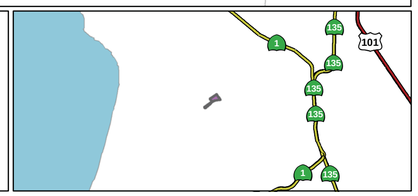

Los Alamos Community Services District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Annexation
- Detachment
- Formation
- Parcel Boundary

N
W E
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GRAPHIC SCALE

0 0.05 0.1 0.2 0.3 0.4

Miles

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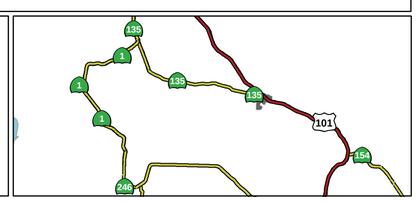

Vandenburg Village Community Services District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Annexation
- Detachment
- Formation
- Parcel Boundary

COUNTY OF SANTA BARBARA SURVEYOR

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GRAPHIC SCALE

0 0.125 0.25 0.5 0.75 1

Miles

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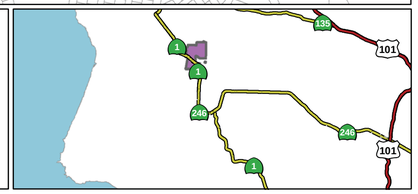

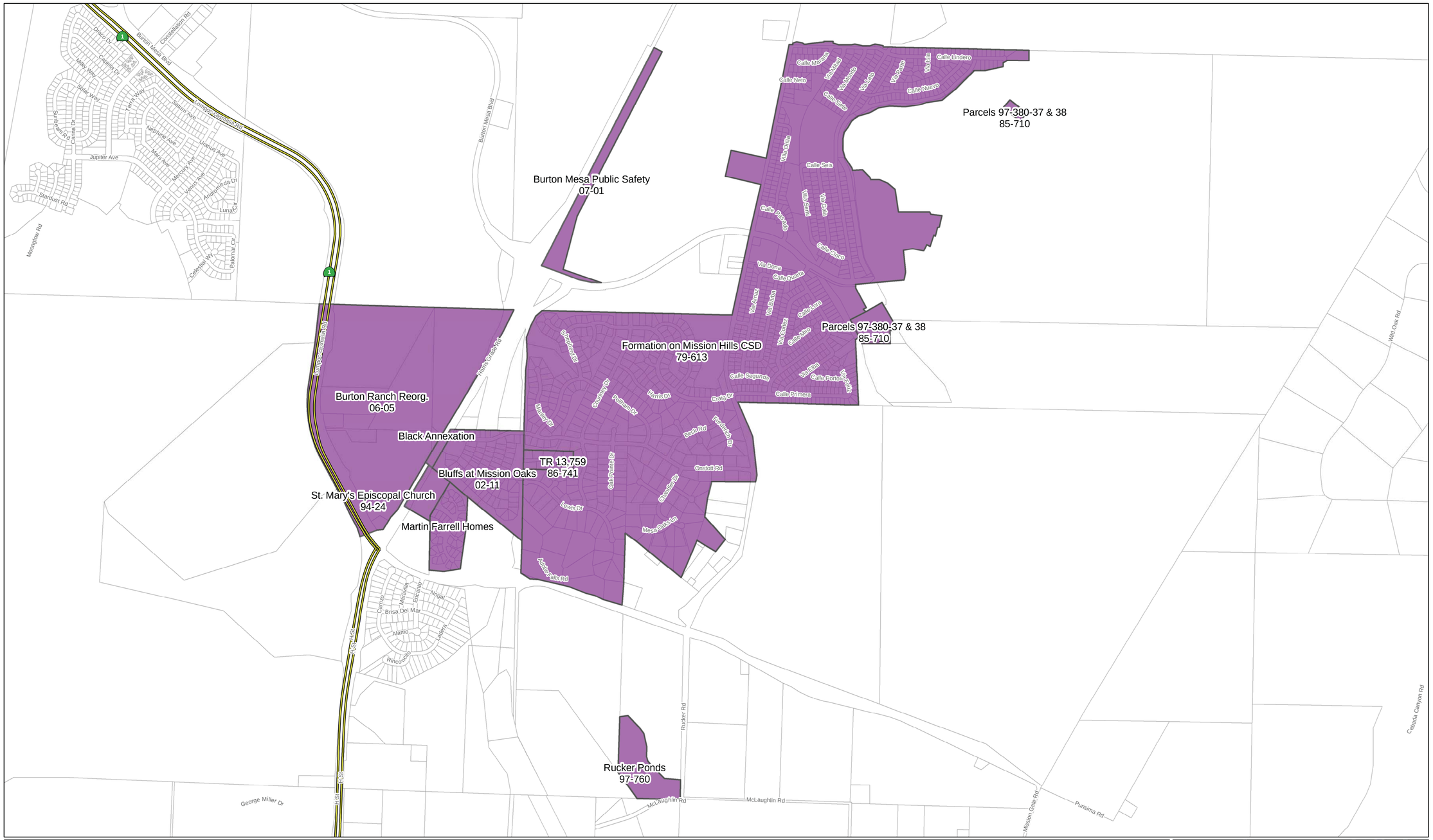

Mission Hills Community Services District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Annexation
- Detachment
- Formation
- Parcel Boundary

COUNTY OF SANTA BARBARA SURVEYOR

N
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S

GRAPHIC SCALE

0 0.15 0.3 0.6 0.9 1.2

Miles

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Santa Ynez River Water Conservation District

Compiled by the Office of the County Surveyor in March of 2011. Formed 10/23/1939 by County Resolution 3109. Last Action: Cachuma Rec. Area, LAFCO 1983-0053181, 7/29/1983. Sphere: 2/7/2011. Boundary activity table at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=23260

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GRAPHIC SCALE

0 1.5 3 6

Miles

Legend

- Freeways
- Highways
- Roads
- Parcels
- Ranchos and Townships
- Los Padres National Forest
- Vandenberg Air Force Base
- Cities
- Sphere of Influence
- Formation
- Annexation
- Detachment

Vicinity Map - Not to scale

Santa Ynez River Water Conservation District Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=23260

InternalNo	File	Action	Effective	County_Res	County_DT	District_Res	Dist_Date	LAFCO_No	LAFCO_Res	LAFCO_Date	Instrument	Recorded
0	Santa Ynez River Water Conservation Dist.	Formation	10/23/1939	3109	10/23/1939							
1	Annexation 1958-1	Annexation	6/2/1959			100	3/3/1959				1631/292-299	6/2/1959
2	Ballard-Los Olivos Annexation 1962-1	Annexation	1/21/1963			263	12/4/1962				1972/906-913	1/21/1963
3	Annexation 1963-1	Annexation	1/21/1963			270	1/29/1963				1974/634-641	1/31/1963
4	Gainey Exclusion 1941-1	Detachment	3/1/1965			303	12/18/1964				2093/942-953	3/1/1965
5	Petan Company 1972-1, Alisal Ranch 1	Annexation	7/27/1972			369	7/27/1972	72-AD-20	285	6/22/1972		
6	Alisal Ranch 2, 1972-2	Annexation	12/5/1972			373			373	12/5/1972	2449/005-010	10/23/1973
7	Rancho San Fernando Rey 1972-1, 1973-2	Annexation	12/4/1973			380		73-AD-23	358	11/29/1973		
8	Power-Bacon Property	Annexation	12/4/1973			381		73-AD-22	359	11/29/1973		
9	Cachuma Recreation Area	Annexation	7/26/1983			449, 451	12/6/1983	83-AD-06	83-643	6/23/1983	1983-0053181	10/4/1983
	SYRWCD Sphere of Influence	SOI	2/7/2011							2/7/2011		

Santa Ynez River Water Conservation District

Improvement District No. 1

Compiled by the Office of the County Surveyor in August of 2010. Formed by Santa Ynez River Water Conservation District Board of Directors Resolution 103, Recorded 7/20/1961.

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GRAPHIC SCALE

0 0.5 1 2

Miles

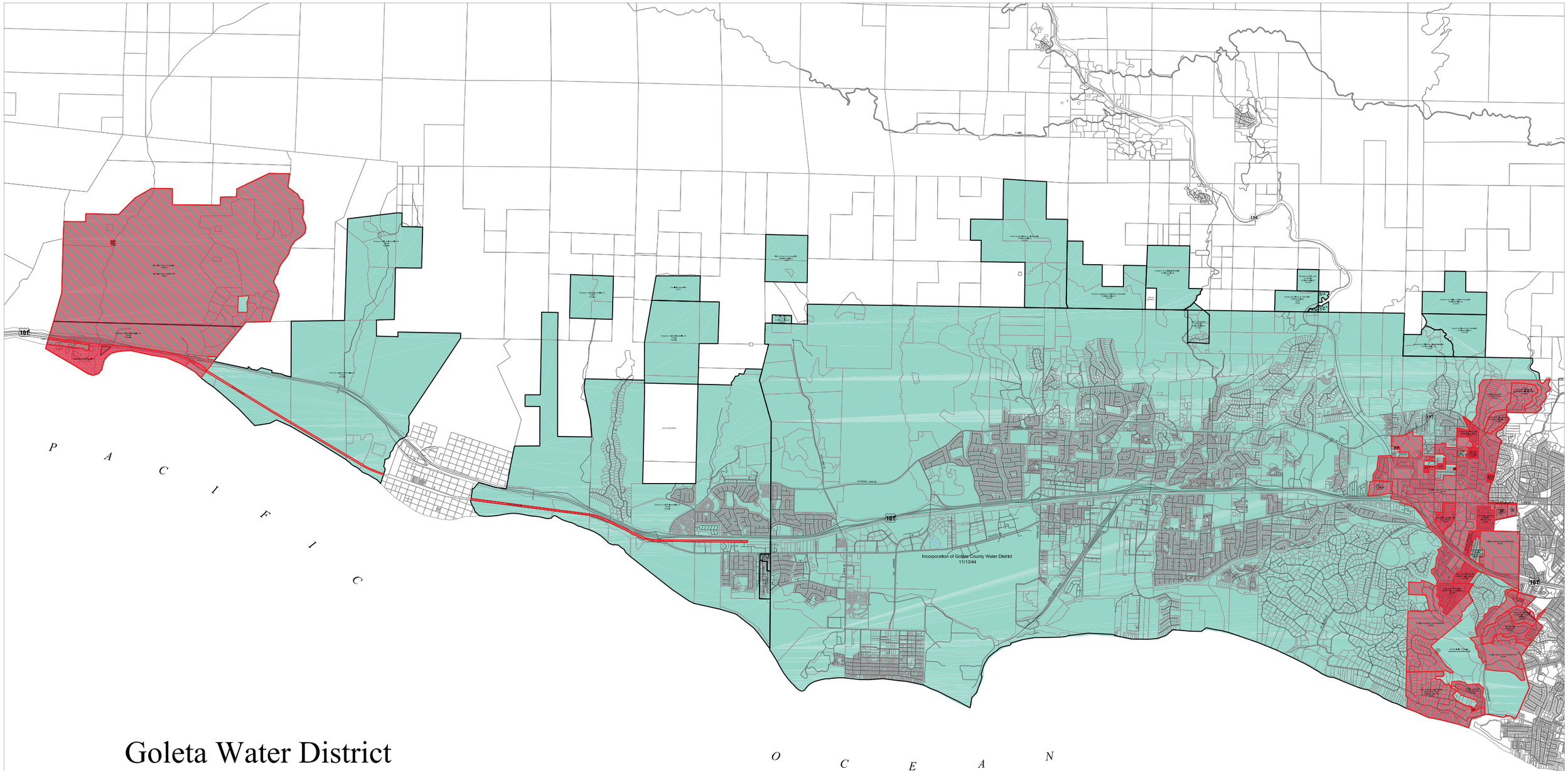
Legend

- Freeways
- Highways
- Roads
- Santa Ynez River
- Parcels
- Cities
- Lake Cachuma
- Sections
- Los Padres National Forest
- Ranchos and Townships
- Annexation
- Formation
- Detachment

Vicinity Map - Not to scale

Santa Ynez River Water Conservation District Improvement District No. 1

InternalNo	Title	Type	BOS_Date	Dist_Number	District_Res	District_Date	LAFCO_No	LAFCO_Res	LAFCO_Date	Instrument	Recorded	Equalization_Secretary_of_State
0	Formation	Formation			103	7/7/1959						
1	Los Olivos Area, A	Annexation			280	10/3/1963				2017/393-412	10/16/1963	
2	Los Olivos Area, B	Annexation			280	10/3/1963				2017/393-412	10/16/1963	
3	Gainey Ranch	Detachment		1964-1	303	12/18/1964				2093/942-953	3/1/1965	
4	Refugio Road Area	Annexation		1965-1	317, 319	2/3/1966				2146/1378-1400	4/7/1966	
5	Sides Property	Annexation		1965-2	317, 319	2/3/1966				2146/1378-1400	4/7/1966	
6	Hansen Property	Annexation		1965-3	317, 319	2/3/1966				2146/1378-1400	4/7/1966	
7	SMID No. 4 Area	Annexation		1965-4	318, 320	2/3/1966				2146/1401-1413	4/7/1966	
8	SMID No. 9 Area	Annexation		1965-5	318, 320	2/3/1966				2146/1401-1413	4/7/1966	
9	SMID Fredensborg Area	Annexation		1967-1	1967-11	10/13/1967						11/1/1967
10	SMID 1970-1 Area	Annexation	5/7/1973		356	7/8/1970						
11	Alisal Ranch	Annexation		1972-1	367, 370	7/27/1972						
12	Stewart	Annexation		1981-1	424, 426	9/30/1981						
13	Osborne	Annexation		1982-2	425, 427	9/30/1981						
14	Cachuma Park	Annexation		1983-1	291,449	12/13/1983	83-AD-6	83-643	10/30/1983	1983-0053181	10/4/1983	10/17/1983



Goleta Water District

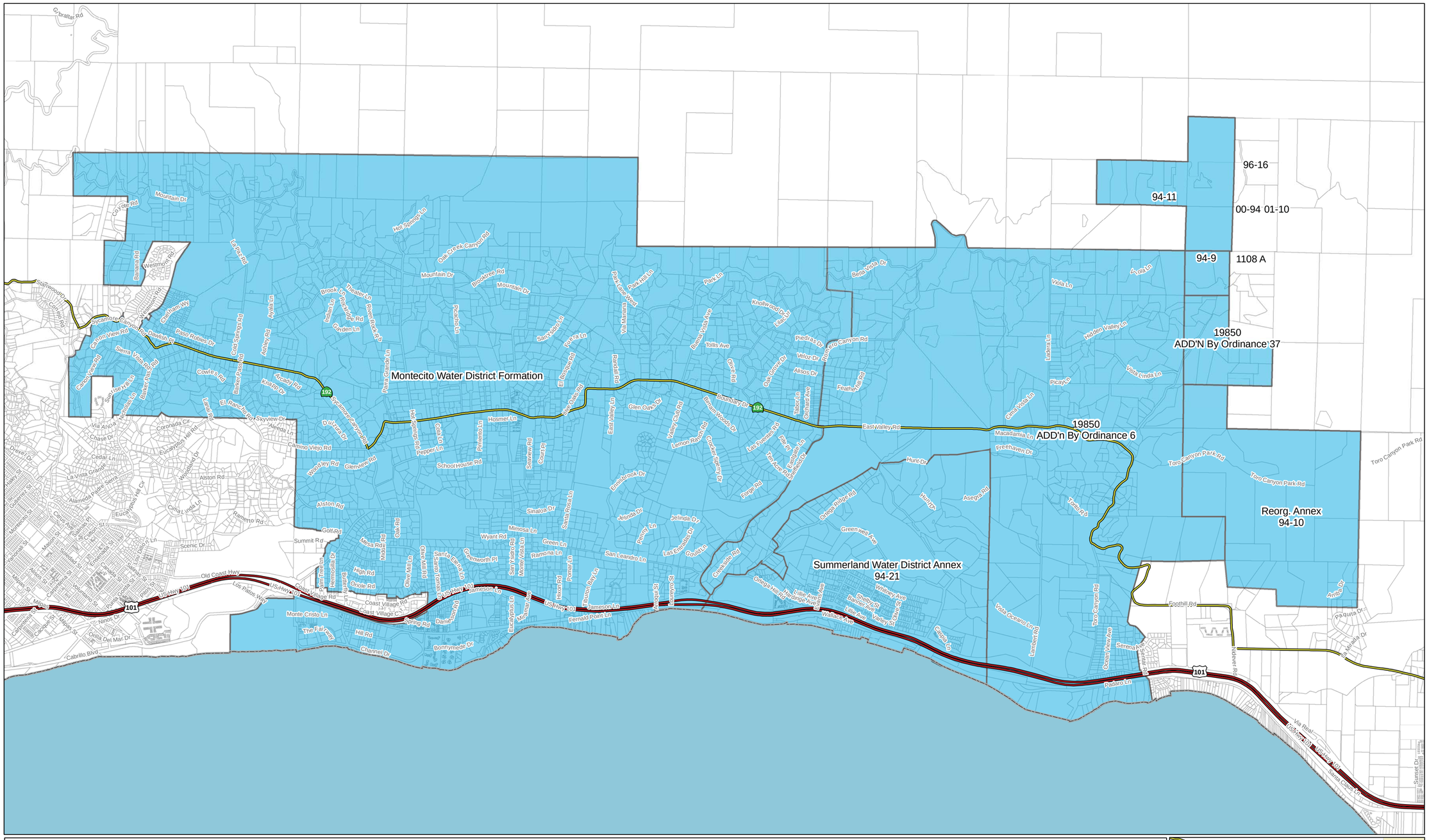
This map is a graphical representation of the Goleta Water District compiled from legal descriptions of annnexations and detachments on file in the Office of the County Surveyor.
No level of accuracy is claimed for the district lines shown hereon and lines should not be used to obtain coordinate values, bearings or distances.
District lines as shown on this map have been modified to fit the base map created and provided by the County Assessor's Office.

Compiled by the County Surveyor's Office in 9/1/99, rev. 12/13/02

Data Sources: County Surveyor's Office
County Planning and Development
County Assessor's Office

NORTH

No Scale



Montecito Water District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Parcel Boundary
- Annexation
- Detachment
- Formation

N
W E
S

GRAPHIC SCALE

0 0.25 0.5 1 1.5 2

Miles

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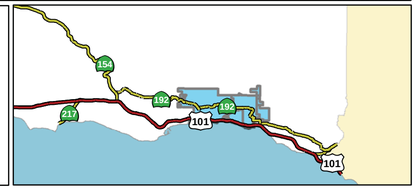

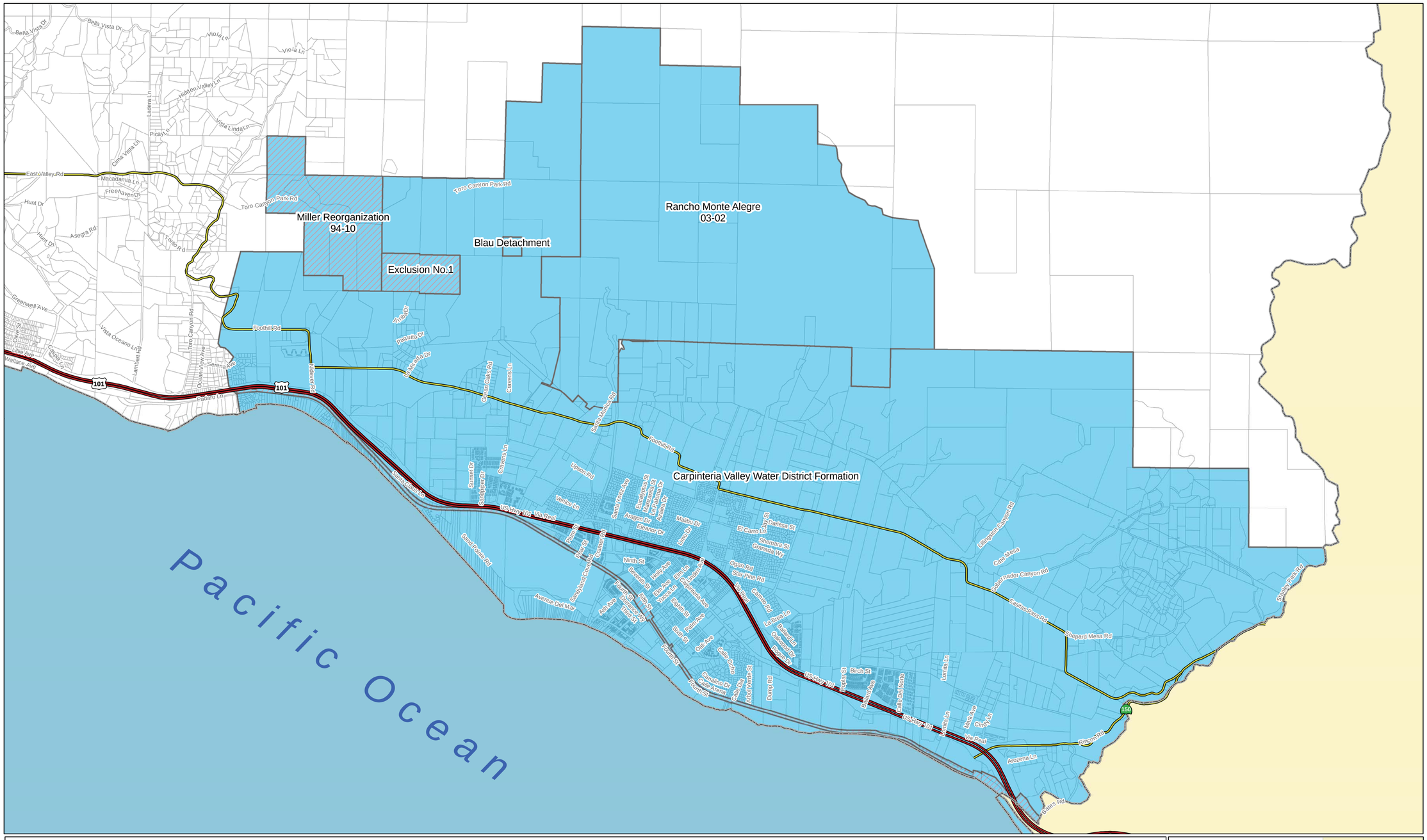

Carpinteria Valley Water District

Compiled by the Office of the County Surveyor in September of 2007

Legend

- Annexation
- Detachment
- Formation
- Parcel Boundary

COUNTY OF SANTA BARBARA SURVEYOR

GRAPHIC SCALE

0 0.25 0.5 1 1.5 2

Miles

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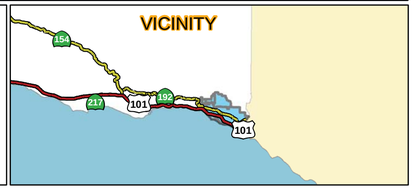

City of Guadalupe

Compiled by the Office of the County Surveyor in December of 2010. Incorporated 8/3/1946 by County Res. 6769. Last Action: Gowing Reorg., LAFCO 07-10, 11/13/2007. Sphere: 11/4/2010. See boundary activity table at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

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GRAPHIC SCALE

0 0.125 0.25 0.5

Miles

Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- County Boundary
- City Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

City of Guadalupe Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	City_Ord	City_Res	City_Date	LAFCO_Res	LAFCO_Date	Instrument	Recorded
0	Incorporation of the City of Guadalupe	Formation	8/3/1946	6769						32/177-179	
1	Ordinance No. 45	Annexation	3/19/1951		45		3/19/1951				
2	Ordinance No. 55	Annexation	9/24/1956		55						
3	Annexation No. 3	Annexation	5/31/1960								
4	Annexation No. 4	Annexation	1/26/1961		71		12/27/1960				
5	Annexation No. 5	Annexation	8/7/1963		88	6769	7/8/1963				
6	Pioneer Street Annexaton No. 1	Annexation	12/5/1974			432		1974-385	12/5/1974		
7	Sewer Lift Station	Annexation	3/31/1975			433	2/7/1975	1974-386			
8	El Club Comote Civico Mexicano de Guadalupe	Annexation	3/28/1980			554		1979-533	4/2/1982	1980-0012905	3/28/1980
9	Annexation No. 6, Wastewater Treatment Plant	Annexation	11/29/1988		88-846			1988-774	11/18/1988	1988-0076520	11/29/1988
10	DJ Farms Reorganization	Annexation	6/5/1995			95-05	5/11/1995	1993-14	5/23/1995	1995-0030210	6/8/1995
11	Jasco Reorganization	Annexation	8/5/2004					2003-11	9/4/2004	2004-0111676	10/20/2004
12	Gowing Reorganization	Annexation	11/13/2007					2007-10	11/13/2007	2007-0078906	11/13/2007
	City of Guadalupe Sphere of Influence	SOI	11/4/2010						11/4/2010		

City of Santa Maria

Compiled by the Office of the County Surveyor in December of 2011.
Incorporated 9/18/1905, Board of Supervisors Minute Book J/ 150-152.
Last Action: 106, Wastewater Treatment Plant Reorg., LAFCO 07-08, 10/5/2007.
Sphere: 11/4/2010. See Boundary Activity Table at
http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

A missing number means no completion information was found for a proposed boundary change.
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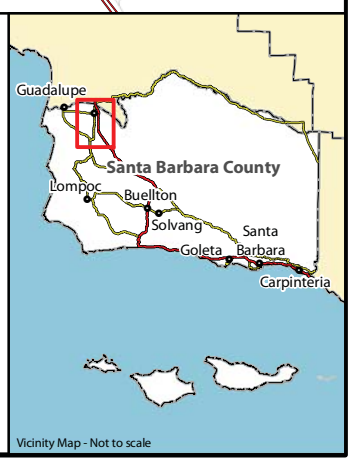
Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- County Boundary
- City Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

GRAPHIC SCALE

0 0.25 0.5 1 1.5 2

Miles



City of Santa Maria Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	City_Ord	City_Res	City_Date	County_Res	LAFCO_Res	LAFCO_Date	Instrument	Recorded	State_Date
0	Incorporation of the City of Santa Maria	Formation	9/18/1905							BOS Min. J 150		
1	S. M. Freezer	Annexation	7/16/1956	340		7/16/1956						
2	La Brea Securities	Annexation	7/15/1957	354		7/15/1957						
3	Driver Co.	Annexation	3/15/1958	368		3/15/1958						
4	Sewer Plant	Annexation	3/17/1958				17704					
5	Enos	Annexation	10/24/1958	378		10/24/1958						
6	Porter (Stowell)	Annexation	11/5/1958	382		11/5/1958						
7	Ray Hommes Dev. Co. (Donovan)	Annexation	3/2/1959	384		3/2/1959						
8	Diani Hanson	Annexation	4/6/1959	389		4/6/1959						
9	Enos	Annexation	2/16/1959	390		2/16/1959						
10	Thompson (Holcomb)	Annexation	2/16/1959	392		2/16/1959						
11	Maria Vista (Pasquini)	Annexation	3/23/1959	396		3/23/1959						
12	Pace - Paige	Annexation	1/16/1961	413		1/16/1961						
13	EB Taylor Estate (No Park.)	Annexation	7/27/1959	405		7/27/1959						
14	Porter - Ruiz	Annexation	4/4/1960	428		4/4/1960						
15	Airport	Annexation	7/18/1960	445		7/18/1960						
17	Enos	Annexation	3/7/1960	431		3/7/1960						
18	Mahoney	Annexation	8/15/1960	436		8/15/1960						
19	Cortez Land and Mortgage Co.	Annexation	2/6/1961	463		2/6/1961						
20	Thompson Associates	Annexation	7/17/1961	472		7/17/1961						
21	Newlove	Annexation	9/18/1961	492		9/18/1961						
23	Mayer Tract	Annexation	9/4/1962	546		9/4/1962						
24	City Dump	Annexation	8/7/1961	481		8/7/1961						
26	Pasquini	Annexation	1/22/1962	510		1/22/1962						
27	Cossa (East Gate)	Annexation	11/20/1961	502		11/20/1961						
28	Freeway R/W (Sec. 12)	Annexation	3/5/1962	513		3/5/1962						
29	Bognuda	Annexation	4/24/1962	517		4/24/1962						
30	S. Counties Gas Co.	Annexation	4/2/1962	518		4/2/1962						
31	Cemetery Association	Annexation	7/16/1962	523		7/16/1962						
32	McCoy	Annexation	6/4/1962	530		6/4/1962						
33	South Side of E. Stowell Rd. and Vicinity	Annexation	6/18/1962	532		6/18/1962						
34	Machado	Annexation	8/20/1962	533		8/20/1962						
35	Suey Iliff	Annexation	4/1/1963	564		4/1/1963						
36	Theo Holcomb	Annexation	7/24/1962	538		7/24/1962						
39	South Bradley Road (Jones to Stowell)	Annexation	11/5/1962	551		11/5/1962						
40	Bob Roberts and Aguirre	Annexation	1/21/1963	554		1/21/1963						
48	Petrolane Gas	Annexation	1/17/1964	589		1/17/1964						
53	Airport (SMPA2), et al	Annexation	3/31/1967	659		3/31/1967		17	6/23/1966			
54	Viking AFCO (Iverson)	Annexation	8/1/1966		2442	8/1/1966						

InternalNo	Title	Type	Effective	City_Ord	City_Res	City_Date	County_Res	LAFCO_Res	LAFCO_Date	Instrument	Recorded	State_Date
55	Skyway Drive Annex (SMPA)	Annexation	12/17/1976	1976-879		11/2/1976				1976-0054319	12/17/1976	
56	"A" Street	Annexation	12/27/1977		1977-444	8/2/1977		1976-445		1977-0063359	12/27/1977	
57	Foster Road	Annexation	12/27/1977		1977-4446	12/6/1977		1977-469	6/1/1977	1977-0063357	12/27/1977	
58	Sander Mobile Home Park	Annexation	9/9/1970	746		9/9/1970		1970-205	7/9/1970			
60	Suey Disposal Site	Annexation	11/20/1972		3395	11/20/1972		1972-319	10/26/1972			
61	Columbia Broadcasting System	Annexation	11/20/1972		3383	11/20/1972		310	9/28/1972			
62	Suey Crossing	Annexation	11/11/1977	1977-907		6/7/1977		1976-412	1/8/1976	1977-0056586	11/11/1977	12/12/1977
63	Country Club	Annexation	5/5/1975		3898	4/1/1975		1975-391	2/27/1975	1975-0015095		5/5/1975
65	Mahoney	Annexation	12/28/1977	1977-924		11/1/1977		1977-472	7/28/1977	1977-0063659	12/28/1977	1/11/1978
67	Pertusi	Annexation	12/17/1976	1976-881		12/16/1976				1976-0054320	12/17/1976	
68	Libeu	Annexation	6/15/1979		1979-4804	7/15/1979		1979-526	5/24/1979	1979-0027232	6/15/1979	7/5/1979
69	Kerr Hall Hurly Deutsch (SB Research)	Annexation	7/14/1982		1982-416	6/22/1982				1982-0029007	7/14/1982	7/28/1982
71	Hidden Pines	Annexation	3/17/1987		1986-190	12/16/1986		1986-738	11/13/1986	1987-0019714	3/17/1987	5/5/1987
73	First Christian Church	Annexation	5/13/1987		1987-44	4/7/1987		1987-745	2/26/1987	1987-0035655	5/13/1987	7/14/1987
77	Jeff White ("A" Street)	Annexation	9/27/1989		1989-112	9/19/1989		1989-793	6/15/1989	1989-0064342	9/27/1989	10/27/1989
78	Foxenwoods	Annexation	12/5/1990		1990-146	11/20/1990		1990-804	9/6/1990	1990-0077404	12/5/1990	1/18/1991
80	Robinson Helicopter Co.	Annexation	2/10/1992		1992-03	2/5/1992		1991-828	12/5/1991	1992-0008884	2/10/1992	3/5/1992
81	Hidden Pines Estates Reorg.	Annexation	5/7/1992		1991-191	12/17/1991		1991-826	11/7/1991	1992-0034516	5/7/1992	01920605
82	Hidden Pines Reorg. (Cherry Blossom)	Annexation	12/27/1994		1994-204	11/15/1994				1994-0092336	12/27/1994	
83	Hidden Pines II/Riverside MHP Reorg.	Annexation	7/29/1992		1992-72	6/2/1992		1992-835	5/7/1992	1992-0058964	7/29/1992	8/31/1992
84	Old Country Club Estates	Annexation	9/15/1993		1993-114	9/9/1993		1992-02	6/10/1993	1994-0018617	3/3/1994	
85	West Main Reorg.	Annexation	10/24/1994		1994-160	8/16/1994				1994-0079390	10/24/1994	
86	Blosser Southeast Reorg.	Annexation	12/30/1994		1994-205					1994-0093861	12/30/1994	
87	Blosser Southwest Reorg.	Annexation	12/27/1994		1994-206	11/15/1994				1994-0092337	12/27/1994	
89	West Stowell Reorg.	Annexation	9/30/1994		1994-161	8/16/1994				1994-0074841	9/30/1994	
90	Entrada Este Reorg.	Annexation	12/27/1994		1994-207	11/15/1994				1994-0092335	12/27/1994	
91	Sur Del Rio Reorg.	Annexation	7/24/1995		1995-93	7/17/1995		1993-04	8/18/1994	1995-0039890	7/24/1995	
93	Sur Del Rio Reorg. (Costco/Carls)	Annexation	7/24/1995		1995-93	7/17/1995		1993-04	8/18/1994	1995-0039890	7/24/1995	
95	Refiled Bradley Land Co. Reorg.	Annexation	7/24/2000					2000-01	2/3/2000	2000-0044768	7/24/2000	
96	City Wastewater Treatment Plant Reorg.	Annexation	12/3/1999					1999-13	10/7/1999	1999-0094776	12/3/1999	
96	City Wastewater Treatment Plant Reorg.	Detachment	12/3/1999					1999-13	10/7/1999	1999-0094776	12/3/1999	
97	North Preisker Ranch Reorg.	Annexation	3/16/2000					1999-06	8/5/1999	2000-0015587	3/16/2000	
99	Robinson Annex	Annexation	4/12/2004					2002-15	2/6/2003	2004-0036513	4/12/2004	
100A	Santa Maria Cemetery Reorg.	Annexation	11/19/2003					2002-18	9/4/2003	2003-0158428	11/19/2003	
100	Enos-[Buss] Ranchos Reorg.	Annexation	8/7/2008					2008-04	7/3/2008	2008-0046995	8/7/2008	
102	Refiled Mahoney Ranch Annex	Annexation	11/9/2004					2003-05	3/4/2004	2004-0119171	11/9/2004	
103	Black Road Reorg.	Annexation	11/23/2004					2004-01	9/17/2004	2004-0124282	11/23/2004	
104	Hagerman Sports Complex (CSM)	Annexation	7/14/2006					2005-17	12/1/2005	2006-0055703	7/14/2006	
105	Quail Run Reorg. (ADAM)	Annexation	1/28/2008					2007-11	12/28/2007	2008-0004886	1/28/2008	
106	Wastewater Treatment Plant Reorg.	Annexation	10/5/2007					2007-08	9/6/2007	2007-0071432	10/5/2007	
	City of Santa Maria Sphere of Influence	SOI	2/2/2006						2/2/2006			

City of Lompoc

Compiled by the Office of the County Surveyor in December of 2010.
Incorporated 8/6/1888, Board of Supervisors Minute Book F/71-72.
Last Action: Burton Ranch Reoganization, LAFCO 06-05, 5/13/2007.
Sphere: 11/4/2010. Boundary activity table at
http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

A missing number means no completion information was found for a proposed boundary change.
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Legend

- Highways
- Roads
- Railroads
- Parcels
- Sections
- Vandenberg AFB
- Ranchos and Townships
- City Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

GRAPHIC SCALE

0 0.25 0.5 1 1.5

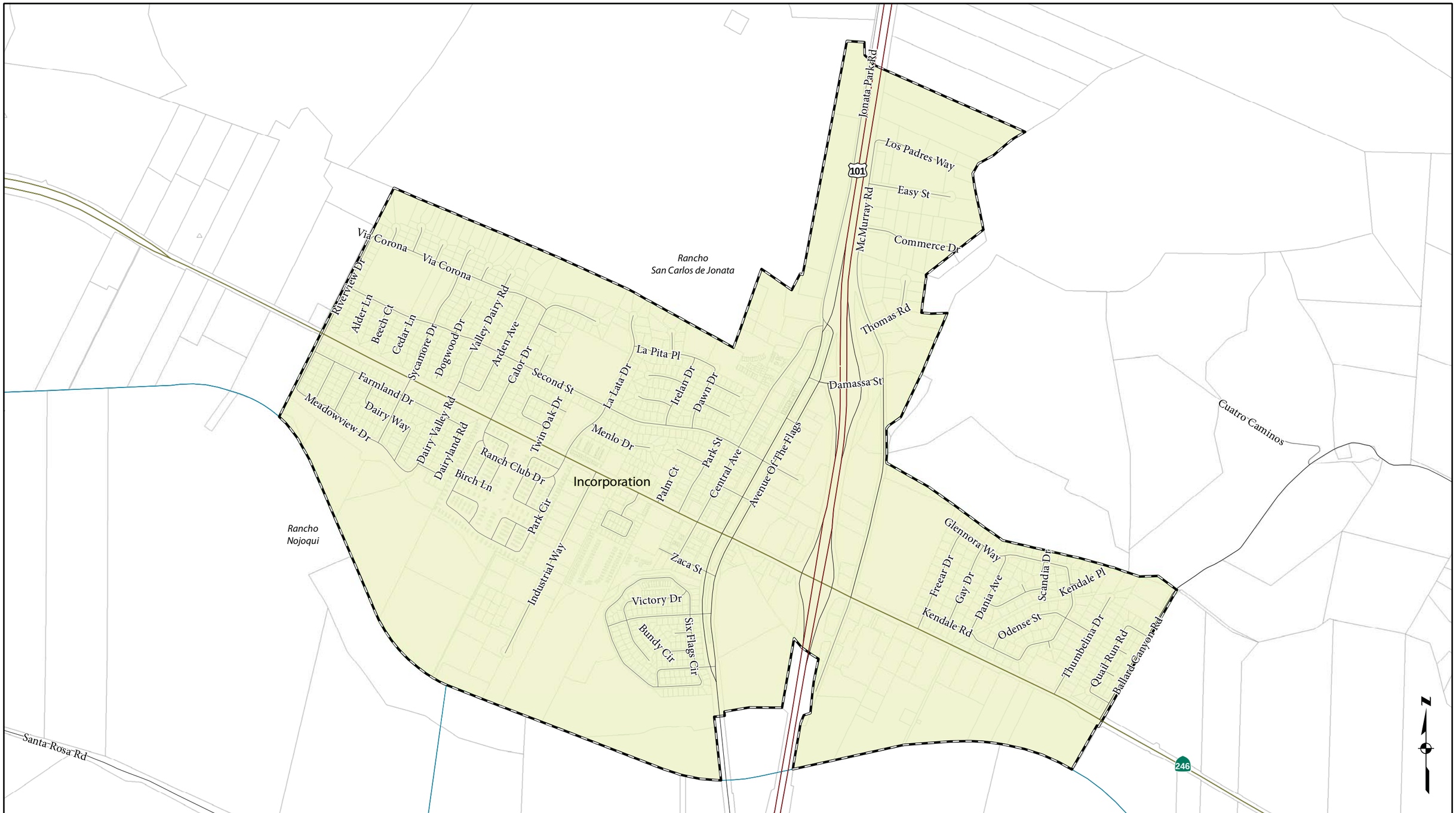
Miles

City of Lompoc Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	City_Ord	City_Res	City_Date	LAFCO_Res	Instrument	Recorded
0	City of Lompoc Incorporation	Formation	8/6/1888						Min. F 71-72	
1	Burpee-Zvolanek	Annexation	2/3/1959		502					
2	Sudden	Annexation	2/17/1959		506					
3	Dyer	Annexation	2/17/1959		508					
4	Burrell	Annexation	2/3/1959		513					
5	Richardson	Annexation	7/28/1959		530					
6	Signature Homes	Annexation	8/4/1959		531					
7	Perimeter Streets	Annexation	4/26/1960		579					
8	Substatial Homes	Annexation	11/29/1960		604					
9	Thomas Companies, Inc.	Annexation	12/20/1960		606					
10	Central & H streets	Annexation	5/23/1961		621					
11	Pine Ave	Annexation	10/19/1961		627					
12	Schuyler Developement company	Annexation	12/11/1961		634					
13	Tah-Vil	Annexation	3/22/1962		642					
14	Wurl	Annexation	4/3/1962		645					
15	Sophistica	Annexation	7/17/1962		664					
16	Northmont	Annexation	8/21/1962		667					
17	Wurl-Burke-Collins	Annexation	9/15/1962		675					
18	La Canada	Annexation	9/11/1962		673					
19	La Honda	Annexation	9/11/1962		674					
20	Gregg	Annexation	11/20/1962		678					
21	Lehman	Annexation	11/20/1962		679					
22	City water plant	Annexation	7/4/1963		701					
23	Sewer plant site	Annexation	2/25/1963	22949						
24	"O" Street Resevoir	Annexation	2/25/1963	22949						
25	Miguelito - Canyon Reservoir Site	Annexation	2/25/1963	22949						
26	Kirkpatric	Annexation	7/4/1963		794					
27	City Police Pistol Range	Annexation	8/14/1963	23331						
28	Frick Springs	Annexation	8/14/1963	23331						
29	Shuyler Development	Annexation	6/21/1963		699					
31	Kukey	Annexation	6/18/1964		727					
32	Church	Annexation	2/16/1965		748					
33	Bodger	Annexation	3/15/1966			1795				
34	Church of Christ	Annexation	5/15/1973			2278				
35	Williams Bros.	Annexation	4/5/1967			1854				

InternalNo	Title	Type	Effective	County_Res	City_Ord	City_Res	City_Date	LAFCO_Res	Instrument	Recorded
36	Bodger, Hirashima, Kyte & Johnson	Annexation	6/6/1967			1875				
38	Federal Correctional Institution	Annexation	12/22/1969					1969-189		
39	Crestview Drainage Ditch	Annexation	5/5/1970			2045				
41	Grefco	Annexation	2/7/1972			2174				
45	Everett	Annexation	12/26/1975				8/18/1975	1975-402	1976-0000507	1/6/1976
46	Brom-Mitchell	Annexation	9/23/1975			2499				
47	Beattie Park	Annexation	12/17/1976			2584	11/3/1976	1976-439	1976-0054306	12/17/1976
48	Schuyler Property	Annexation	11/11/1977			2658	7/19/1977		1977-0056575	11/11/1977
49	River Park	Annexation	5/30/1980			2843	8/7/1979	1979-545	1980-0021665	5/30/1980
50	Annex 50	Annexation	5/30/1980			2843	8/7/1979	1979-546	1980-0021666	5/30/1980
51	Culberson	Annexation	12/26/1984			3410	12/18/1984	1984-683	1984-0068260	12/26/1984
53	Pasquini	Annexation	11/26/1980			2982	11/18/1980	1980-567	1980-0049289	11/26/1980
54	Walsh	Annexation	8/13/1982			3160	8/3/1982	1982-618	1982-0033961	8/13/1982
55	Morris Sobhani Property	Annexation	12/12/1980			2990	12/2/1980	1980-568	1980-0051675	12/12/1980
57	Sanitary Landfill	Annexation	10/11/1983			3282	9/20/1983	1983-646	1983-0054551	10/11/1983
58	Bondietti	Annexation	4/9/1986			3551	4/1/1986	1986-715	1986-0020111	4/9/1986
59	McFaddin	Annexation	4/18/1986			3545	4/1/1986	1985-711	1986-0022021	4/18/1986
60	Hauenstein	Annexation	4/1/1987			3633	3/17/1986	1986-733	1987-0023814	4/1/1987
61	Callahan	Annexation	9/9/1986			3594	8/19/1986	1986-731	1986-0057374	9/9/1986
62	La Purisma Highlands	Annexation	5/4/1992					1992-833	1992-0033332	5/4/1992
67	Summers Property	Annexation	5/8/1989			3818	2/7/1989	1989-784	1989-0030089	5/8/1989
68	Lompoc Airport	Annexation	4/26/1991					1991-811	1991-0024306	4/26/1991
69	Hudgens Reorg	Annexation	9/2/2005					2005-11	2005-0086081	9/2/2005
70	Burton Ranch Reorg.	Annexation	5/13/2007					2006-05	2007-0040552	5/13/2007
	City of Lompoc Sphere of Influence	SOI	2/3/2005							



City of Buellton

Compiled by the Office of the County Surveyor in December of 2010. Incorporated 2/1/1992 by 1991-0081535, Official Records of Santa Barbara County. Sphere: 11/4/2010. Boundary activity table at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

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GRAPHIC SCALE

0 0.1 0.2 0.4

Miles

Legend

- Freeways
- Highways
- Roads
- Ranchos and Townships
- City Boundary
- Sections
- Parcels
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

City of Buellton Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	LAFCO_Res	LAFCO_No	Instrument	Recorded
0	City of Buellton Incorporation	Formation	2/1/1992	1991-676	1991-821	1990-R-01	1991-0081535	12/5/1991
	City of Buellton Sphere of Influence	SOI	11/4/2010					

City of Solvang

Compiled by the Office of the County Surveyor in June of 2010.
Incorporated 12/17/1984, by 1984-0066853, Official Records.
Last Action: Seltzer Modification, LAFCO 05-14, 9/1/2005.
Sphere: 11/4/2010. See boundary activity table at
http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

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Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- City Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

GRAPHIC SCALE

0 0.125 0.25 0.5 0.75 1

Miles

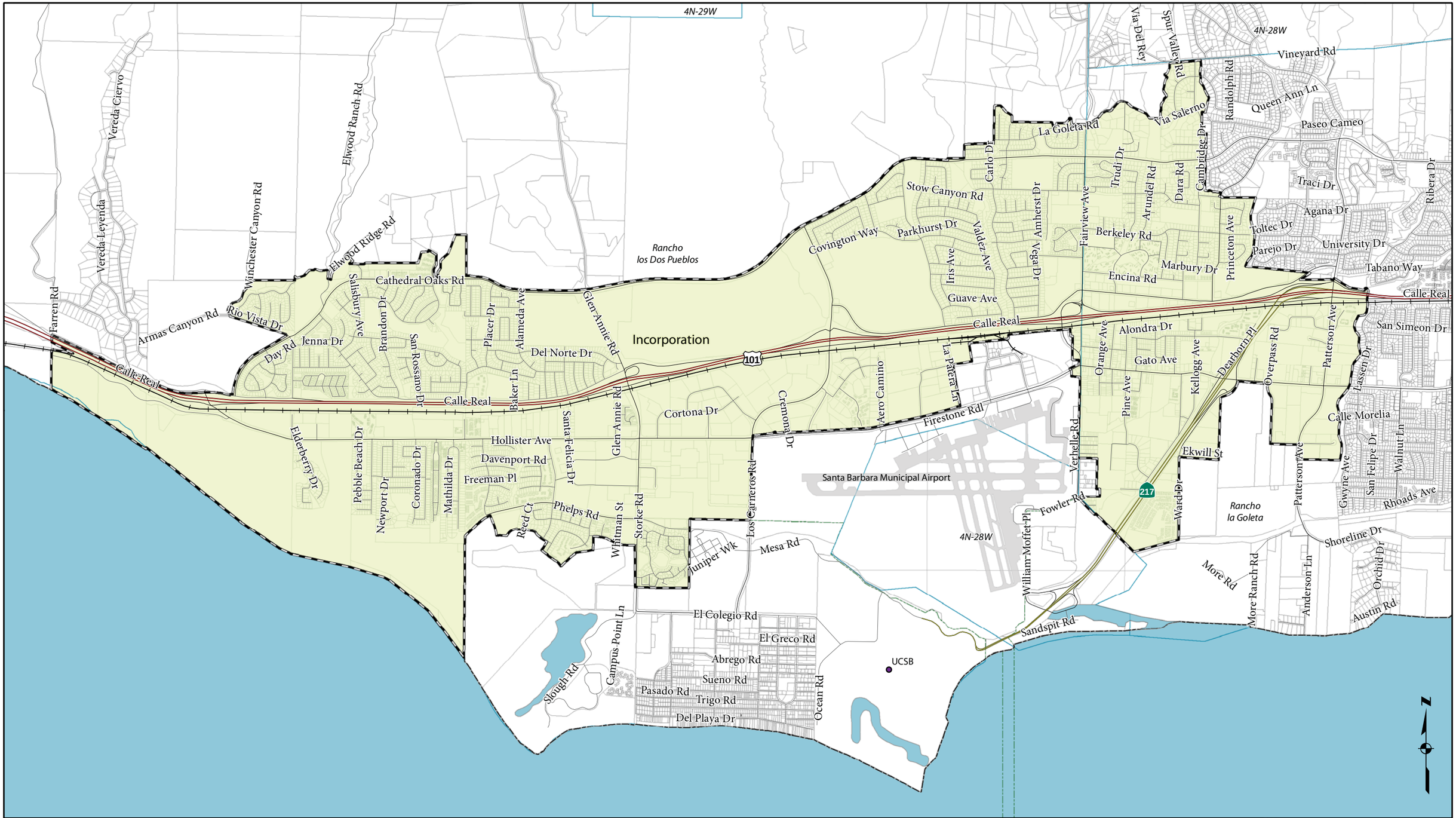
Vicinity Map - Not to scale

Guadalupe
Santa Maria
Santa Barbara County
Lompoc
Buellton
Solvang
Goleta
Santa Barbara
Carpinteria

City of Solvang Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	LAFCO_Res	LAFCO_No	LAFCO_Date	Instrument	Recorded
0	Incorporation of Solvang 1985	Formation	5/1/1985	1984-560	1984-667	1982-R-01	4/19/1984	1984-0066853	12/17/1984
1	Shley Reorg	Annexation	8/9/1995		1995-01	1995-01	4/12/1995	1995-0043869	8/9/1995
2	Triangle Park Reorganization	Annexation	10/20/2005		2004-08	2004-08	12/16/2004	2005-0102320	10/20/2005
3	Seltzer Modification	OOASA	9/1/2005		2005-14	2005-14	9/1/2005		
	City of Solvang Sphere of Influence	SOI	4/6/2006				4/6/2006		



City of Goleta

Compiled by the Office of the County Surveyor in December of 2010. Incorporated 2/1/2002 by 2002-0013744, Official Records of Santa Barbara County. Sphere: 3/5/2009. Boundary activity table at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

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GRAPHIC SCALE

0 0.25 0.5 1

Miles

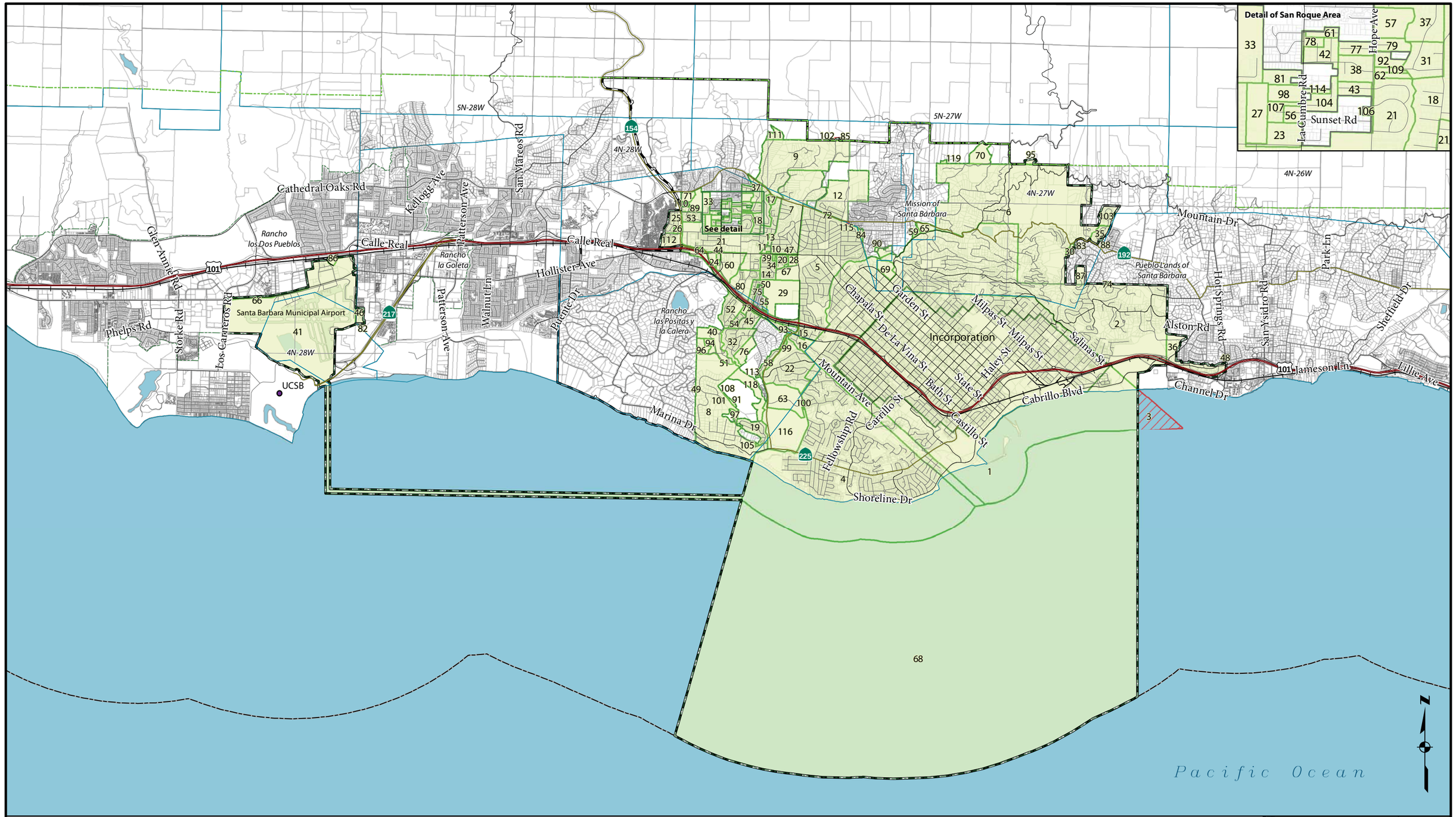
Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- City Boundary
- County Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

City of Goleta Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	LAFCO_Res	LAFCO_No	Instrument	Recorded
0	City of Goleta Incorporation	Formation	2/1/2002	2001-400	1999-20	1999-20	2002-0013744	2/11/2002
	City of Goleta Sphere of Influence	SOI	3/5/2009					



City of Santa Barbara

Compiled by the Office of the County Surveyor in December of 2010. Incorporated April, 1850.
Last Action: Las Canoas Reorganization, LAFCO 09-08, 9/7/2010. Sphere: 8/1/2002.
See boundary activity table at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

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GRAPHIC SCALE

0 0.5 1 2

Miles

Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- City Boundary
- Los Padres National Forest
- County Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

City of Santa Barbara Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	City_Ord	City_Res	City_Date	County_Res	LAFCO_Res	LAFCO_No	LAFCO_Date	Instrument	Recorded
0	Haley - Official Maps 1 & 2	Formation	8/9/1855	7								
1	City Charter Article I	Annexation	4/4/1898			4/4/1898						
2	city boundary	Annexation	9/21/1915	454		10/21/1903						
3	Line Change statute of 1917 (Elmer L. Jones)	Detachment	1/1/1917			1/1/1917						
4	Mesa Annexation, Territory No.1	Annexation	5/6/1921	1066		5/6/1921						
5	Pedregosa Annexation, Territory No.2	Annexation	5/6/1921	1066		5/6/1921						
6	Las Canoas, Territory No.3	Annexation	5/6/1921	1066		5/6/1921						
7	City Boundaries (Foothill)	Annexation	1/8/1926	1282		1/8/1926						
8	Braemar Tract	Annexation	12/31/1945	2052		11/29/1945						
9	Ontare Annexation	Annexation	11/29/1945	2053		1/19/1946						
10	Dixon Tract	Annexation	4/12/1946	2076		4/12/1946						
11	Higbee Tract	Annexation	5/1/1947	2139		5/1/1947						
12	Johnston Property	Annexation	5/5/1948	2182		3/4/1948						
13	Greene Tract	Annexation	8/26/1948	2202		8/26/1948						
14	San Roque Gardens	Annexation	3/26/1951	2315		3/26/1951						
15	West Property	Annexation	4/5/1951	2318		4/5/1951						
16	Las Positas Estates No.1	Annexation	5/31/1956	2541		5/31/1956						
17	Blackmore Annexation	Annexation	7/19/1956	2555		7/19/1956						
18	Schooler Annexation	Annexation	8/23/1956	2563		8/23/1956						
19	Braemar Annexation	Annexation	8/30/1956	2566		8/30/1956						
20	Phillips State Street Annexation	Annexation	9/13/1956	2571		9/13/1956						
21	State-Hope-La Cumbre Annex	Annexation	2/21/1957	2594		2/21/1957						
22	Las Positas Estates No.2	Annexation	3/14/1957	2601		3/14/1957						
23	La Colina Annexation	Annexation	2/27/1958	2649		2/27/1958						
24	Hollister Wye Annexation	Annexation	3/20/1958	2651		3/20/1958						
25	San Marcos Gardens Annexation	Annexation	3/27/1958	2654		3/27/1958						
26	Watling Annexation	Annexation	3/27/1958	2655		3/27/1958						
27	Hope School Property of the Hope Elem. School Dist	Annexation	8/7/1958	2681		7/21/1958	18187					
28	De Loreto Annexation	Annexation	11/20/1958	2692		11/20/1958						
29	Municipal Golf Course and Adams School Annex.	Annexation	7/7/1959	2716		7/7/1959						
30	Sycamore Canyon Annexation	Annexation	7/16/1959	2721		7/16/1959						
31	Coleman Annexation	Annexation	7/16/1959	2723		7/16/1959						
32	Hidden Valley Annexation	Annexation	7/16/1959	2722		7/16/1959						
33	La Colina Jr. High School Property	Annexation	9/3/1959	2731		9/3/1959						
34	Shapiro Annexation	Annexation	10/26/1959	2733		9/17/1959						
35	Montecito Circle Annexation	Annexation	1/27/1960	2752		1/27/1960						
36	Montecito Strip Annexation	Annexation	5/13/1960	2765		4/12/1960	2765					
37	Archer Annexation	Annexation	6/17/1960	2770		5/17/1960						
38	Hope Terrace Annexation	Annexation	9/6/1960	2779		8/2/1960						

InternalNo	Title	Type	Effective	City_Ord	City_Res	City_Date	County_Res	LAFCO_Res	LAFCO_No	LAFCO_Date	Instrument	Recorded
39	Ormiston Annexation	Annexation	9/6/1960	2783		8/2/1960						
40	Rutherford Annexation	Annexation	9/6/1960	2783		8/2/1960						
41	Santa Barbara Airport Annexation	Annexation	11/14/1961	2846		11/14/1961						
42	Moxcey Annexation	Annexation	4/27/1962	2870								
43	Lincoln Road Annexation	Annexation	5/1/1962	2874		5/1/1962						
44	State Street-South La Cumbre Road	Annexation	7/31/1962	2887		7/31/1962						
45	Hidden Valley Estates Annexation	Annexation	1/22/1963	2907		1/22/1963						
46	Airport Clear Zone Annexation	Annexation	3/12/1963	2914		3/12/1963						
47	Schaefer Annexation	Annexation	5/7/1963	2923		5/7/1963						
48	Robillard Annexation	Annexation	10/29/1963	2947	5682	9/24/1963						
49	Hope Ranch Estates Annexation	Annexation	10/29/1963	2949		10/29/1963						
50	Widling Annexation	Annexation	12/10/1963	2959		12/10/1963						
51	Hope Ranch Misc (Boundary Correction)	Annexation	1/21/1964	2964		1/21/1964						
52	Williams, et al Annexation	Annexation	1/30/1964	2963		12/31/1963						
53	Rue Property Annexation	Annexation	3/3/1964	2969		3/3/1964						
54	Cavaletto Annexation	Annexation	4/21/1964	2977		4/21/1964						
55	Karleskint Annexation	Annexation	9/8/1964	3005		9/8/1964						
56	Stacy Lane Annexation	Annexation	4/5/1965	3031		2/23/1965						
57	Hope School District Annex. No. 2	Annexation	7/6/1965				24812					
58	Esperanza Estates	Annexation	7/13/1965	3056		7/13/1965						
59	City Water Dept Property Annexation	Annexation	8/17/1965	3062		8/17/1965						
60	Prevedello-Lasarzig et al Annexation	Annexation	2/23/1966	3160		2/23/1966						
61	Blankenship Annexation	Annexation	6/14/1966	3152		6/14/1966						
62	Bethany Congregational Church Annexation	Annexation	7/5/1966	3161		7/5/1966						
63	City Sanitary Fill Site, et al. Annexation	Annexation	7/19/1966	3166		7/19/1966						
64	Calle Real Property Annexation	Annexation	12/6/1966	3184		12/6/1966						
65	John F. Kennedy School Site Annexation	Annexation	12/13/1966	3188		12/13/1966						
66	Hollister Avenue Annexation	Annexation	1/3/1967	3198		1/3/1967						
67	Renwick Annexation	Annexation	4/4/1967	3212		4/4/1967						
68	Tidelands Annexation	Annexation	11/7/1967	3257		11/7/1967						
69	Old Mission-Museum Annexation	Annexation	3/19/1968	3283				1967-43	1967-AC-02			
70	St. Mary's Seminary Annexation	Annexation	4/16/1968	3289	6554	4/16/1968						
71	Gainor Annexation	Annexation	4/23/1968	3293		4/23/1968						
72	Foothill Road Annexation	Annexation	9/12/1968	3309				1968-100	1968-AC-03			
73	Emanuel Lutheran Church Annexation	Annexation	5/20/1969	3367		5/20/1969						
74	Alexander Annexation	Annexation	10/14/1969	3384	6960	10/14/1969						
75	Thompson-Anderman Annexation	Annexation	12/23/1969	3397		12/23/1969						
76	Veronica Springs Road Properties Annexation	Annexation	2/19/1970	3400				1969-169	1969-AC-05			
77	Connie Way Properties Annexation	Annexation	7/9/1971	3479		7/9/1971						
78	Brooks Property Annexation	Annexation	10/14/1971	3489		9/14/1971			1971-AC-01			
79	Avco-Demelik Annexation	Annexation	2/20/1973	3581		2/20/1973						

InternalNo	Title	Type	Effective	City_Ord	City_Res	City_Date	County_Res	LAFCO_Res	LAFCO_No	LAFCO_Date	Instrument	Recorded
80	Bueneman, Cavaletto & Transportation Corridor Ann*	Annexation	12/10/1973	3606	7670			1973-333	1973-AC-05			
81	Aiches Property Annexation	Annexation	10/15/1974	3691		10/15/1974						
82	Airport Easterly Clear Zone Annexation	Annexation	5/27/1975	3772		5/27/1975						
83	Eucalyptus Knolls #2 (Williams Property)	Annexation	3/15/1979	1979-016				1978-511	1978-AC-02		1978-0011541	3/15/1979
84	PM 12,700	Annexation	10/11/1979		1979-78,79	10/11/1979		1979-520	1978-AC-04		1979-0047689	
85	Giordani Property	Annexation	5/22/1980								1980-0042163	5/22/1980
86	Airport Property	Annexation	10/16/1980								1980-0042162	10/16/1980
87	Thompson Property (Via Alicia)	Annexation	10/16/1980		1980-055	10/16/1980		1997-481	1977-AC-03		1980-0042161	
88	M. Edwards Property (APN 13-123-09)	Annexation	7/22/1982	1980-576		11/3/1981		1981-594	1979-AC-07		1982-0030245	7/22/1982
89	Reino Land Company Inc. Property Annexation	Annexation	8/16/1982								1982-0034183	8/16/1982
90	Hill Property	Annexation	11/23/1982								1982-0053336	11/23/1982
91	Portion of APN 47-010-43 (Fard & Cambell Property)	Annexation	10/23/1983								1983-0057795	10/23/1983
92	Tatjes Property	Annexation	9/4/1984								1984-0048035	9/4/1984
93	Kirkhart & Ozolins Property (Modoc Road Condos)	Annexation	11/1/1984		1984-164	11/1/1984		1984-663	1983-AC-03	10/23/1984	1984-0059471	
94	Valle Verde Property	Annexation	12/21/1984		1984-184	12/21/1984		1984-681	1984-AC-2	11/8/1984	1984-0067876	
95	Sanchez Property Annexation	Annexation	1/11/1985	1984-191				1984-671	1994-14		1985-0001805	1/11/1985
96	Koelsch/Schwaiger & Rutherford Property Reorg	Annexation	5/20/1986		1986-104	5/20/1986		1985-704	1985-AC-5		1986-0038606	
97	Nichols Property Reorganization	Annexation	6/8/1987								1987-0042369	6/8/1987
98	Feazelle Annexation	Annexation	7/13/1987		1986-165	7/13/1987		1986-732	1986-AC-03		1987-0052422	
99	APN 49-150-47 Reorganization	Annexation	1/11/1988								1988-0001665	1/11/1988
100	Elbek (Jesuit Property) Annexation	Annexation	1/26/1988								1988-0004999	1/26/1988
101	Markel Reorganization	Annexation	4/5/1988								1988-0022828	4/5/1988
102	Giordani Detachment	Detachment	12/10/1993		1993-124	12/10/1993		1992-842	1991-DC-1		1993-0098471	
103	Westmont Reorganization	Annexation	8/28/1995	1995-014		1/17/1995		1994-014	1994-14		1995-0048109	8/28/1995
104	Towbes Reorganization	Annexation	6/11/1996								1996-0035858	6/11/1996
105	Morgan Reorganization	Annexation	2/4/1997								1997-0006130	2/4/1997
106	Cantor Reorg. Part 1	Annexation	9/23/1997					1997-07	1997-07	1/1/1997	1977-0056661	9/23/1997
107	Carey Reorganization	Annexation	12/8/1998								1998-0095550	12/8/1998
108	Compton Reorganization	Annexation	12/24/1998								1998-0100683	12/24/1998
109	Investec Reorganization	Annexation	7/19/2000					2000-10	2000-10	7/18/2000	2000-0044014	7/19/2000
110	Cantor Reorg. Part 2	Annexation	7/25/2000					1997-07	1997-07	1/1/1997	2000-0044976	7/25/2000
111	Northridge Reorganization	Annexation	1/11/2001					2000-24	2000-24	12/18/2000	2001-0002894	1/11/2001
112	St. Vincent's Reorganization	Annexation	10/24/2002					2002-09	2002-09		2002-0107674	10/24/2002
113	Kennedy Reorganization	Annexation	10/21/2003					2003-08	2003-08		2003-0145552	10/21/2003
114	Hart Reorg.	Annexation	8/16/2005					2004-10	2004-10		2005-0078552	8/16/2005
115	Lengsfelder Reorganization	Detachment	5/17/2006					2006-03	2006-03	4/6/2006	2006-0039991	5/17/2006
116	Las Positas Reorganization	Annexation	4/7/2008					2006-06	2006-06		2008-0019858	4/7/2008
117	Rivera Trust Out-of-Agency Service Agreement	OOASA	7/2/2009					2009-03	2009-03		n/a	7/2/2009
118	Veronica Meadows Reorganization	Annexation	7/14/2009					2007-12	2007-12		2009-0042221	7/14/2009
119	Las Canoas Reorganization	Annexation	9/7/2010					2009-08	2009-08	9/7/2010	2010-0048697	9/7/2010
	City of Santa Barbara Sphere of Influence	SOI	7/2/2009			7/2/2009				7/2/2009		

City of Carpinteria

Compiled by the Office of the County Surveyor in December of 2011.
Incorporated 9/27/1965 by County Resolution 24988.
Last Action: 30, Green Heron Springs Annex., LAFCO 09-04, 07/08/2010.
Sphere: 11/4/2010. See Boundary Activity Table at
http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

A missing number means no completion information was found for a proposed boundary change.
NOTICE OF DISCLAIMER: This data is for reference only. Although every effort has been made to ensure the accuracy of information, errors and conditions originating from physical sources used to develop the database may be reflected in this data. Santa Barbara County shall not be liable for any errors, omissions, or damages that result from inappropriate use of this document. No level of accuracy is claimed for the boundary lines shown hereon and lines should not be used to obtain coordinate values, bearings or distances.

Legend

- Freeways
- Highways
- Roads
- Railroads
- Parcels
- Sections
- Ranchos and Townships
- Los Padres National Forest
- County Boundary
- Sphere of Influence
- Annexation
- Incorporation
- Detachment

GRAPHIC SCALE
0 0.25 0.5 1
Miles

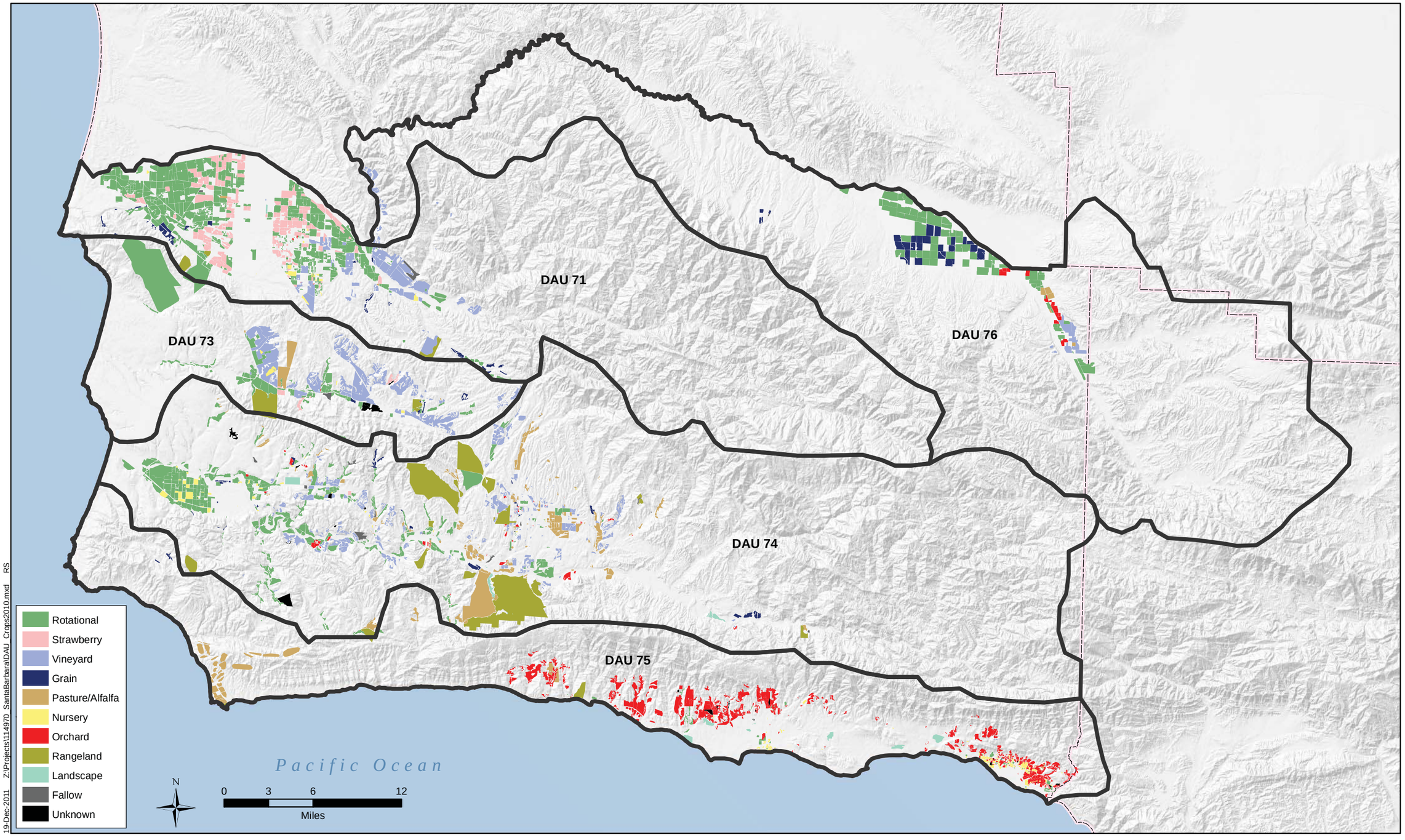
City of Carpinteria Boundary Activity

See map at http://www.countyofsb.org/pwd/pwsurveyor.aspx?id=5118

InternalNo	Title	Type	Effective	County_Res	City_Ord	City_Res	LAFCO_Res	LAFCO_Date	City_Date	Instrument	Recorded	State_Date
0	Incorporation of the City of Carpinteria	Formation	9/27/1965	24988						113/113-118		9/28/1965
1	Carpinteria Tide & Submerged Lands 1A-1	Annexation	5/26/1966									5/26/1966
2	Surf Realty	Annexation	11/20/1967		32, 38		37	3/9/1967	11/13/1967	1967-0033895	11/20/1967	9/29/1967
4	Heltman-Edwards Properties	Annexation	8/20/1968		54		93	6/13/1968	7/8/1968	1968-0025971	8/20/1968	8/12/1968
5	Carpinteria High School	Annexation	12/30/1968		66		130	12/12/1968	12/23/1968	1968-0040148	12/30/1968	12/27/1968
6	Carpinteria Coastal Industrial	Annexation	7/9/1969		75, 76	218	142	3/13/1969	6/9/1969			
7	Tidelands Property	Annexation	7/13/1970			314	206	7/9/1970	7/13/1970			7/23/1970
8	Bailard	Annexation	9/28/1970			323	208	8/27/1970	9/28/1970			
9	Battistone	Annexation	8/25/1971			360	209	8/27/1970	8/9/1971		8/25/1971	8/16/1971
10	Edwards Ranch	Annexation	9/2/1971			361	248	8/18/1971	8/23/1971		9/1/1971	8/27/1971
11	Tract 25026	Annexation	4/2/1973			481	326	11/30/1972	2/28/1973		4/2/1973	3/9/1973
12	Tract 25047	Annexation	11/12/1974			604	1974-382	10/24/1974	11/12/1974			
13	Annexation No. 13	Annexation	4/5/1976			704	1976-418	1/22/1976	2/9/1976	1976-0013021	4/5/1976	3/16/1976
14	Annexation No. 14	Annexation	9/19/1976		207	720	1976-421	2/26/1976	7/12/1976	1976-0037507	9/19/1976	8/13/1976
15	Cadwell Nazarene Church Property	Annexation	1/4/1977			782	1976-441	10/28/1976	11/22/1976	1977-0000468	1/4/1977	12/27/1976
16	Salvestrim	Annexation	11/29/1979			987	1979-536	5/30/1980		1979-0056147	11/29/1979	6/2/1980
17	LDS Church Property	Annexation	9/13/1979			968	1979-532	10/16/1979	8/13/1979	1979-0042706	9/13/1979	9/24/1979
18	Brown/Rubottom	Annexation	12/19/1980			1082	1980-572	12/26/1980	12/8/1980	1980-0052742	12/19/1980	12/30/1980
19	Boys Club/Heck & Breck	Annexation	3/28/1980			999	1979-547	5/30/1980	1/14/1980	1980-0012904	3/28/1980	6/2/1980
20	Annexation No. 20	Annexation	8/31/1982			1253	1982-650	9/3/1982	8/23/1982	1982-0036578	8/31/1982	9/17/1982
21	Monte Vista Park	Annexation	11/18/1982			1274	1982-631	11/23/1982	11/8/1982	1982-0048687	11/18/1982	12/14/1982
22	Tanaka	Annexation	2/1/1983			1291	1983-634	1/28/1983	1/24/1983	1983-0005335	2/1/1983	2/15/1983
23	Hancock, et al.	Annexation	10/3/1985			1499	1985-701	10/1/1985	9/23/1985	1985-0052510	10/3/1985	10/16/1985
24	Amesen/Blakeslee	Annexation	8/21/1985			1485	1985-702	8/19/1985		1985-0043751	8/21/1985	9/4/1985
26	Sandpiper Mobile Home Park	Annexation	5/20/1987			1667	1987-748	5/14/1987	5/11/1987	1987-0037762	5/20/1987	7/14/1987
27	El Carro Park	Annexation	10/13/1987			1702	1987-757	10/22/1987	9/14/1987	1987-0077073	10/13/1987	11/6/1987
28	Rodriguez Detachment	Detachment	2/28/1997				1997-01	2/6/1997		1997-0010698	2/28/1997	
29	Prato Reorganization	Annexation	7/12/2002				2001-18			2002-0067565	7/12/2002	
30	Green Heron Springs	Annexation	7/8/2010				2009-04	10/1/2009		2010-0036308	7/8/2010	
	City of Carpinteria SOI	Sphere-of-Influence	11/4/2010					11/4/2010				

Appendix E

Crop Type and Distribution in Santa Barbara County



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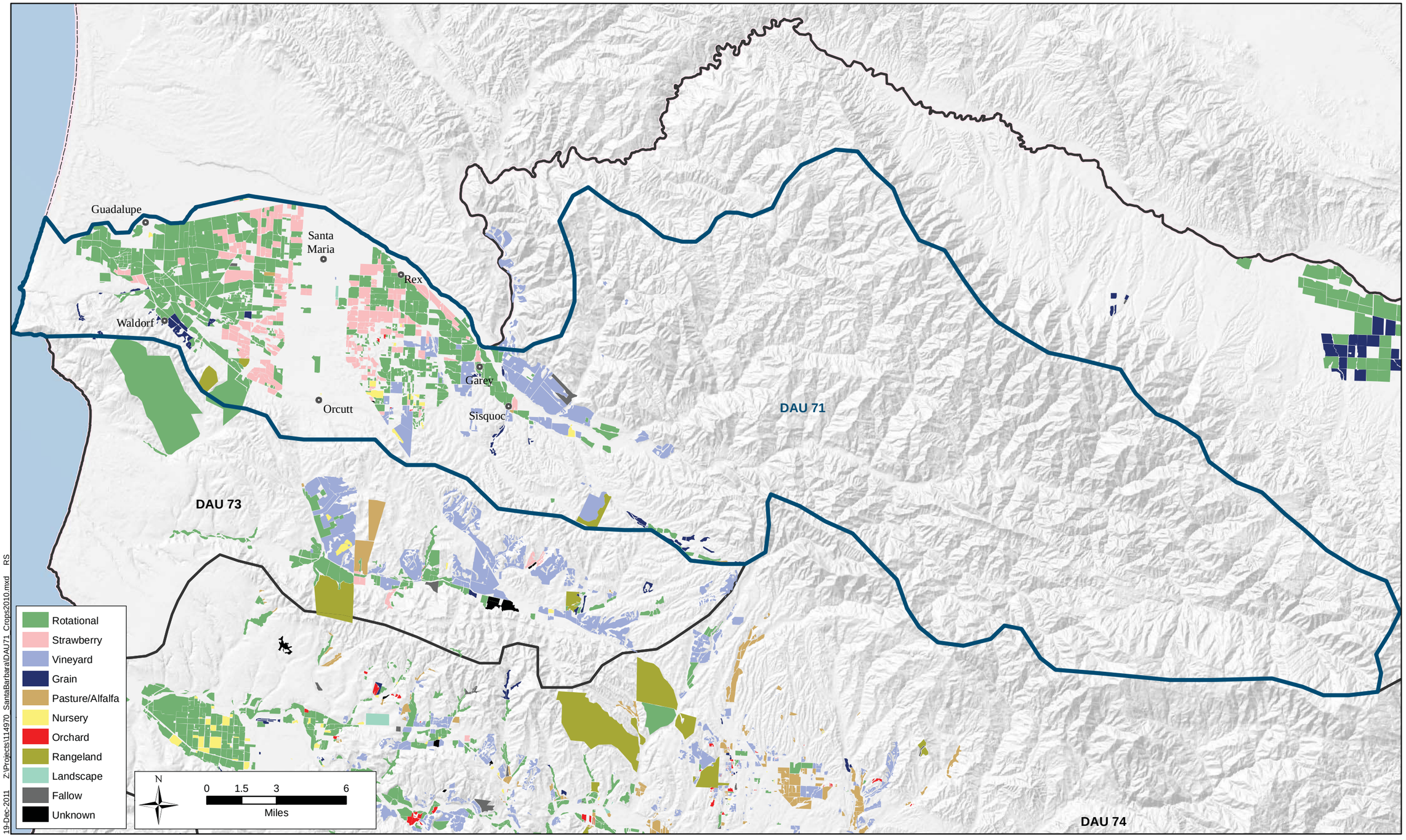

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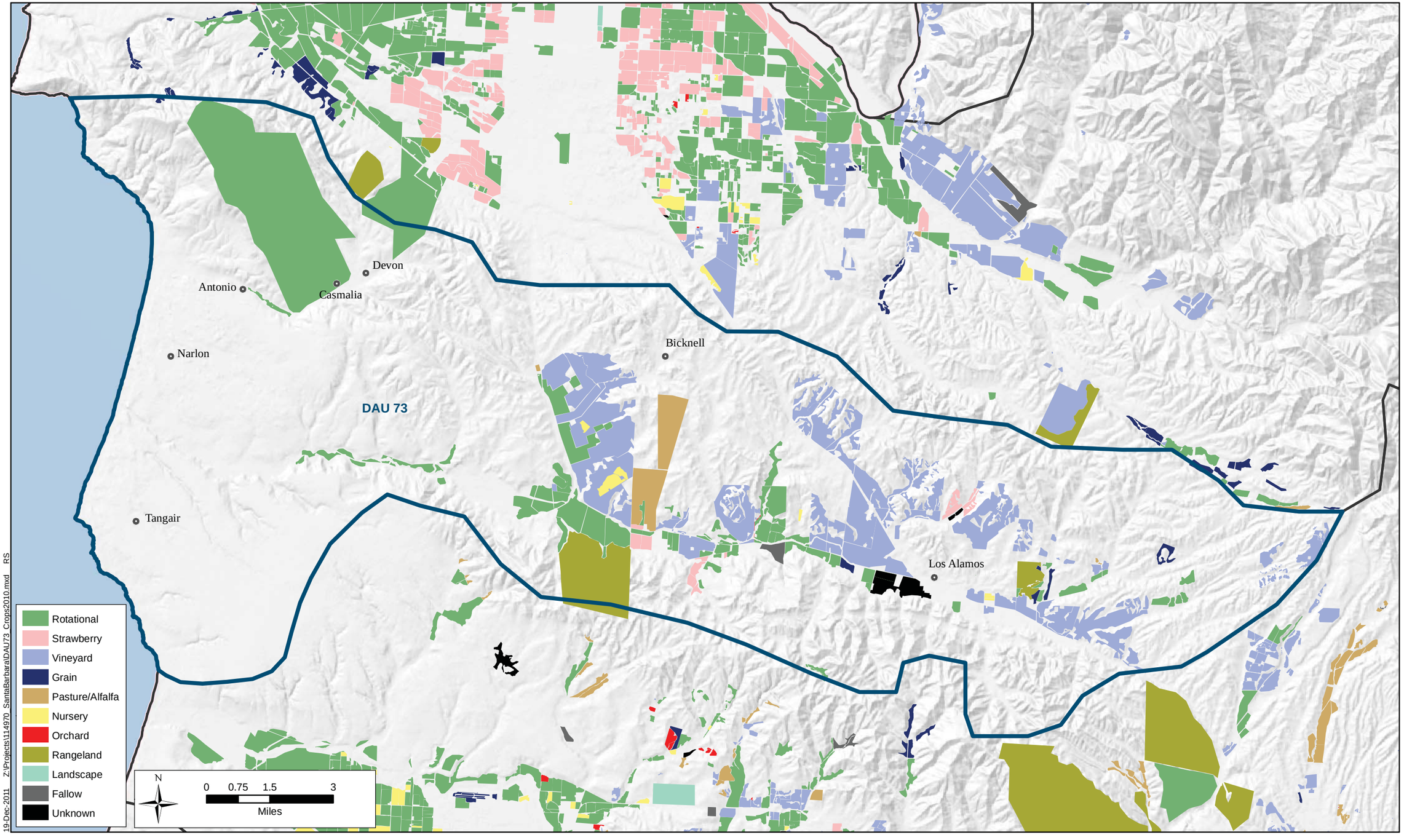

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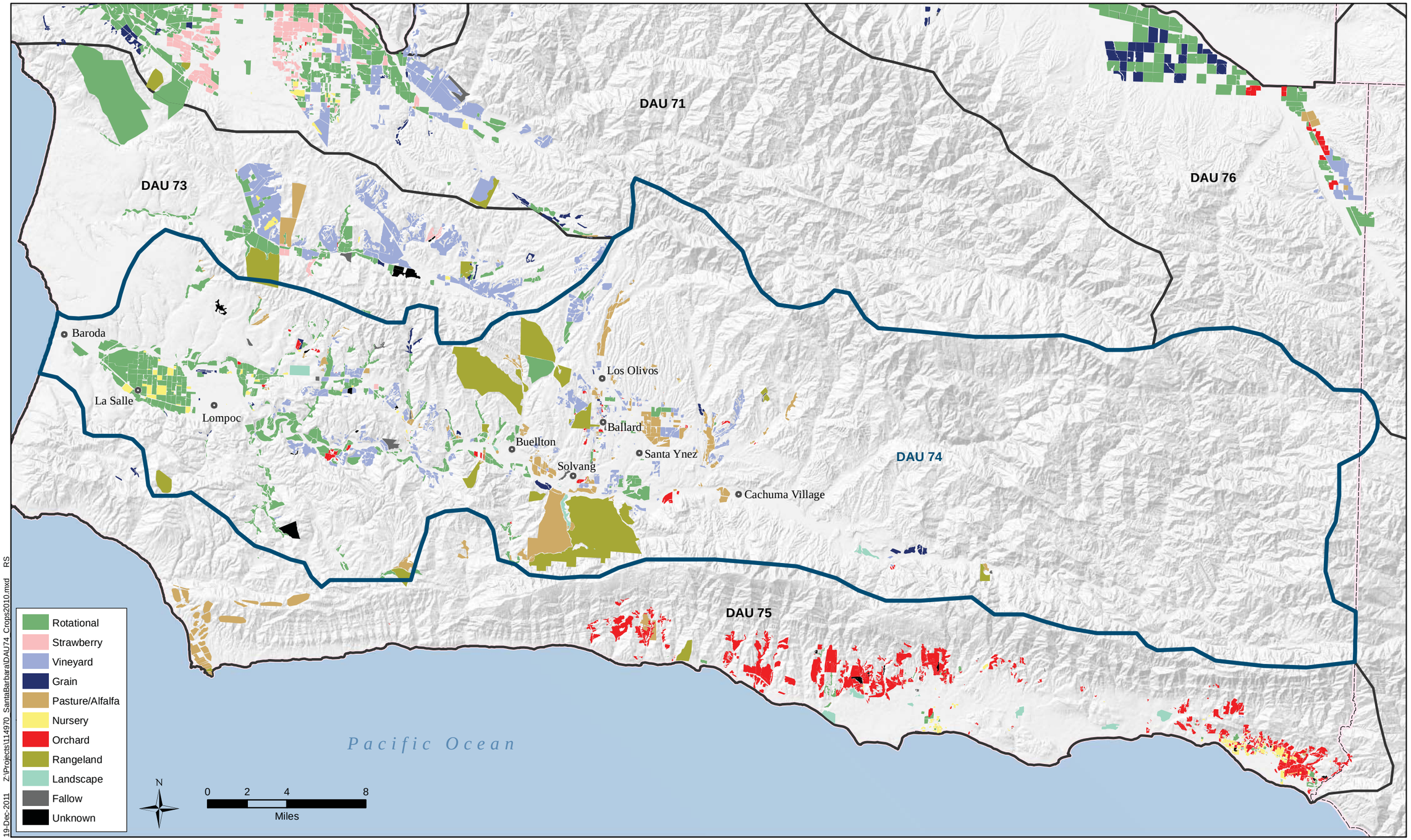
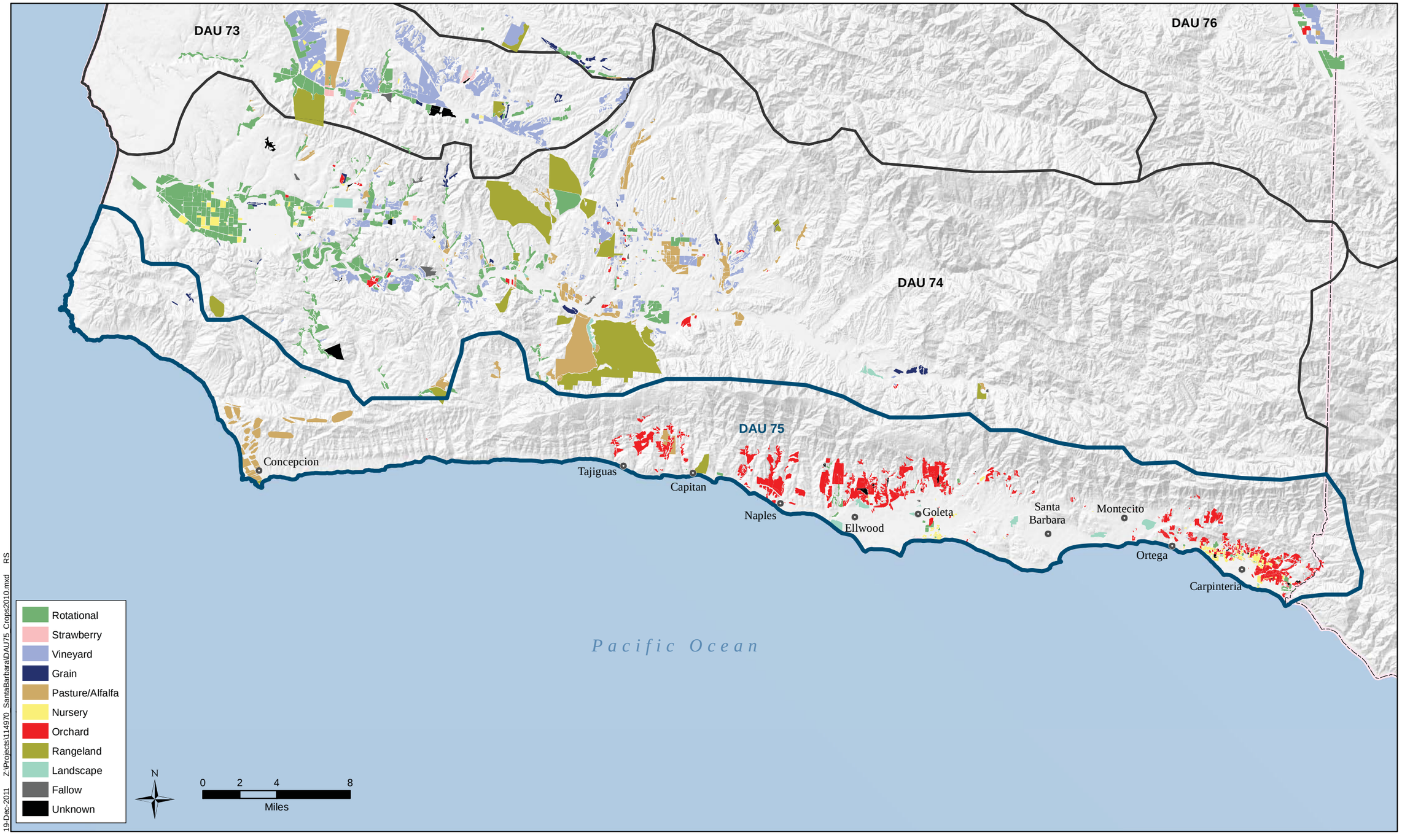

DAU 71
DAU 73
DAU 76
DAU 74
DAU 75
Baroda
La Salle
Lompoc
Los Olivos
Ballard
Buellton
Santa Ynez
Solvang
Cachuma Village
Pacific Ocean
Rotational
Strawberry
Vineyard
Grain
Pasture/Alfalfa
Nursery
Orchard
Rangeland
Landscape
Fallow
Unknown
N
0 2 4 8
Miles
19-Dec-2011 Z:\Projects\114970_SantaBarbaraIDAU74_Crops2010.mxd RS



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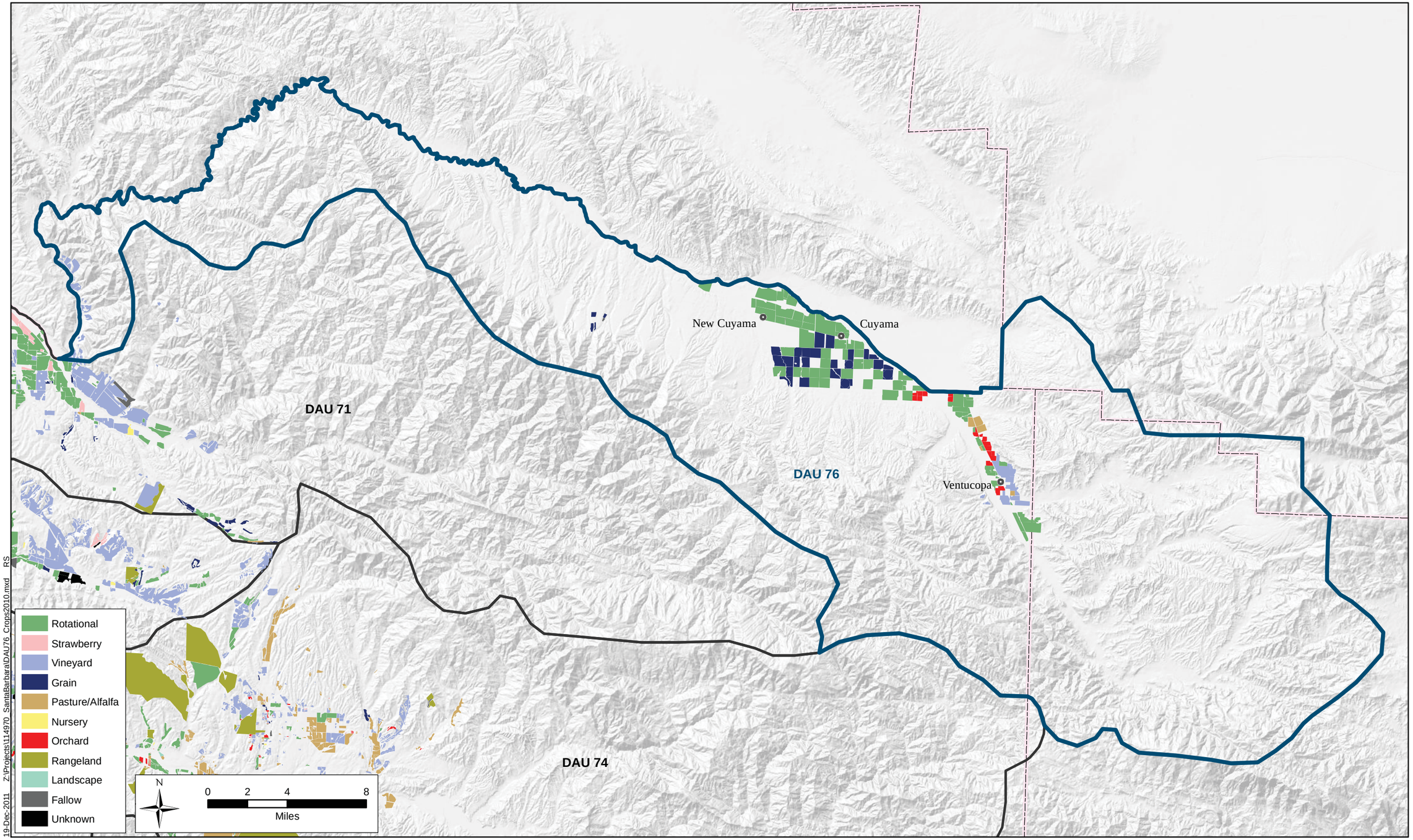
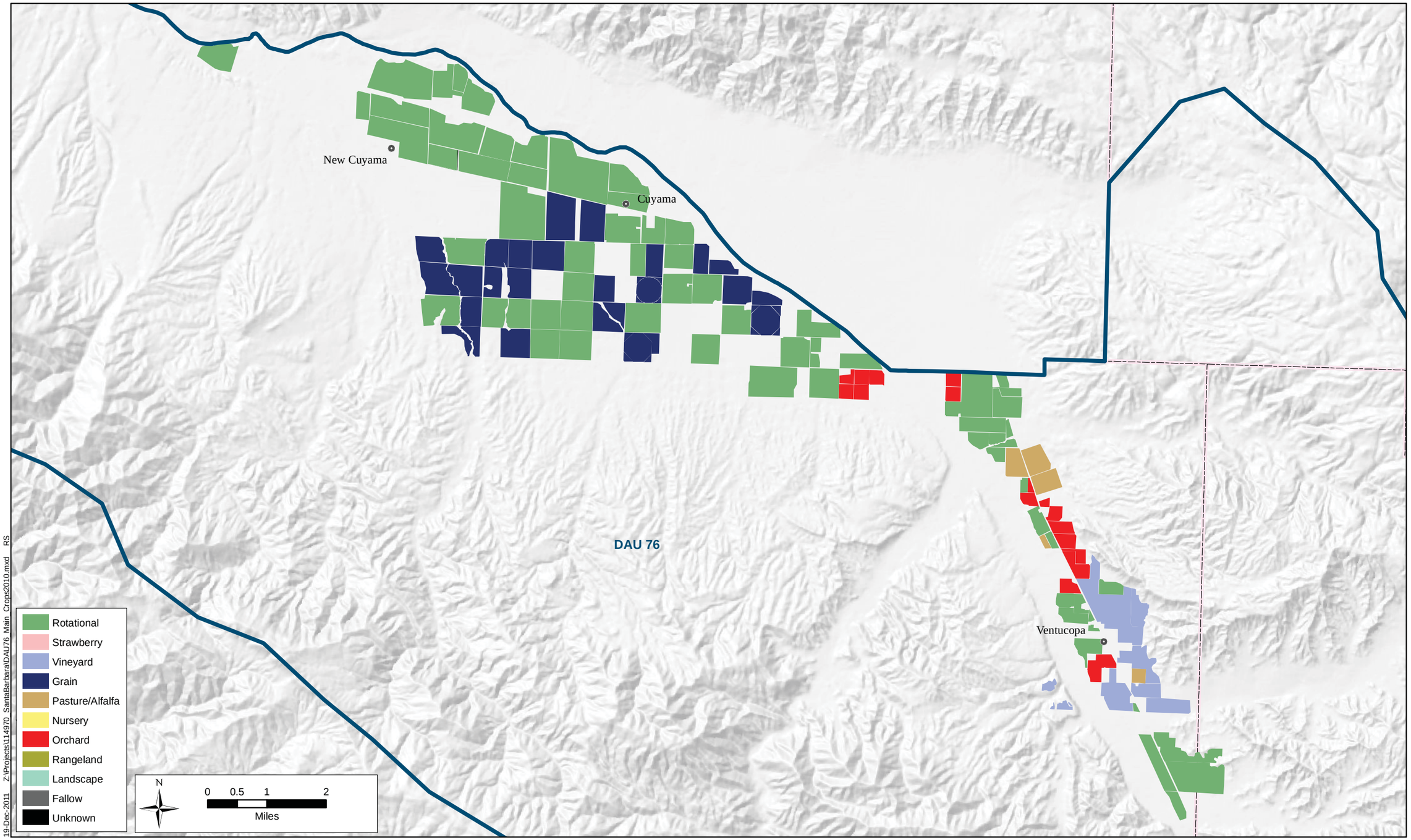

New Cuyama
Cuyama
Ventucopa
DAU 71
DAU 76
DAU 74
Rotational
Strawberry
Vineyard
Grain
Pasture/Alfalfa
Nursery
Orchard
Rangeland
Landscape
Fallow
Unknown
N
0 2 4 8
Miles
19-Dec-2011 Z:\Projects\114970_SantaBarbara\DAU76_Crops2010.mxd RS



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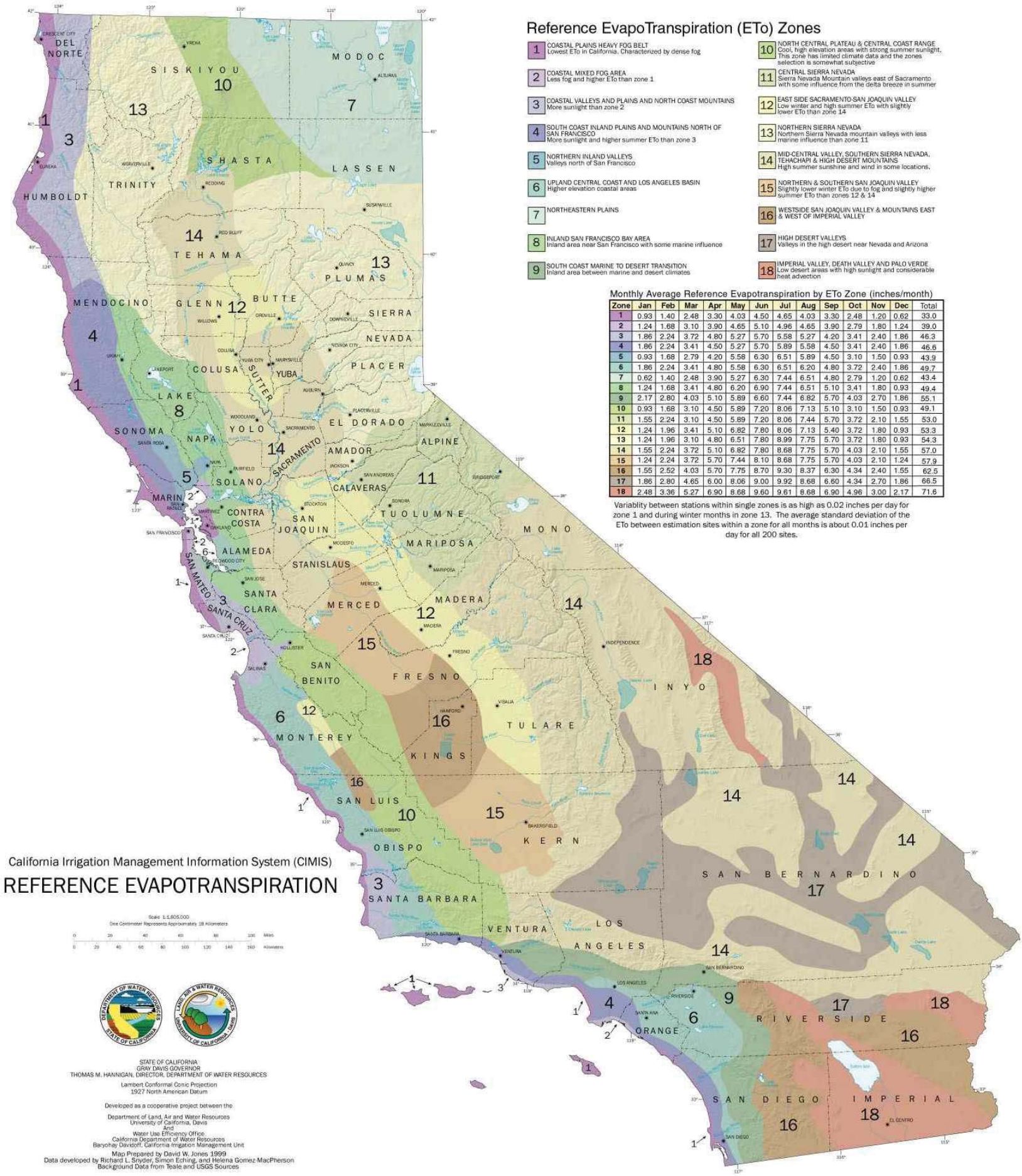


Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	33.0
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.4
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.0
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.3
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

Variablity between stations within single zones is as high as 0.02 inches per day for zone 1 and during winter months in zone 13. The average standard deviation of the ETo between estimation sites within a zone for all months is about 0.01 inches per day for all 200 sites.

Appendix F

Calculations of Agricultural Water Use

(Provided in Digital Form on CD)

Table F-1 Irrigated Acres by DAU **[Santa Barbara County Irrigated Acres Only - Does not include irrigated acres in SLO County (Acres)]**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified	TOTAL
Santa Maria Valley-SB (outside of districts)	7,243	3,550	5,924	---	---	785	390	22	783	---	231	3	18,931
Santa Maria Valley W.C.D.	17,379	4,825	14	48	0	267	26	---	---	42	24	---	22,625
City of Santa Maria Water Syst	463	363	4	0	0	---	---	---	---	35	---	---	864
City of Guadalupe	209	---	---	0	0	---	19	---	---	---	---	---	229
DAU 71 - Santa Maria Valley-SB Co. Only	**25,294**	**8,737**	**5,942**	**48**	**0**	**1,051**	**436**	**22**	**783**	**77**	**255**	**3**	**42,649**
San Antonio	9,943	364	8,874	---	---	152	187	2	2,194	---	101	316	22,132
Santa Ynez River W.C.D.	36	---	---	0	0	---	---	---	---	---	---	---	36
Los Alamos C.S.D.	0	---	---	0	0	---	---	---	---	---	---	16	17
DAU 73 - San Antonio	**9,979**	**364**	**8,874**	**0**	**0**	**152**	**187**	**2**	**2,194**	**0**	**101**	**332**	**22,185**
Santa Ynez (outside of districts)	1,570	---	1,983	374	26	294	7	61	10,564	155	33	320	15,388
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196	24,248
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	---	1,457
City of Lompoc	473	---	---	0	0	69	10	---	---	---	---	---	552
Mission Hills C.S.D.	1	---	---	0	0	---	---	---	---	---	11	---	12
Vandenberg Village C.S.D.	---	---	---	0	0	---	---	---	---	110	---	---	110
City of Buellton	11	---	---	0	0	---	---	---	---	21	---	---	32
City of Solvang W.S.A.	---	---	---	0	3	---	---	6	1	168	44	---	221
DAU 74 - Santa Ynez	**15,547**	**36**	**6,999**	**545**	**255**	**819**	**835**	**714**	**14,277**	**956**	**522**	**516**	**42,021**
South Coast (outside of districts)	154	---	---	---	---	58	0	2,791	340	0	3	0	3,347
Goleta W.D.	158	---	0	0	0	---	197	4,372	---	310	133	11	5,182
City of Santa Barbara W.S.A.	---	---	---	0	0	---	3	56	---	205	1	---	266
Montecito W.D.	11	---	3	0	0	---	17	429	---	206	0	---	667
Carpinteria Valley W.D.	175	2	8	0	9	---	642	1,849	---	16	42	17	2,760
DAU 75 - South Coast	**498**	**2**	**12**	**0**	**9**	**58**	**860**	**9,498**	**340**	**737**	**180**	**28**	**12,220**
Cuyama Crop Categories from 2008 Study	**Rotational**	**Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**	
DAU 76 - Cuyama Valley-SB	**6,867**	**2,212**	**1,693**	**15**	**---**	**3,110**	**---**	**695**	**---**	**---**	**18**	**106**	**14,716**
TOTAL Irrigated Acres in SB County	**58,185**	**11,351**	**23,520**	**608**	**264**	**5,190**	**2,317**	**10,931**	**17,594**	**1,771**	**1,075**	**985**	**133,791**

Table F-2 Irrigated Acres and Estimated Applied Water **[Santa Barbara County Irrigated Acres Only - Does not include irrigated acres in SLO County]**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified	Acres TOTAL	Acre-Feet Applied Water (AF)	Check (AF)
Santa Maria Valley-SB (outside of districts)	7,243	3,550	5,924	0	0	785	390	22	783	0	231	3	**18,931**		
Santa Maria Valley W.C.D.	17,379	4,825	14	48	0	267	26	0	0	42	24	0	**22,625**		
City of Santa Maria Water Syst	463	363	4	0	0	0	0	0	0	35	0	0	**864**		
City of Guadalupe	209	0	0	0	0	0	19	0	0	0	0	0	**229**		
DAU 71 - Santa Maria Valley-SB (Acres)	**25,294**	**8,737**	**5,942**	**48**	**0**	**1,051**	**436**	**22**	**783**	77	**255**	**3**	**42,649**		
SMVMA 2006-2010 Average (AF/AC)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
Santa Maria Valley-SB (outside of districts)	16,441	4,899	6,398	0	0	235	789	58	0	0	0	0		**28,820**	
Santa Maria Valley W.C.D.	39,451	6,658	15	166	0	80	53	0	0	0	0	0		**46,424**	
City of Santa Maria Water Syst	1,050	501	4	0	0	0	0	0	0	0	0	0		**1,555**	
City of Guadalupe	475	0	0	0	0	0	39	0	0	0	0	0		**514**	
DAU 71 SB Only Estimated (AF)	**57,417**	**12,058**	**6,418**	**166**	**0**	**315**	**881**	**58**	**0**	**0**	**0**	**0**		**77,313**	77,313
San Antonio	9,943	364	8,874	0	0	152	187	2	2,194	0	101	316	**22,132**		
Santa Ynez River W.C.D.	36	0	0	0	0	0	0	0	0	0	0	0	**36**		
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	16	**17**		
DAU 73 - San Antonio (Acres)	**9,979**	**364**	**8,874**	**0**	**0**	**152**	**187**	**2**	**2,194**	**0**	**101**	**332**	**22,185**		
SMVMA 2006-2010 Average (AF/AC)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
San Antonio	22,570	502	9,583	0	0	46	378	6	0	0	0	0		**33,086**	
Santa Ynez River W.C.D.	82	0	0	0	0	0	0	0	0	0	0	0		**82**	
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0		**0**	
DAU 73 Estimated (AF)	**22,653**	**502**	**9,583**	**0**	**0**	**46**	**378**	**6**	**0**	**0**	**0**	**0**		**33,168**	33,168
Santa Ynez (outside of districts)	1,570	0	1,983	374	26	294	7	61	10,564	155	33	320	**15,388**		
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196	**24,248**		
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	0	**1,457**		
City of Lompoc	473	0	0	0	0	69	10	0	0	0	0	0	**552**		
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	11	0	**12**		
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	110	0	0	**110**		
City of Buellton	11	0	0	0	0	0	0	0	0	21	0	0	**32**		
City of Solvang W.S.A.	0	0	0	0	3	0	0	6	1	168	44	0	**222**		
DAU 74 - Santa Ynez (Acres)	**15,547**	**36**	**6,999**	**545**	255	**819**	**835**	**714**	**14,277**	956	**522**	**516**	**42,021**		
SMVMA 2006-2010 Average (AF/AC)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
Santa Ynez (outside of districts)	3,563	0	2,142	1,294	0	88	15	162	0	0	0	0		**7,264**	
Santa Ynez River W.C.D.	29,833	49	4,730	386	0	131	1,638	1,495	0	0	0	0		**38,263**	
Santa Ynez R.W.C.D.Imp.Dist.#1	794	0	688	208	0	6	12	212	0	0	0	0		**1,919**	
City of Lompoc	1,074	0	0	0	0	21	21	0	0	0	0	0		**1,116**	
Mission Hills C.S.D.	2	0	0	0	0	0	0	0	0	0	0	0		**2**	
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0		**0**	
City of Buellton	24	0	0	0	0	0	0	0	0	0	0	0		**24**	
City of Solvang W.S.A.	0	0	0	0	0	0	0	15	0	0	0	0		**15**	
DAU 74 Estimated (AF)	**35,291**	**49**	**7,559**	**1,887**	**0**	**246**	**1,686**	**1,884**	**0**	**0**	**0**	**0**		**48,603**	48,603
South Coast (outside of districts)	154	0	0	0	0	58	0	2,791	340	0	3	0	**3,347**		
Goleta W.D.	158	0	0	0	0	0	197	4,372	0	310	133	11	**5,182**		
City of Santa Barbara W.S.A.	0	0	0	0	0	0	3	56	0	205	1	0	**266**		
Montecito W.D.	11	0	3	0	0	0	17	429	0	206	0	0	**667**		
Carpinteria Valley W.D.	175	2	8	0	9	0	642	1,849	0	16	42	17	**2,760**		
DAU 75 - South Coast (Acres)	**498**	**2**	**12**	**0**	9	**58**	**860**	**9,498**	**340**	737	**180**	**28**	**12,220**		
SMVMA 2006-2010 Average (AF/AC)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
South Coast (outside of districts)	350	0	0	0	0	17	0	7,368	0	0	0	0		**7,736**	
Goleta W.D.	359	0	0	0	0	0	398	11,542	0	0	0	0		**12,301**	
City of Santa Barbara W.S.A.	0	0	0	0	0	0	7	149	0	0	0	0		**155**	
Montecito W.D.	25	0	4	0	0	0	35	1,132	0	0	0	0		**1,196**	
Carpinteria Valley W.D.	397	2	8	0	0	0	1,296	4,882	0	0	0	0		**6,586**	
DAU 75 Estimated (AF)	**1,131**	**2**	**13**	**0**	**0**	**17**	**1,736**	**25,074**	**0**	**0**	**0**	**0**		**27,974**	27,974
Cuyama Crop Categories from 2008 Study	**Rotational**	**Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**			
DAU 76 - Cuyama Valley-SB (Acres)	**6,867**	**2,212**	**1,693**	**15**	**0**	**3,110**	**0**	**695**	**0**	**0**	**18**	**106**	**14,716**		
Cuyama 2008 Study (AF/AC)	**2.80**	**3.00**	**2.80**	**5.00**		**1.50**		**3.80**							
DAU 76 SB Only Estimated (AF)	**19,228**	**6,636**	**4,740**	**76**	**0**	**4,665**	**0**	**2,642**	**0**	**0**	**0**	**0**		**37,987**	37,987
TOTAL Irrigated Acres in SB County													**133,791**		
Irrigated Applied Water (AF) in SB County													**1.7**	**225,043**	

Table F-3 Estimate of Return Flow based on Weighted Average of DU **[Santa Barbara County Irrigated Acres Only - Does not include irrigated acres in SLO County]**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified		Weighted Ave DU (Percent)	Return Flow (Percent)	Return Flow (AF)
Santa Maria Valley-SB (outside of districts)	7,243	3,550	5,924	0	0	785	390	22	783	0	231	3				
Santa Maria Valley W.C.D.	17,379	4,825	14	48	0	267	26	0	0	42	24	0				
City of Santa Maria Water Syst	463	363	4	0	0	0	0	0	0	35	0	0				
City of Guadalupe	209	0	0	0	0	0	19	0	0	0	0	0				
DAU 71 - Santa Maria Valley-SB (Acres)	**25,294**	**8,737**	**5,942**	**48**		**1,051**		**22**					**41,095**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
Santa Maria Valley-SB (outside of districts)	5,794	3,017	5,628	0	0	628	0	19	0	0	0	0				
Santa Maria Valley W.C.D.	13,903	4,101	13	38	0	213	0	0	0	0	0	0				
City of Santa Maria Water Syst	370	308	4	0	0	0	0	0	0	0	0	0				
City of Guadalupe	167	0	0	0	0	0	0	0	0	0	0	0				
DAU 71 SB Only Estimated (Acres * DU)	**20,235**	**7,427**	**5,645**	**38**		**841**		**19**					**34,205**	**83%**	**17%**	**12,962**
San Antonio	9,943	364	8,874	0	0	152	187	2	2,194	0	101	316				
Santa Ynez River W.C.D.	36	0	0	0	0	0	0	0	0	0	0	0				
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	16				
DAU 73 - San Antonio (Acres)	**9,979**	**364**	**8,874**	**0**		**152**		**2**					**19,371**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
San Antonio	7,954	309	8,430	0	0	122	0	2	0	0	0	0				
Santa Ynez River W.C.D.	29	0	0	0	0	0	0	0	0	0	0	0				
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0				
DAU 73 Estimated (Acres * DU)	**7,983**	**309**	**8,430**	**0**		**122**		**2**					**16,846**	**87%**	**13%**	**4,323**
Santa Ynez (outside of districts)	1,570	0	1,983	374	26	294	7	61	10,564	155	33	320				
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196				
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	0				
City of Lompoc	473	0	0	0	0	69	10	0	0	0	0	0				
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	11	0				
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	110	0	0				
City of Buellton	11	0	0	0	0	0	0	0	0	21	0	0				
City of Solvang W.S.A.	0	0	0	0	3	0	0	6	1	168	44	0				
DAU 74 - Santa Ynez (Acres)	**15,547**	**36**	**6,999**	**545**		**819**		**714**					**24,660**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
Santa Ynez (outside of districts)	1,256	0	1,884	299	0	235	0	52	0	0	0	0				
Santa Ynez River W.C.D.	10,514	30	4,161	89	0	349	0	481	0	0	0	0				
Santa Ynez R.W.C.D.Imp.Dist.#1	280	0	605	48	0	16	0	68	0	0	0	0				
City of Lompoc	379	0	0	0	0	55	0	0	0	0	0	0				
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	0	0				
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0				
City of Buellton	9	0	0	0	0	0	0	0	0	0	0	0				
City of Solvang W.S.A.	0	0	0	0	0	0	0	5	0	0	0	0				
DAU 74 Estimated (Acres * DU)	**12,438**	**30**	**6,649**	**436**		**656**		**607**					**20,816**	**84%**	**16%**	**7,577**
South Coast (outside of districts)	154	0	0	0	0	58	0	2,791	340	0	3	0				
Goleta W.D.	158	0	0	0	0	0	197	4,372	0	310	133	11				
City of Santa Barbara W.S.A.	0	0	0	0	0	0	3	56	0	205	1	0				
Montecito W.D.	11	0	3	0	0	0	17	429	0	206	0	0				
Carpinteria Valley W.D.	175	2	8	0	9	0	642	1,849	0	16	42	17				
DAU 75 - South Coast (Acres)	**498**	**2**	**12**	**0**		**58**		**9,498**					**10,067**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
South Coast (outside of districts)	124	0	0	0	0	46	0	2,372	0	0	0	0				
Goleta W.D.	127	0	0	0	0	0	0	3,716	0	0	0	0				
City of Santa Barbara W.S.A.	0	0	0	0	0	0	0	48	0	0	0	0				
Montecito W.D.	9	0	3	0	0	0	0	365	0	0	0	0				
Carpinteria Valley W.D.	140	1	7	0	0	0	0	1,572	0	0	0	0				
DAU 75 Estimated (Acres * DU)	**399**	**1**	**11**	**0**		**46**		**8,073**					**8,530**	**85%**	**15%**	**4,270**
Cuyama Crop Categories from 2008 Study	**Rotational**	**Strawberry & Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**				
DAU 76 - Cuyama Valley-SB (Acres)	**6,867**	**2,212**	**1,693**	**15**		**3,110**		**695**					**14,592**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
DAU 76 SB Only Estimated (Acres * DU)	**5,494**	**1,880**	**1,608**	**12**		**2,488**		**591**					**12,073**	**83%**	**17%**	**6,558**

Table F-4 Irrigated Acres by DAU **[Santa Barbara and San Luis Obispo County Irrigated Acres - Does include irrigated acres in SLO County]**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified	TOTAL
SMVMA (L&S Boundary) (2006-2010 average)	35,184	8,893	4,660	0	0	642	228	35	379	0	849	0	**50,870**
SM Exceptions (Outside L&S Boundary, in SB CO DAU)	1,284	0	843	0	0	360	0	0	731	0	0	0	**3,218**
DAU 71 - Santa Maria Valley-SB and SLO (Acres)	**36,468**	**8,893**	**5,503**	**0**	**0**	**1,002**	**228**	**35**	**1,110**	**0**	**849**	**0**	**54,088**
San Antonio	9,943	364	8,874	---	---	152	187	2	2,194	---	101	316	**22,132**
Santa Ynez River W.C.D.	36	---	---	0	0	---	---	---	---	---	---	---	**36**
Los Alamos C.S.D.	0	---	---	0	0	---	---	---	---	---	---	16	**17**
DAU 73 - San Antonio (Acres)	**9,979**	**364**	**8,874**	**0**	**0**	**152**	**187**	**2**	**2,194**	**0**	**101**	**332**	**22,185**
Santa Ynez (outside of districts)	1,570	---	1,983	374	26	294	7	61	10,564	155	33	320	**15,388**
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196	**24,248**
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	---	**1,457**
City of Lompoc	473	---	---	0	0	69	10	---	---	---	---	---	**552**
Mission Hills C.S.D.	1	---	---	0	0	---	---	---	---	---	11	---	**12**
Vandenberg Village C.S.D.	---	---	---	0	0	---	---	---	---	110	---	---	**110**
City of Buellton	11	---	---	0	0	---	---	---	---	21	---	---	**32**
City of Solvang W.S.A.	---	---	---	0	3	---	---	6	1	168	44	---	**221**
DAU 74 - Santa Ynez (Acres)	**15,547**	**36**	**6,999**	**545**	**255**	**819**	**835**	**714**	**14,277**	**956**	**522**	**516**	**42,021**
South Coast (outside of districts)	154	---	---	---	---	58	0	2,791	340	0	3	0	**3,347**
Goleta W.D.	158	---	0	0	0	---	197	4,372	---	310	133	11	**5,182**
City of Santa Barbara W.S.A.	---	---	---	0	0	---	3	56	---	205	1	---	**266**
Montecito W.D.	11	---	3	0	0	---	17	429	---	206	0	---	**667**
Carpinteria Valley W.D.	175	2	8	0	9	---	642	1,849	---	16	42	17	**2,760**
DAU 75 - South Coast (Acres)	**498**	**2**	**12**	**0**	**9**	**58**	**860**	**9,498**	**340**	**737**	**180**	**28**	**12,220**
Cuyama Crop Categories from 2008 Study	**Rotational**	**Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**	
SB and SLO Acres in Main Area (2008 Report)	4,000	6,000	220	3,000	0	5,000	0	1,000	0	0	0	0	**19,220**
Cuyama Valley, in SB Co away from Main Area	0	0	684	0	0	108	0	0	0	0	18	0	**810**
DAU 76 - Cuyama Valley, SB and SLO (Acres)	**4,000**	**6,000**	**904**	**3,000**	**0**	**5,108**	**0**	**1,000**	**0**	**0**	**18**	**0**	**20,030**
	Rotational	**Strawberry or Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**	
TOTAL Irrigated Acres (SB and SLO)	**66,492**	**15,294**	**22,291**	**3,545**	**264**	**7,139**	**2,109**	**11,249**	**17,921**	**1,693**	**1,670**	**876**	**150,544**

Table F-5 Irrigated Acres and Estimated Applied Water — **Santa Barbara County Irrigated Acres Only - Does include irrigated acres in SLO County**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified	Acres TOTAL	Acre-Feet Applied Water (AF)	Check (AF/AC)
SMVMA (L&S Boundary) (2006-2010 average)	35,184	8,893	4,660	0	0	642	228	35	379	0	849	0	**50,870**		
SM Exceptions (Outside L&S Boundary, in SB CO DAU)	1,284	0	843	0	0	360	0	0	731	0	0	0	**3,218**		
DAU 71 - Santa Maria Valley-SB and SLO (Acres)	**36,468**	**8,893**	**5,503**	**0**	**0**	**1,002**	**228**	**35**	**1,110**	**0**	**849**	**0**	**54,088**		
SMVMA 2006-2010 Average (AF/A)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
SMVMA (L&S Boundary)	79,868	12,272	5,033	0	0	193	461	92	0	0	0	0		**97,918**	
SM Exceptions (Outside L&S Boundary, in SB CO DAU)	2,915	0	910	0	0	108	0	0	0	0	0	0		**3,933**	
DAU 71 Applied Water for Irrigation (AF)	**82,782**	**12,272**	**5,943**	**0**	**0**	**301**	**461**	**92**	**0**	**0**	**0**	**0**		**101,852**	101,852
San Antonio	9,943	364	8,874	0	0	152	187	2	2,194	0	101	316	**22,132**		
Santa Ynez River W.C.D.	36	0	0	0	0	0	0	0	0	0	0	0	**36**		
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	16	**17**		
DAU 73 - San Antonio (Acres)	**9,979**	**364**	**8,874**	**0**	**0**	**152**	**187**	**2**	**2,194**	**0**	**101**	**332**	**22,185**		
SMVMA 2006-2010 Average (AF/A)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
San Antonio	22,570	502	9,583	0	0	46	378	6	0	0	0	0		**33,086**	
Santa Ynez River W.C.D.	82	0	0	0	0	0	0	0	0	0	0	0		**82**	
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0		**0**	
DAU 73 Applied Water for Irrigation (AF)	**22,653**	**502**	**9,583**	**0**	**0**	**46**	**378**	**6**	**0**	**0**	**0**	**0**		**33,168**	33,168
Santa Ynez (outside of districts)	1,570	0	1,983	374	26	294	7	61	10,564	155	33	320	**15,388**		
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196	**24,248**		
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	0	**1,457**		
City of Lompoc	473	0	0	0	0	69	10	0	0	0	0	0	**552**		
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	11	0	**12**		
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	110	0	0	**110**		
City of Buellton	11	0	0	0	0	0	0	0	0	21	0	0	**32**		
City of Solvang W.S.A.	0	0	0	0	3	0	0	6	1	168	44	0	**222**		
DAU 74 - Santa Ynez (Acres)	**15,547**	**36**	**6,999**	**545**	255	**819**	**835**	**714**	**14,277**	956	**522**	**516**	**42,021**		
SMVMA 2006-2010 Average (AF/A)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
Santa Ynez (outside of districts)	3,563	0	2,142	1,294	0	88	15	162	0	0	0	0		**7,264**	
Santa Ynez River W.C.D.	29,833	49	4,730	386	0	131	1,638	1,495	0	0	0	0		**38,263**	
Santa Ynez R.W.C.D.Imp.Dist.#1	794	0	688	208	0	6	12	212	0	0	0	0		**1,919**	
City of Lompoc	1,074	0	0	0	0	21	21	0	0	0	0	0		**1,116**	
Mission Hills C.S.D.	2	0	0	0	0	0	0	0	0	0	0	0		**2**	
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0		**0**	
City of Buellton	24	0	0	0	0	0	0	0	0	0	0	0		**24**	
City of Solvang W.S.A.	0	0	0	0	0	0	0	15	0	0	0	0		**15**	
DAU 74 Applied Water for Irrigatin (AF)	**35,291**	**49**	**7,559**	**1,887**	**0**	**246**	**1,686**	**1,884**	**0**	**0**	**0**	**0**		**48,603**	48,603
South Coast (outside of districts)	154	0	0	0	0	58	0	2,791	340	0	3	0	**3,347**		
Goleta W.D.	158	0	0	0	0	0	197	4,372	0	310	133	11	**5,182**		
City of Santa Barbara W.S.A.	0	0	0	0	0	0	3	56	0	205	1	0	**266**		
Montecito W.D.	11	0	3	0	0	0	17	429	0	206	0	0	**667**		
Carpinteria Valley W.D.	175	2	8	0	9	0	642	1,849	0	16	42	17	**2,760**		
DAU 75 - South Coast (Acres)	**498**	**2**	**12**	**0**	9	**58**	**860**	**9,498**	**340**	737	**180**	**28**	**12,220**		
SMVMA 2006-2010 Average (AF/A)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
South Coast (outside of districts)	350	0	0	0	0	17	0	7,368	0	0	0	0		**7,736**	
Goleta W.D.	359	0	0	0	0	0	398	11,542	0	0	0	0		**12,301**	
City of Santa Barbara W.S.A.	0	0	0	0	0	0	7	149	0	0	0	0		**155**	
Montecito W.D.	25	0	4	0	0	0	35	1,132	0	0	0	0		**1,196**	
Carpinteria Valley W.D.	397	2	8	0	0	0	1,296	4,882	0	0	0	0		**6,586**	
DAU 75 Applied Water for Irrigation (AF)	**1,131**	**2**	**13**	**0**	**0**	**17**	**1,736**	**25,074**	**0**	**0**	**0**	**0**		**27,974**	27,974
Cuyama Crop Categories from 2008 Study	**Rotational**	**Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**			
SB and SLO Acres in Main Area (2008 Report)	4,000	6,000	220	3,000	0	5,000	0	1,000	0	0	0	0	**19,220**		
Cuyama Valley, SB Co away from Main Area	0	0	684	0	0	108	0	0	0	0	18	0	**810**		
DAU 76 - Cuyama (Acres)	**4,000**	**6,000**	**904**	**3,000**	**0**	**5,108**	**0**	**1,000**	**0**	**0**	**18**	**0**	**20,030**		
Cuyama 2008 Study (AF/A) Main Area	**2.80**	**3.00**	**2.80**	**5.00**		**1.50**		**3.80**							
SMVMA 2006-2010 Average (AF/A)	**2.27**	**1.38**	**1.08**	**3.46**		**0.30**	**2.02**	**2.64**							
SB and SLO Acres in Main Area (2008 Report)	11,200	18,000	616	15,000	0	7,500	0	3,800	0	0	0	0		**56,116**	
Cuyama Valley, SB Co away from Main Area	0.00	0	739	0	0	32	0	0	0	0	0	0		**771**	
DAU 76 SB and SLO Applied Water for Irrigation (AF)	**11,200**	**18,000**	**1,355**	**15,000**	**0**	**7,532**	**0**	**3,800**	**0**	**0**	**0**	**0**		**56,887**	56,887
TOTAL Irrigated Acres; SB and SLO Acres													**150,544**		
Irrigated Applied Water (AF) in SB and SLO Areas													**1.8**	**268,482**	

Appendix F-6 Estimate of Return Flow based on Weighted Average of DU **[Santa Barbara County Irrigated Acres Only - Does include irrigated acres in SLO County]**

DAU No. - NAME	Rotational	Strawberry	Vineyard	Alfalfa	Turf/Sod	Grain	Nursery	Orchard	Rangeland	Landscape	Fallow	Unidentified	(Acres)	Weighted Ave DU (Percent)	Return Flow (Percent)	
SMVMA (L&S Boundary) (2006-2010 average)	35,184	8,893	4,660	0	0	642	228	35	379	0	849	0				
SM Exceptions (Outside L&S Boundary, in SB CO DAU)	1,284	0	843	0	0	360	0	0	731	0	0	0				
DAU 71 - Santa Maria Valley-SB and SLO (Acres)	**36,468**	**8,893**	**5,503**	**0**		**1,002**		**35**					**51,901**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
SMVMA (L&S Boundary) (2006-2010 average)	28,147	7,559	4,427	0	0	514	0	30	0	0	0	0				
SM Exceptions (Outside L&S Boundary, in SB CO DAU)	1,027	0	801	0	0	288	0	0	0	0	0	0				
DAU 71 SB and SLO (Acres * DU) (weighted average)	**29,174**	**7,559**	**5,228**	**0**		**802**		**30**					**42,793**	**82%**	**18%**	**17,874**
San Antonio	9,943	364	8,874	0	0	152	187	2	2,194	0	101	316				
Santa Ynez River W.C.D.	36	0	0	0	0	0	0	0	0	0	0	0				
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	16				
DAU 73 - San Antonio (Acres)	**9,979**	**364**	**8,874**	**0**		**152**		**2**					**19,371**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
San Antonio	7,954	309	8,430	0	0	122	0	2	0	0	0	0				
Santa Ynez River W.C.D.	29	0	0	0	0	0	0	0	0	0	0	0				
Los Alamos C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0				
DAU 73 Estimated (Acres * DU)	**7,983**	**309**	**8,430**	**0**		**122**		**2**					**16,846**	**87%**	**13%**	**6,335**
Santa Ynez (outside of districts)	1,570	0	1,983	374	26	294	7	61	10,564	155	33	320				
Santa Ynez River W.C.D.	13,142	36	4,380	111	116	437	811	566	3,641	445	367	196				
Santa Ynez R.W.C.D.Imp.Dist.#1	350	0	637	60	109	20	6	80	71	57	67	0				
City of Lompoc	473	0	0	0	0	69	10	0	0	0	0	0				
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	11	0				
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	110	0	0				
City of Buellton	11	0	0	0	0	0	0	0	0	21	0	0				
City of Solvang W.S.A.	0	0	0	0	3	0	0	6	1	168	44	0				
DAU 74 - Santa Ynez (Acres)	**15,547**	**36**	**6,999**	**545**		**819**		**714**					**24,660**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
Santa Ynez (outside of districts)	1,256	0	1,884	299	0	235	0	52	0	0	0	0				
Santa Ynez River W.C.D.	10,514	30	4,161	89	0	349	0	481	0	0	0	0				
Santa Ynez R.W.C.D.Imp.Dist.#1	280	0	605	48	0	16	0	68	0	0	0	0				
City of Lompoc	379	0	0	0	0	55	0	0	0	0	0	0				
Mission Hills C.S.D.	1	0	0	0	0	0	0	0	0	0	0	0				
Vandenberg Village C.S.D.	0	0	0	0	0	0	0	0	0	0	0	0				
City of Buellton	9	0	0	0	0	0	0	0	0	0	0	0				
City of Solvang W.S.A.	0	0	0	0	0	0	0	5	0	0	0	0				
DAU 74 Estimated (Acres * DU)	**12,438**	**30**	**6,649**	**436**		**656**		**607**					**20,816**	**84%**	**16%**	**4,361**
South Coast (outside of districts)	154	0	0	0	0	58	0	2,791	340	0	3	0				
Goleta W.D.	158	0	0	0	0	0	197	4,372	0	310	133	11				
City of Santa Barbara W.S.A.	0	0	0	0	0	0	3	56	0	205	1	0				
Montecito W.D.	11	0	3	0	0	0	17	429	0	206	0	0				
Carpinteria Valley W.D.	175	2	8	0	9	0	642	1,849	0	16	42	17				
DAU 75 - South Coast (Acres)	**498**	**2**	**12**	**0**		**58**		**9,498**					**10,067**			
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**								
South Coast (outside of districts)	124	0	0	0	0	46	0	2,372	0	0	0	0				
Goleta W.D.	127	0	0	0	0	0	0	3,716	0	0	0	0				
City of Santa Barbara W.S.A.	0	0	0	0	0	0	0	48	0	0	0	0				
Montecito W.D.	9	0	3	0	0	0	0	365	0	0	0	0				
Carpinteria Valley W.D.	140	1	7	0	0	0	0	1,572	0	0	0	0				
DAU 75 Estimated (Acres * DU)	**399**	**1**	**11**	**0**		**46**		**8,073**					**8,530**	**85%**	**15%**	**8,684**

Cuyama Crop Categories from 2008 Study	**Rotational**	**Strawberry & Carrots**	**Vineyard**	**Alfalfa**	**Turf/Sod**	**Grain**	**Nursery**	**Orchard**	**Rangeland**	**Landscape**	**Fallow**	**Unidentified**			
DAU 76 - Cuyama Valley-SB (Acres)	**4,000**	**6,000**	**904**	**3,000**		**5,108**		**1,000**					**20,012**		
SMVMA 2006-2010 Average (DU)	**80%**	**85%**	**95%**	**80%**		**80%**		**85%**							
DAU 76 SB Only Estimated (Acres * DU)	**3,200**	**5,100**	**859**	**2,400**		**4,086**		**850**					**16,495**	**82%**	**18%**

Table F-7 Applied Crop Water Requirements Unit Calculation, Average for 2006-2010, Santa Maria Valley Management Area - Basis for Climate Zone 3

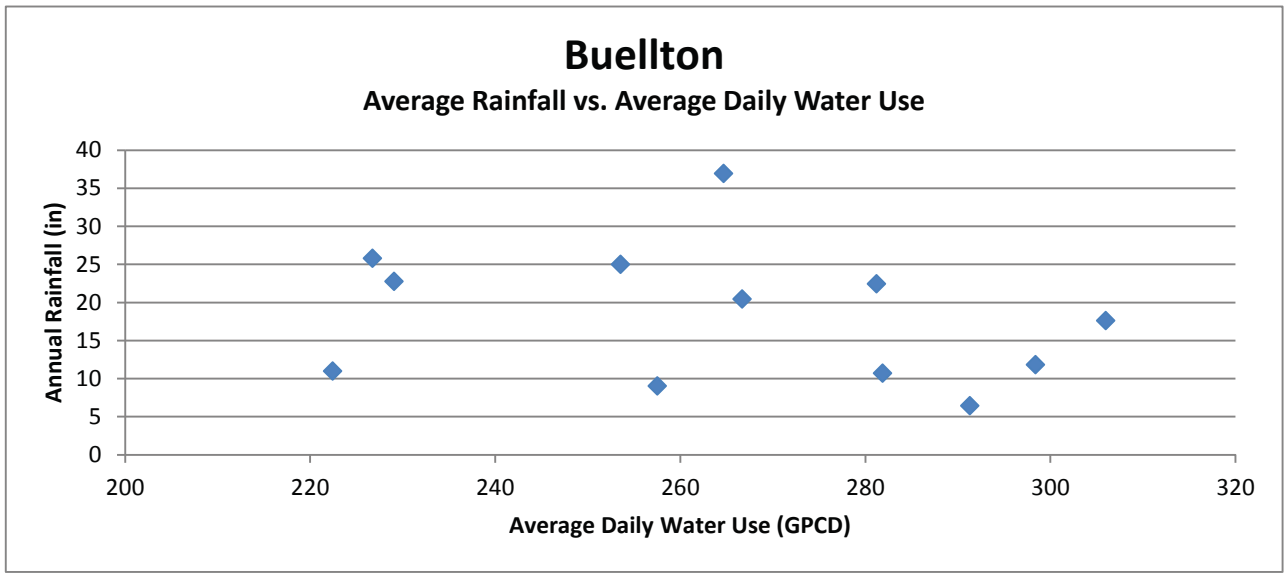
Crop Category	DU (Percent)	2006 (AF/A)	2007 (AF/A)	2008 (AF/A)	2009 (AF/A)	2010 (AF/A)	Avg 2006-2010 (AF/A)
Rotational Veg	80	1.88	2.52	2.7	2.19	2.06	2.27
Stawberries	85	0.88	1.57	1.66	1.49	1.28	1.38
Vineyard	95	0.9	1.3	1.3	1.3	0.6	1.08
Alfalfa	80	3.27	4.38	2.25	4.00	3.41	3.46
Grain	80	0	0.8	0.3	0.4	0	0.30
Nursery		2.0	2.0	2.1	2.0	2.0	2.02
Deciduous	85	2.5	3.1	2.7	2.8	2.1	2.64
Avocado	85	2.8	3.1	2.9	2.9	2.6	2.86
Fallow		0	0	0	0	0	0.00

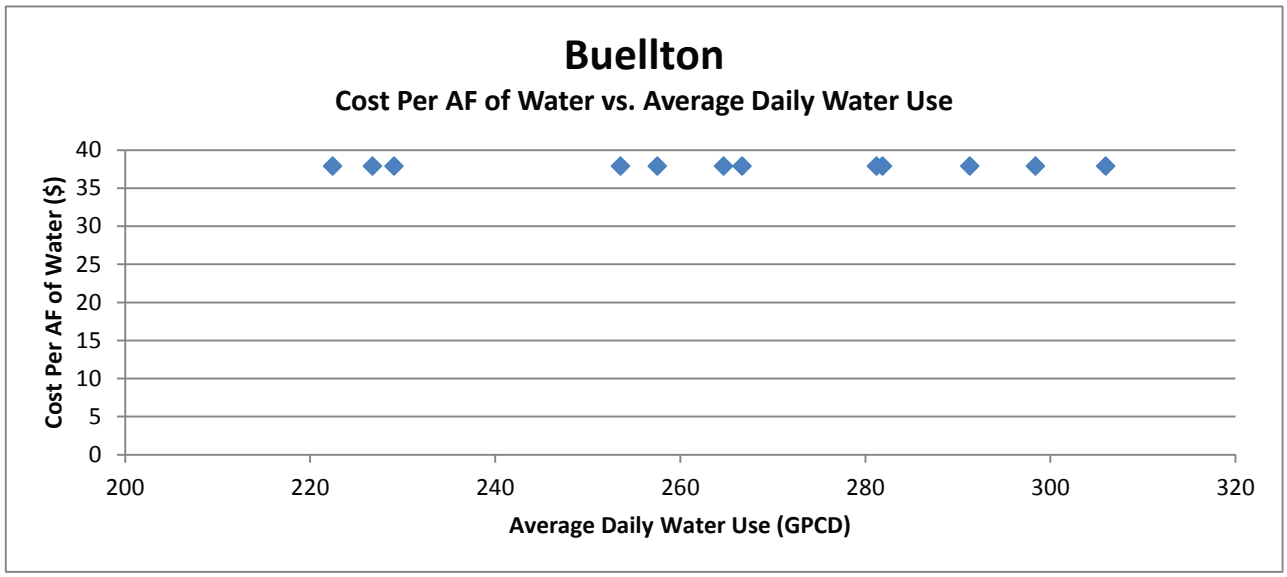
Table F-8 Applied Crop Water Requirements Unit Calculation, Average for 2008, for Cuyama Valley

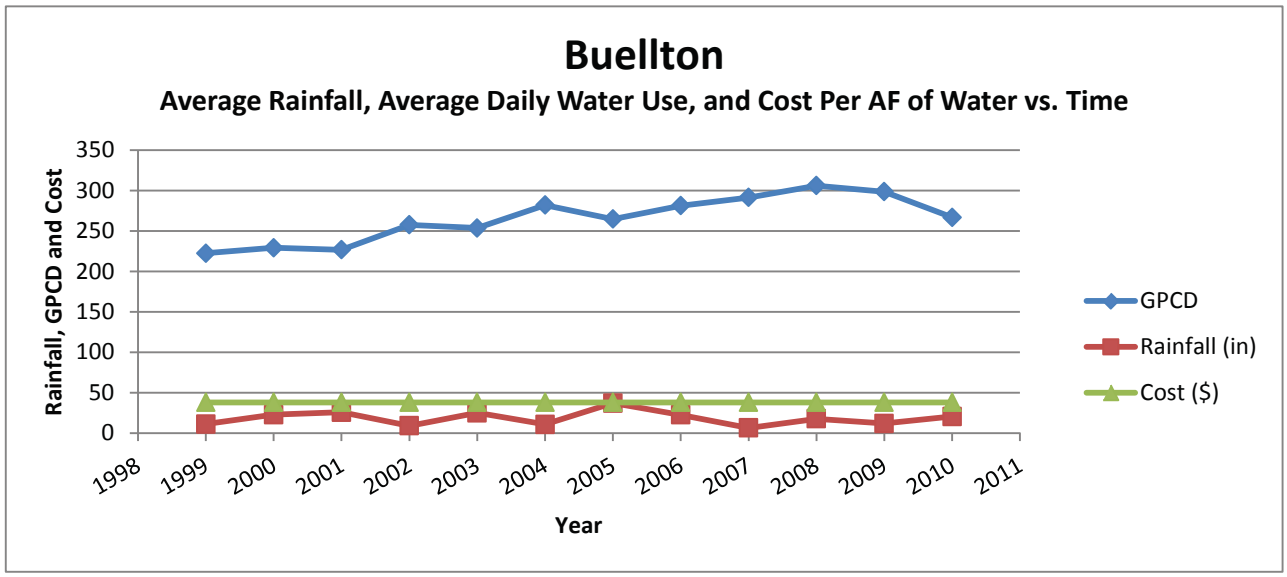
Cuyama Valley		On-line Study			
Crop Category	2008 Report (AF/A) 2008	Away from Main Area Acres 2010	SB & SLO (Acres) 2008	(AF/A)	SB & SLO (Acre-feet) 2008
Rotational Veg	2.8		4,000		11,200
Carrots (Cuyama)	3.0		6,000		18,000
Vineyard	2.8	684	220		616
Pasture/Alf	5.0		3,000		15,000
Grain	1.5	108	5,000		7,500
Orchard (Deciduous, Citrus, and Avacado)	3.8		600		2,280
Pistachios	3.3		400		1,320
Fallow	0	18			
		810	19,220		55,916
				2.9	
			All areas ~ to this…		56,700

Appendix G

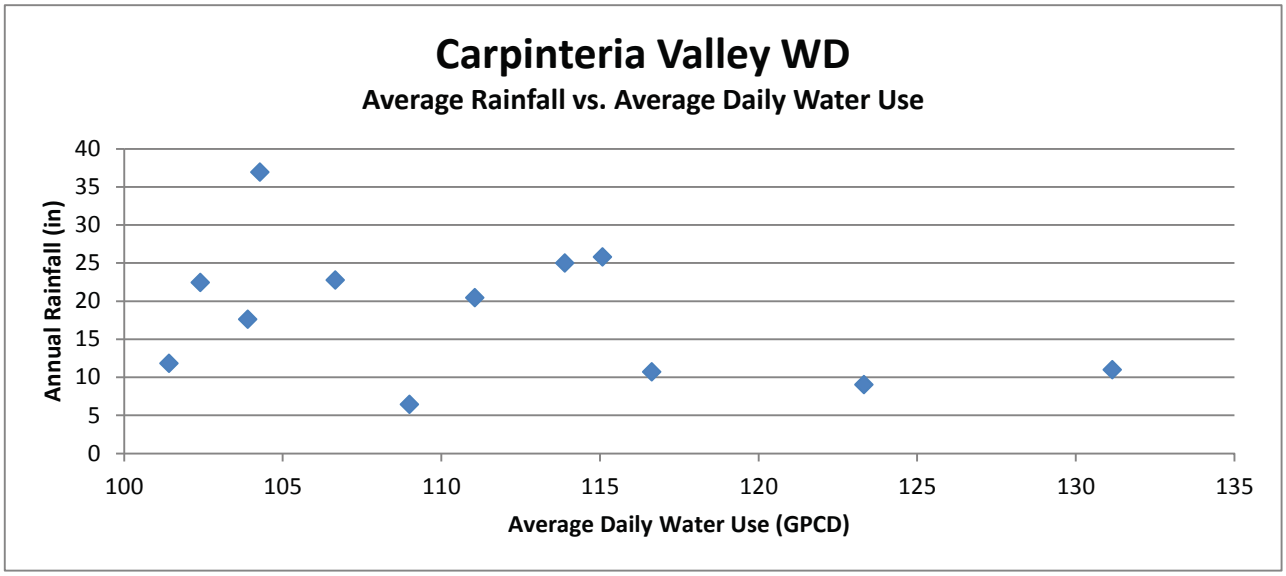
Correlation of Per-capita Water Use with Price and Rainfall

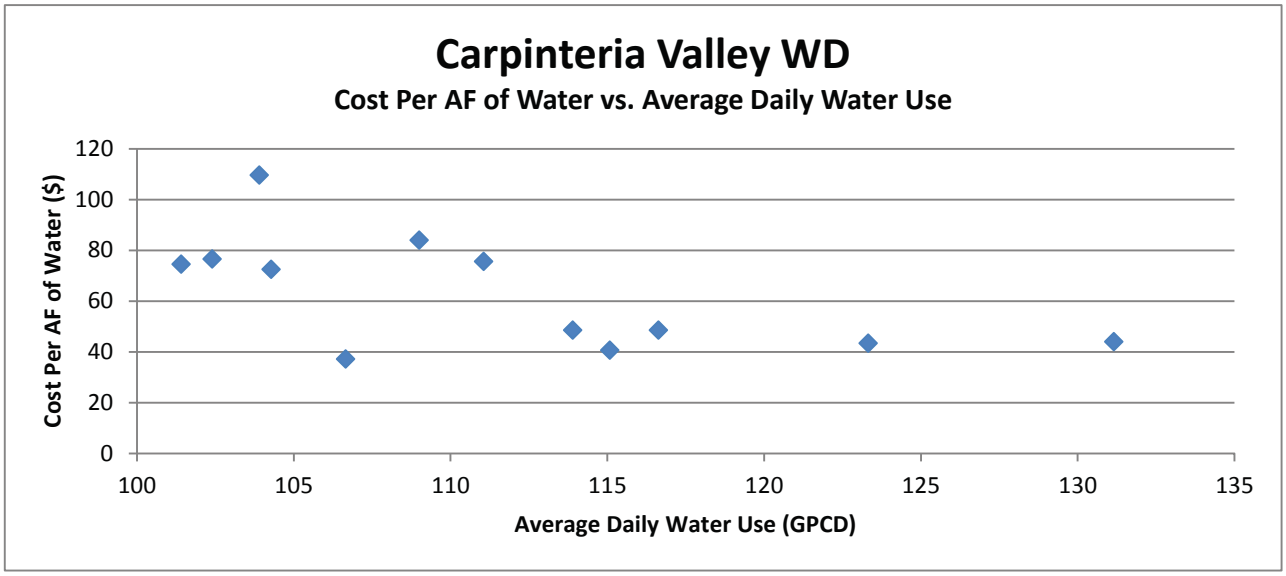


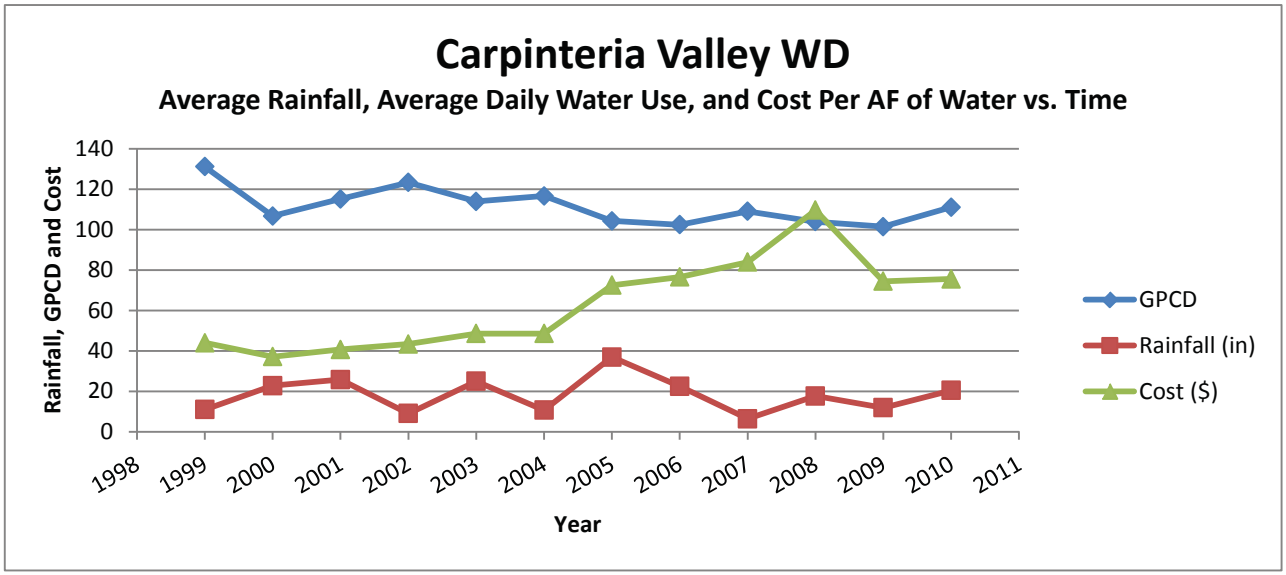




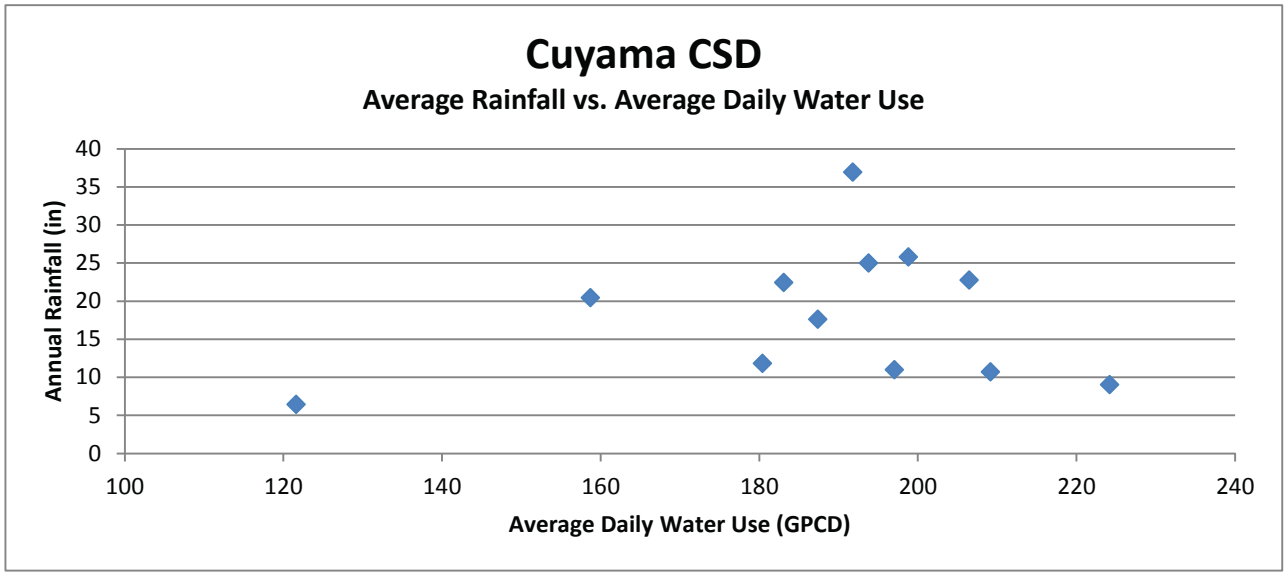
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-1

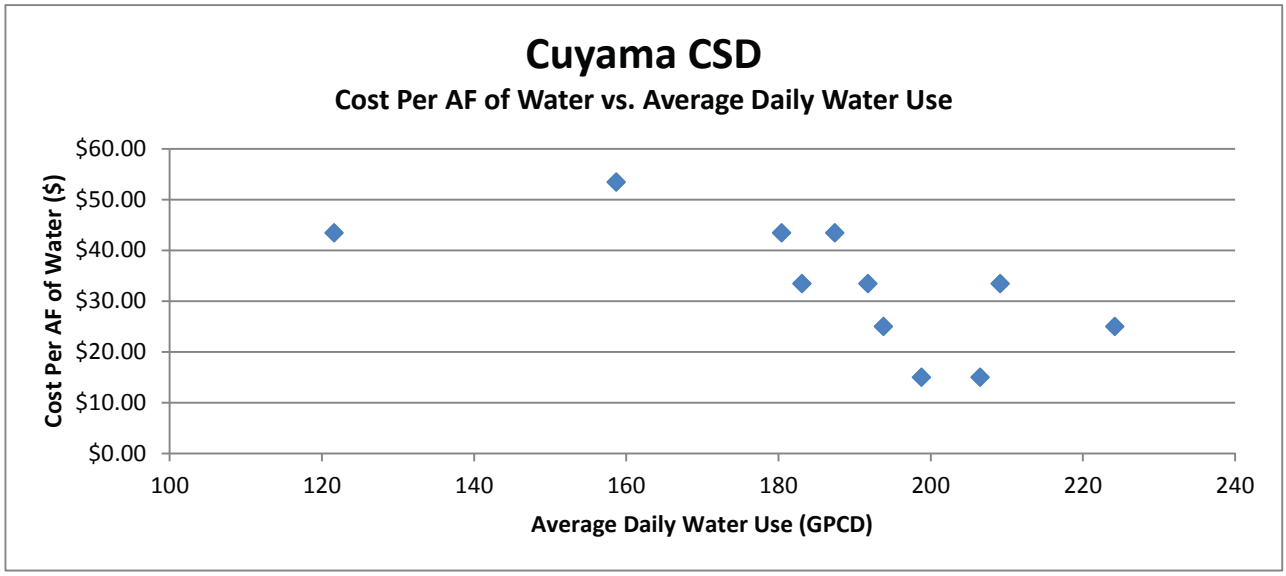


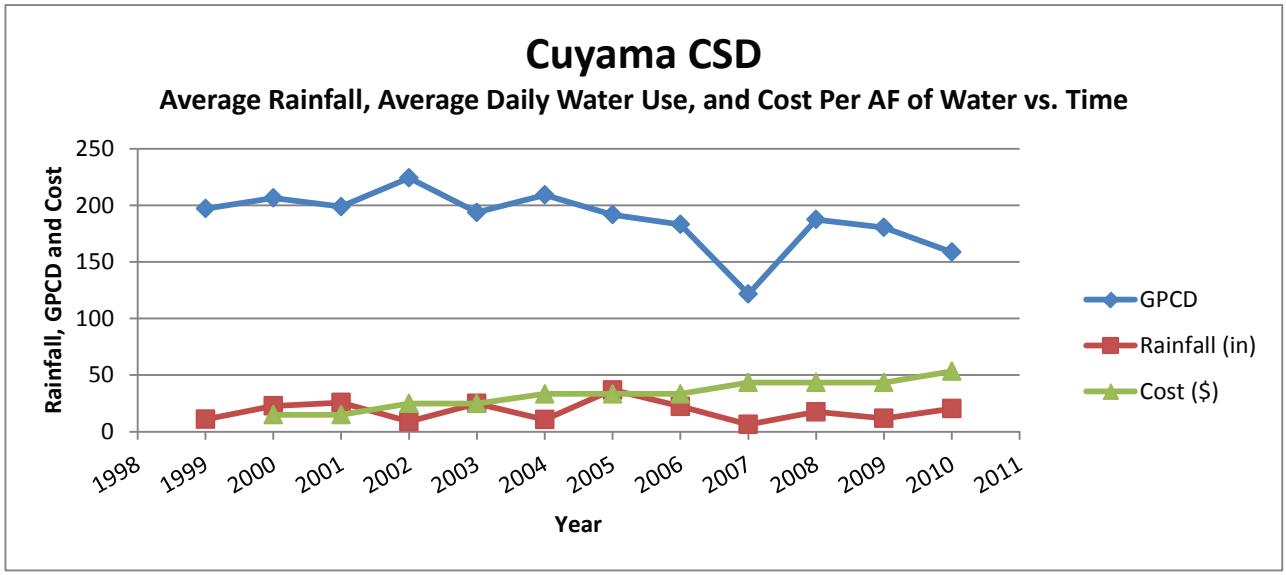


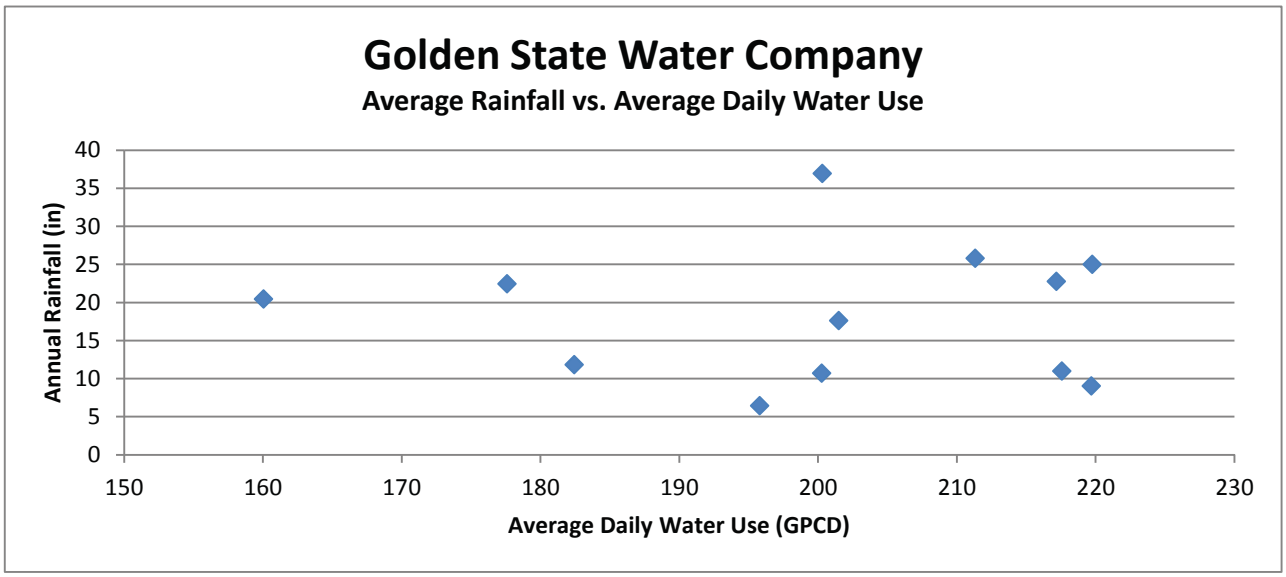


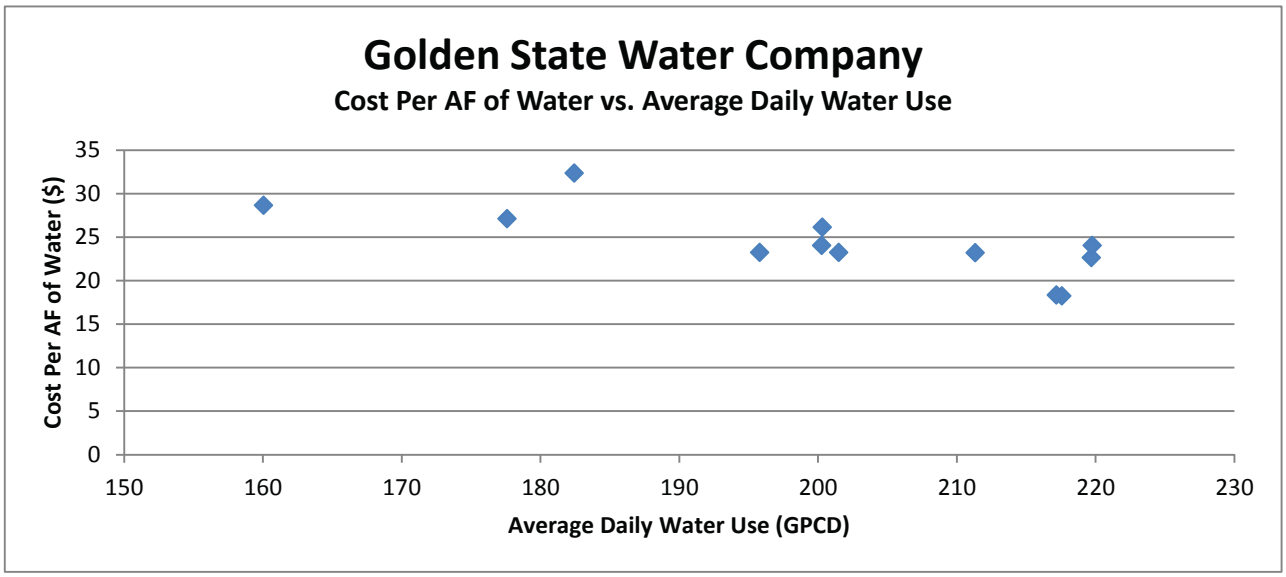
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-2

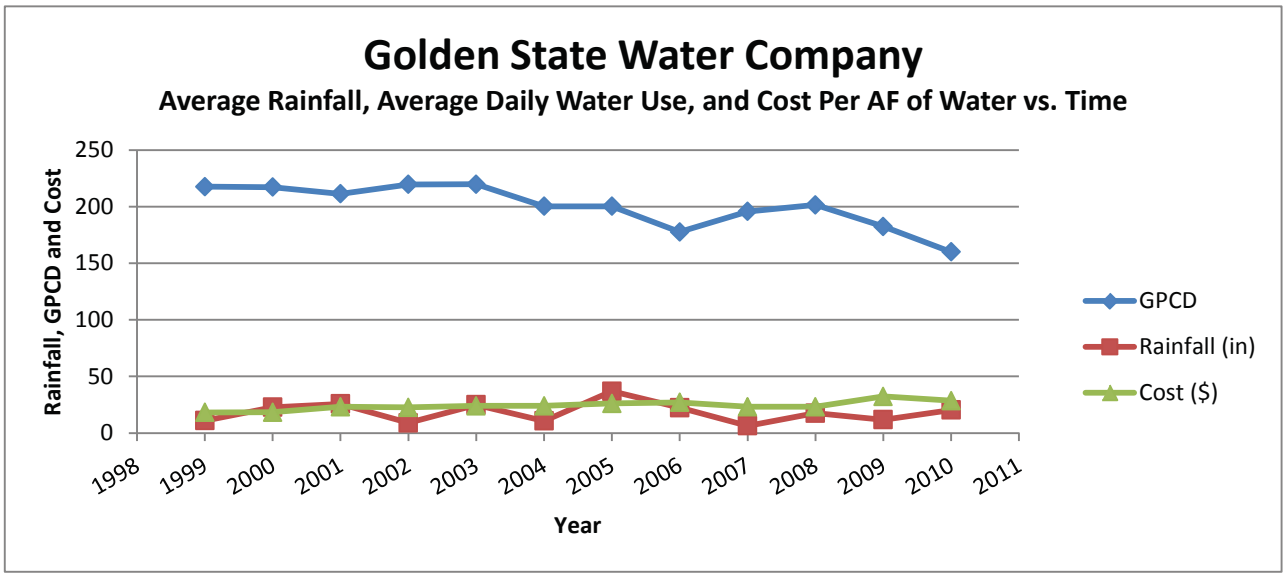

Cuyama CSD
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
0
5
10
15
20
25
30
35
40
100
120
140
160
180
200
220
240
Average Daily Water Use (GPCD)

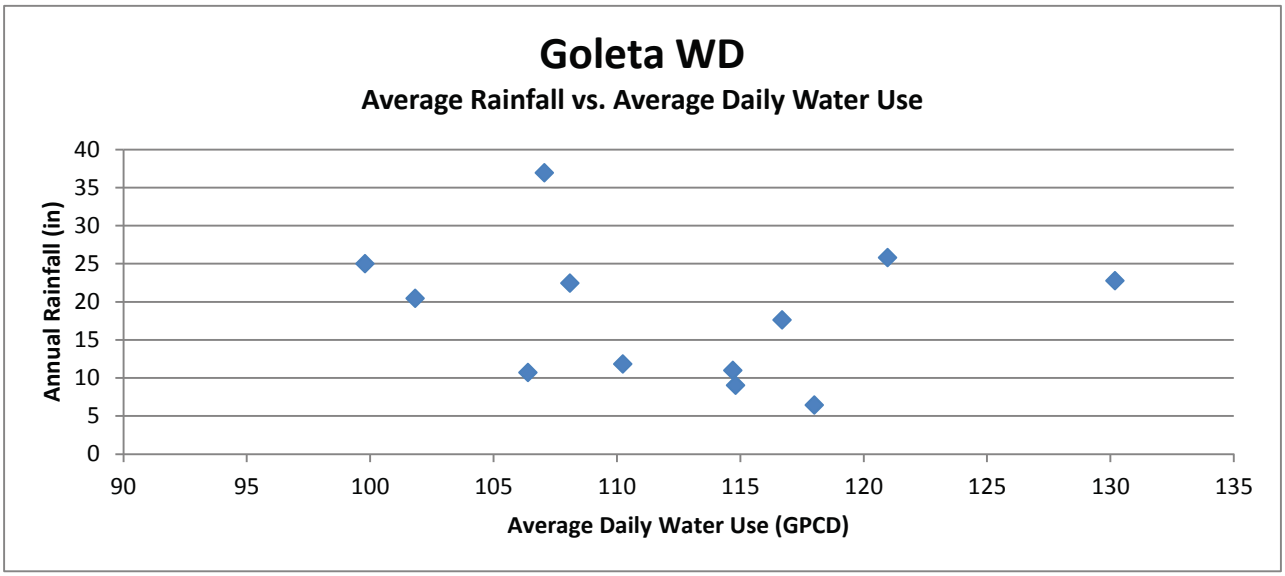

Cuyama CSD
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
$0.00
$10.00
$20.00
$30.00
$40.00
$50.00
$60.00
100
120
140
160
180
200
220
240
Average Daily Water Use (GPCD)

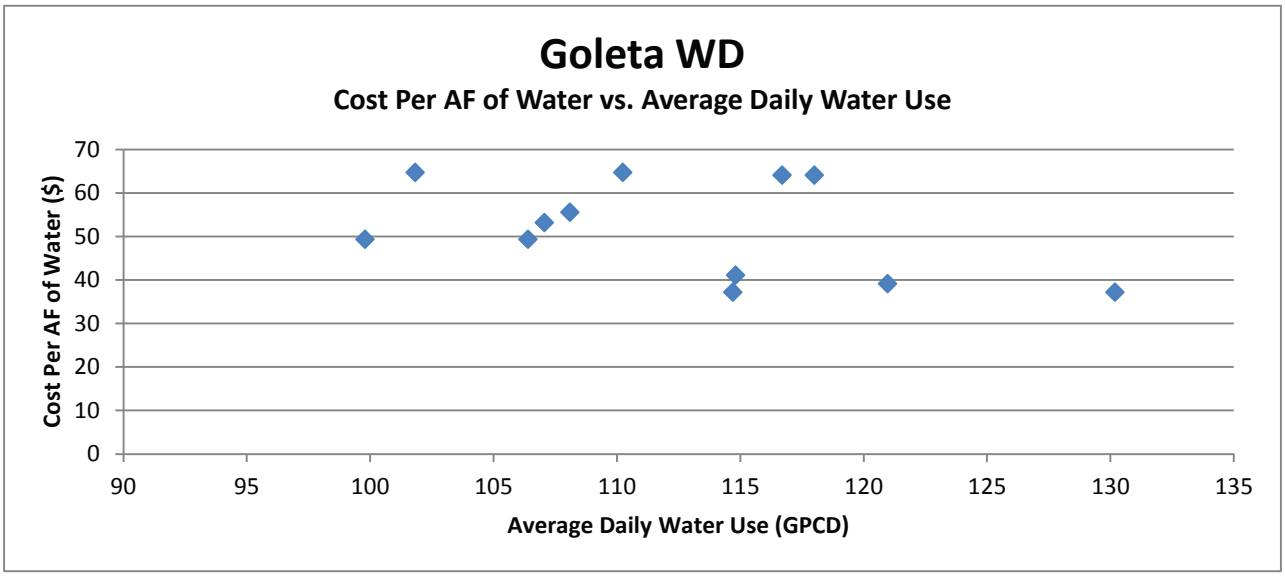

Cuyama CSD
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
0
50
100
150
200
250
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

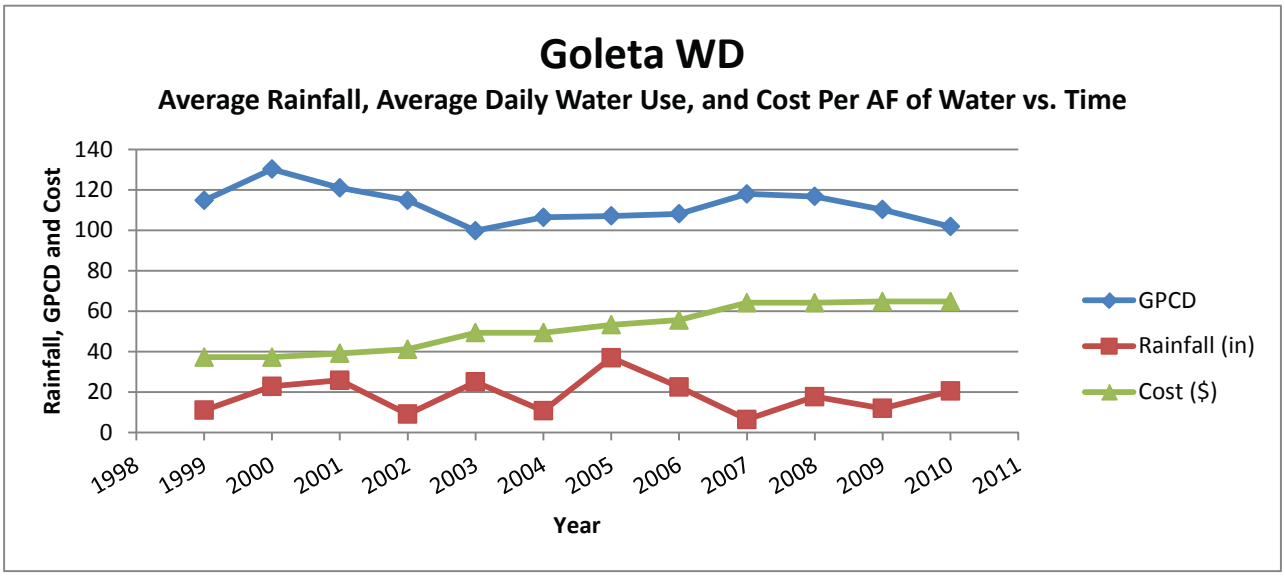

Golden State Water Company
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
0
5
10
15
20
25
30
35
40
150
160
170
180
190
200
210
220
230
Average Daily Water Use (GPCD)


Golden State Water Company
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
0
5
10
15
20
25
30
35
150
160
170
180
190
200
210
220
230
Average Daily Water Use (GPCD)

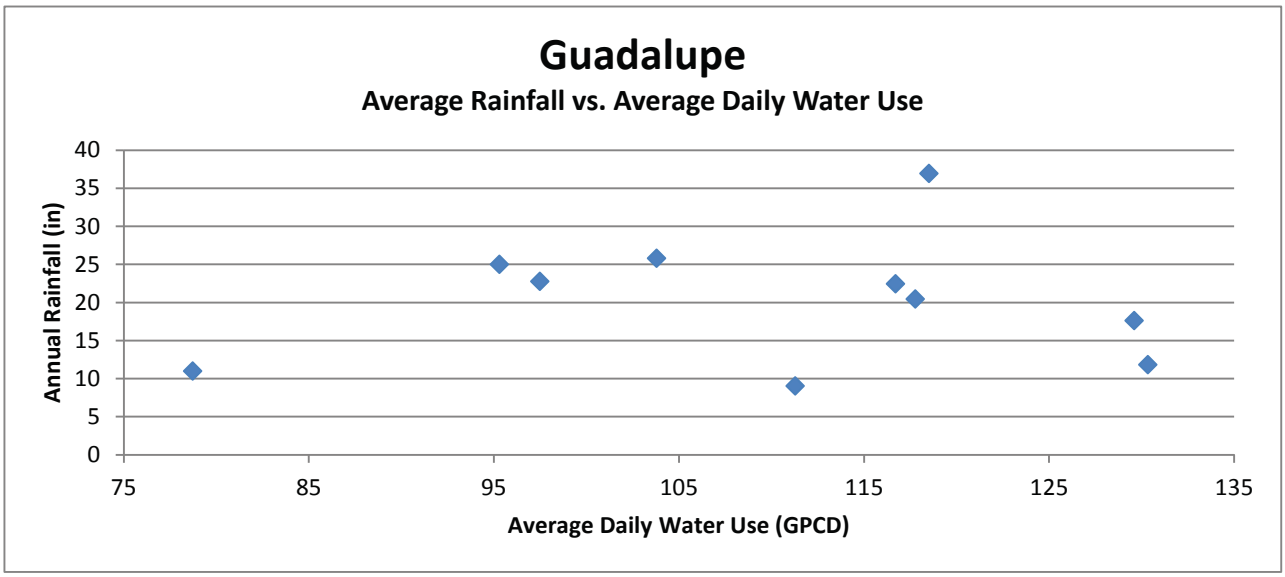

Golden State Water Company
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
0
50
100
150
200
250
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

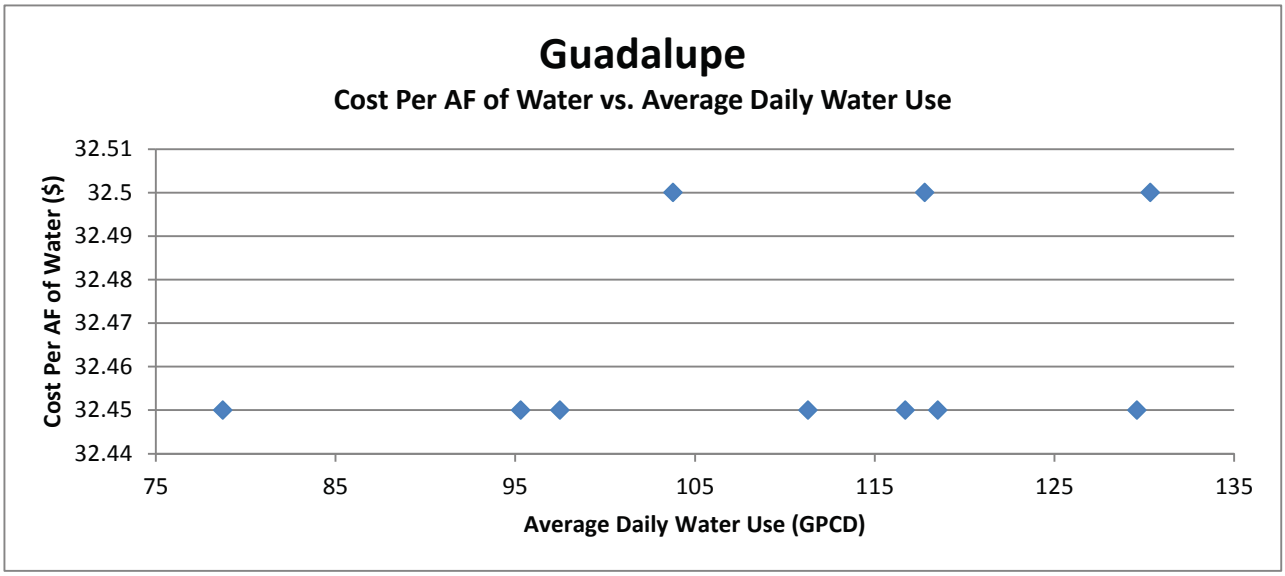


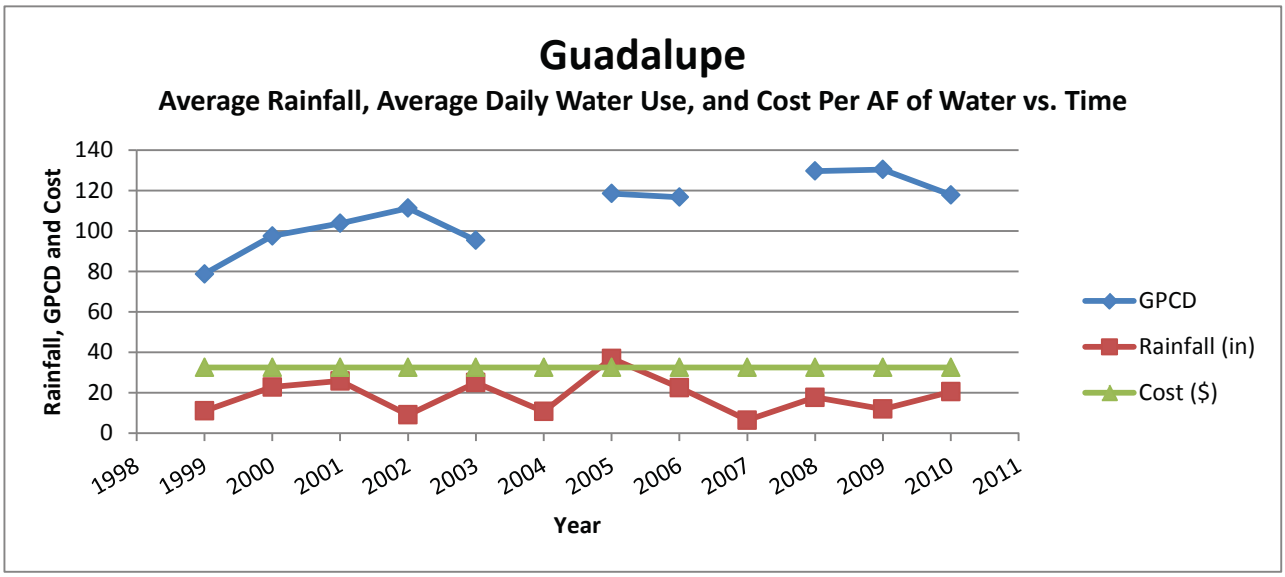




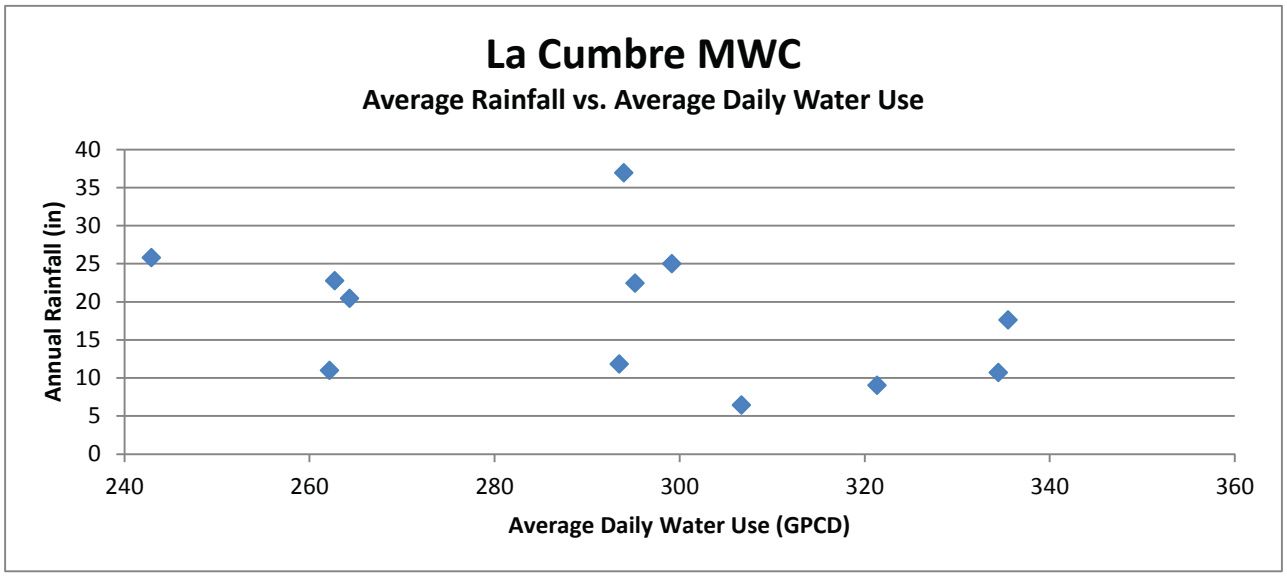
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-5

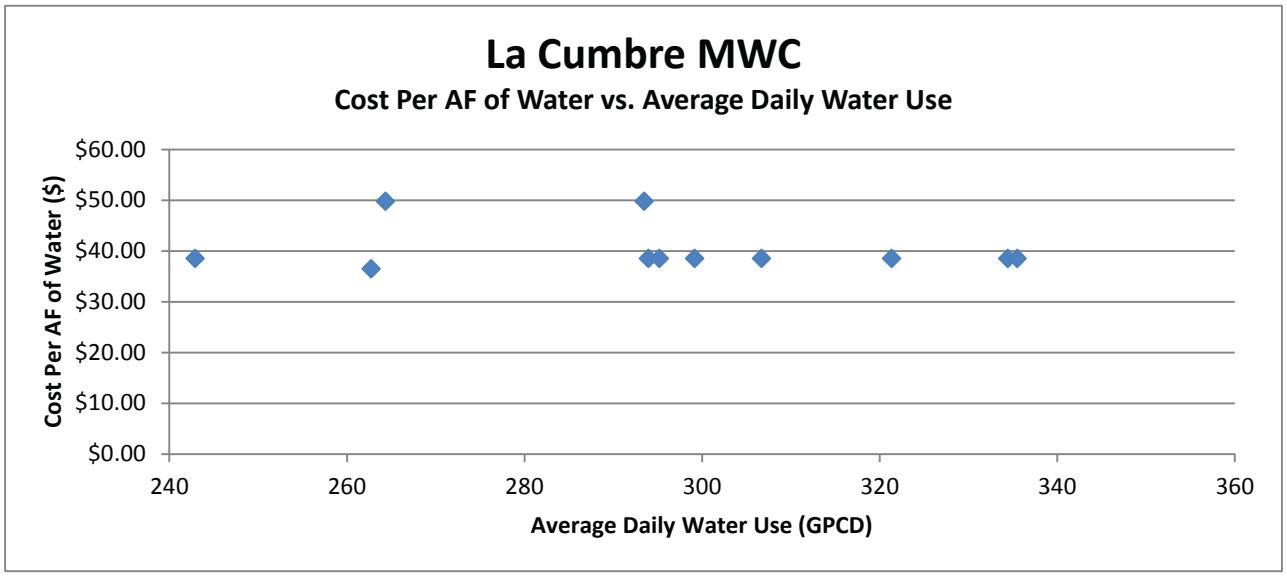


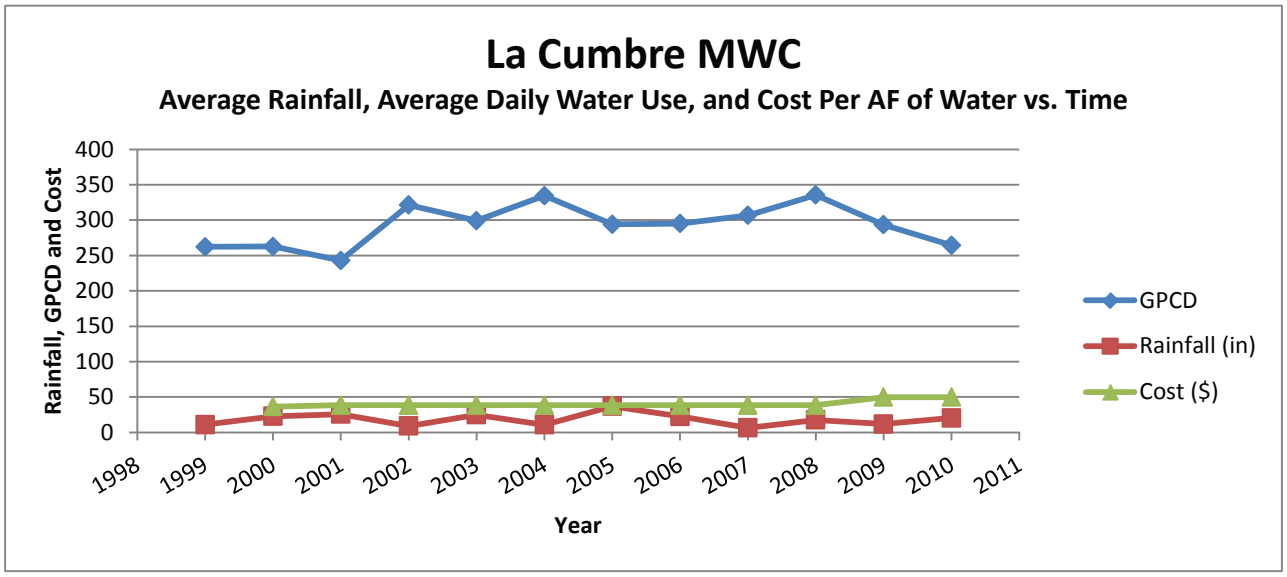


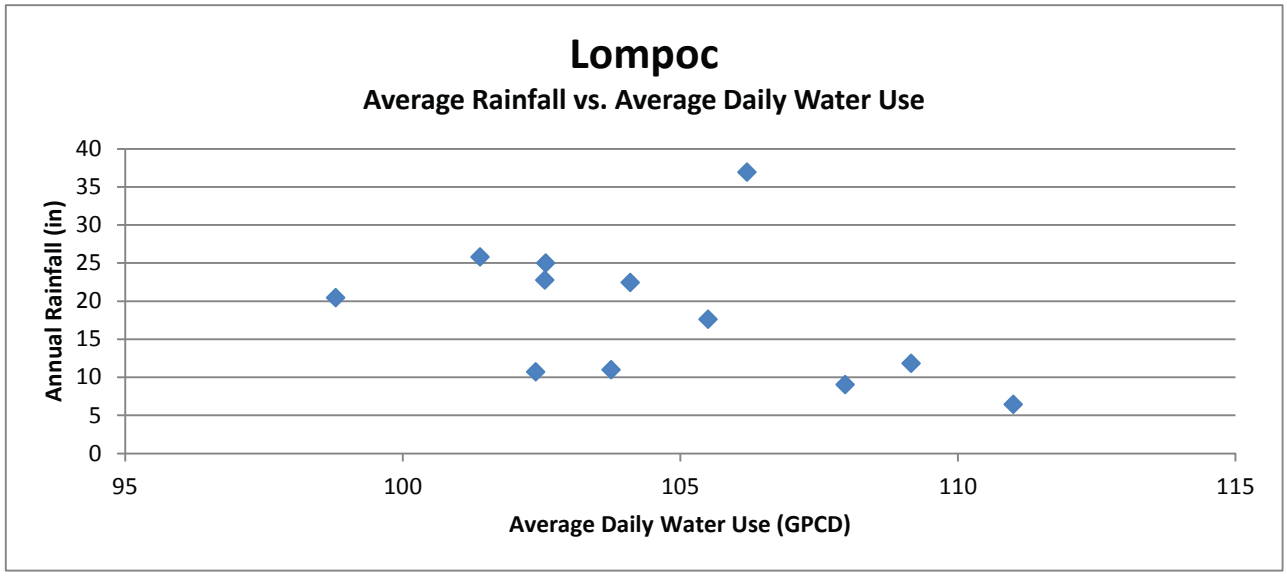


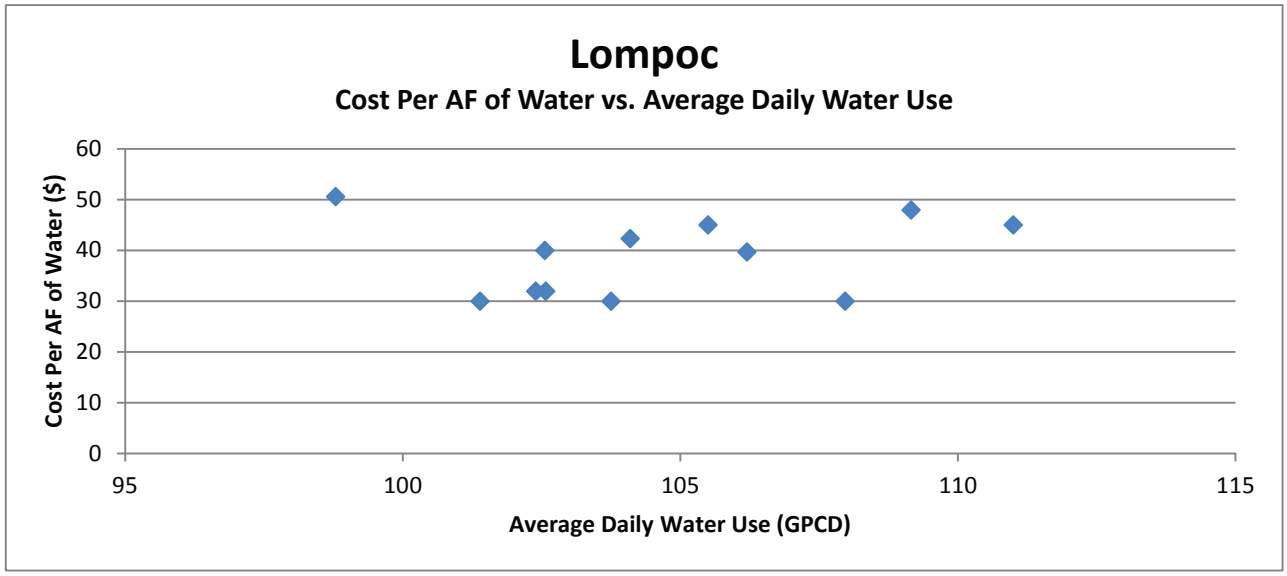
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-6

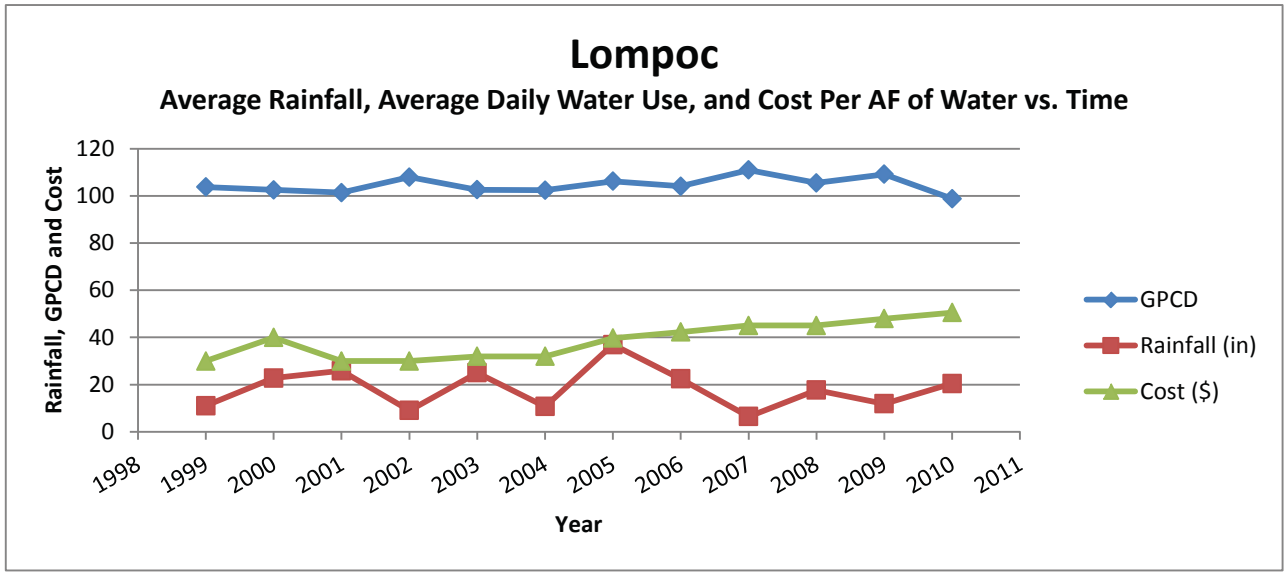

La Cumbre MWC
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
0
5
10
15
20
25
30
35
40
240
260
280
300
320
340
360
Average Daily Water Use (GPCD)

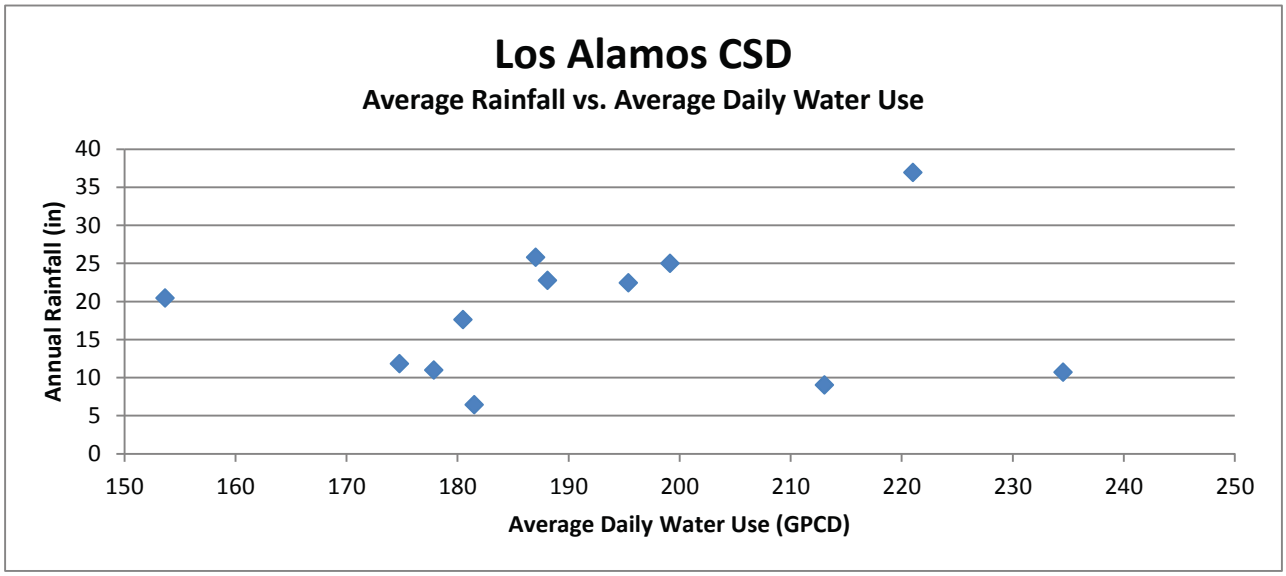

La Cumbre MWC
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
$0.00
$10.00
$20.00
$30.00
$40.00
$50.00
$60.00
240
260
280
300
320
340
360
Average Daily Water Use (GPCD)

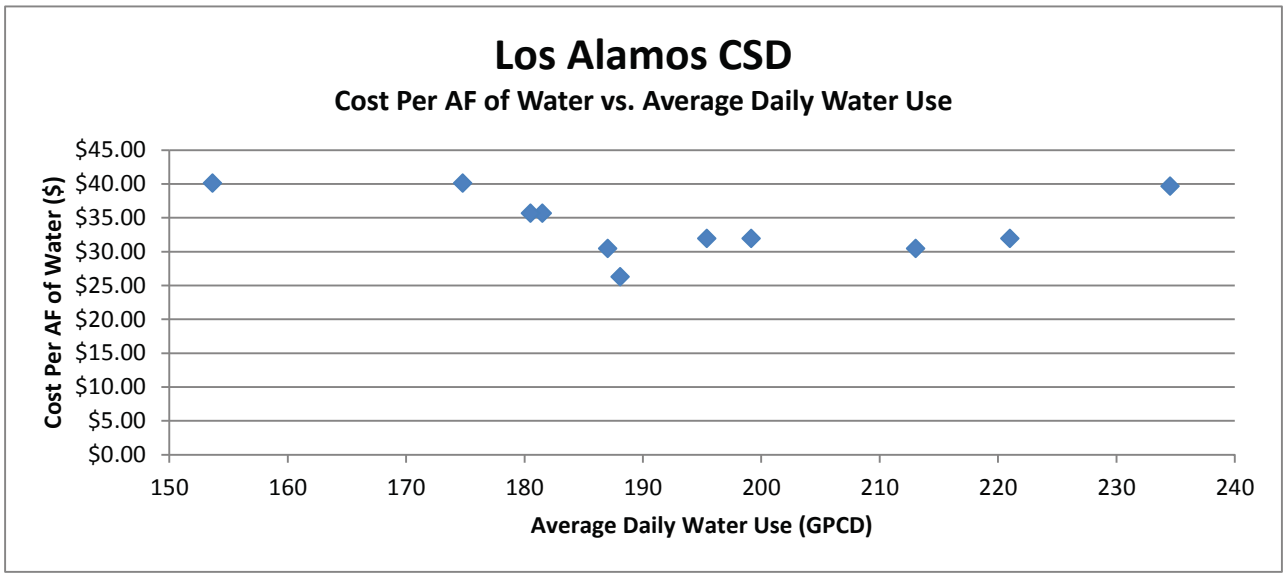

La Cumbre MWC
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
0
50
100
150
200
250
300
350
400
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

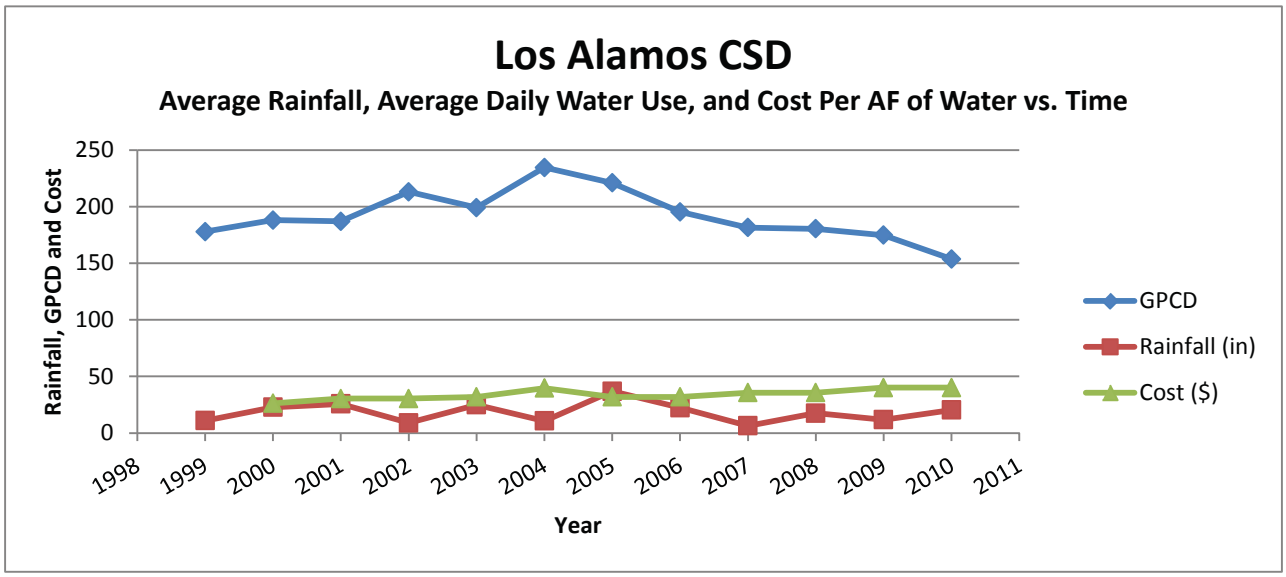

Lompoc
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
0
5
10
15
20
25
30
35
40
95
100
105
110
115
Average Daily Water Use (GPCD)

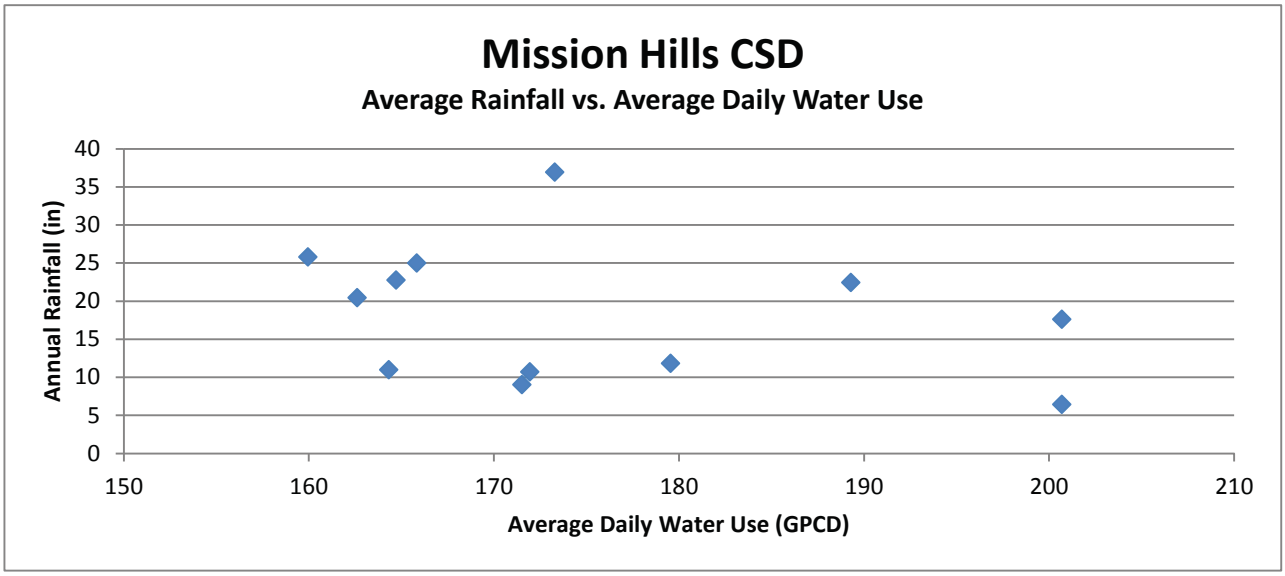

Lompoc
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
0
10
20
30
40
50
60
95
100
105
110
115
Average Daily Water Use (GPCD)

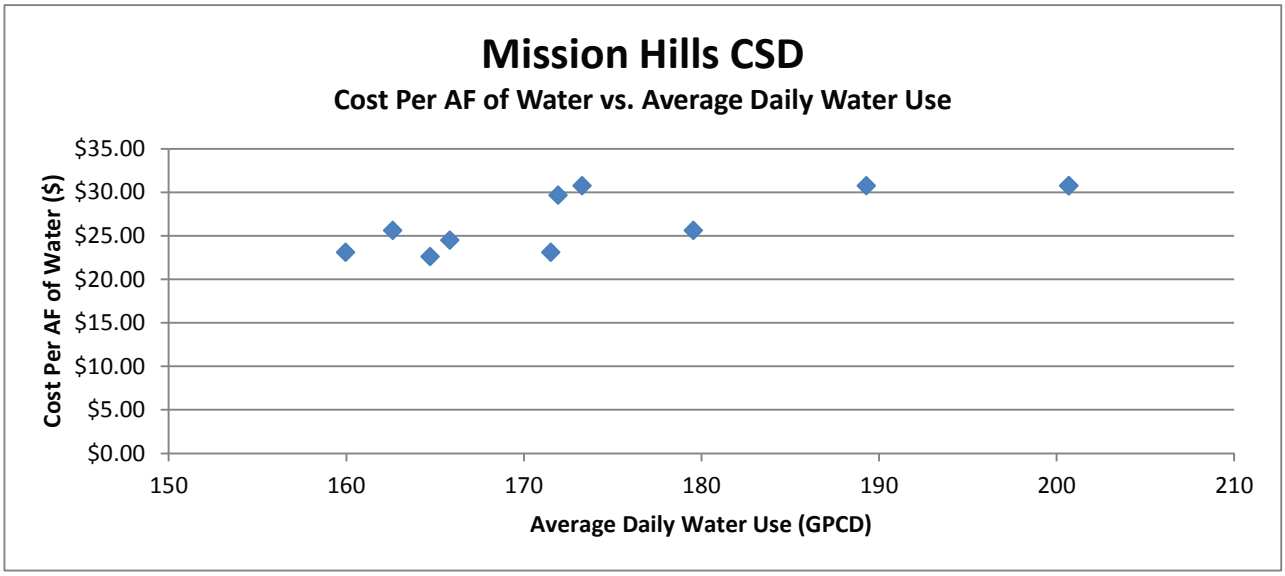

Lompoc
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
0
20
40
60
80
100
120
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

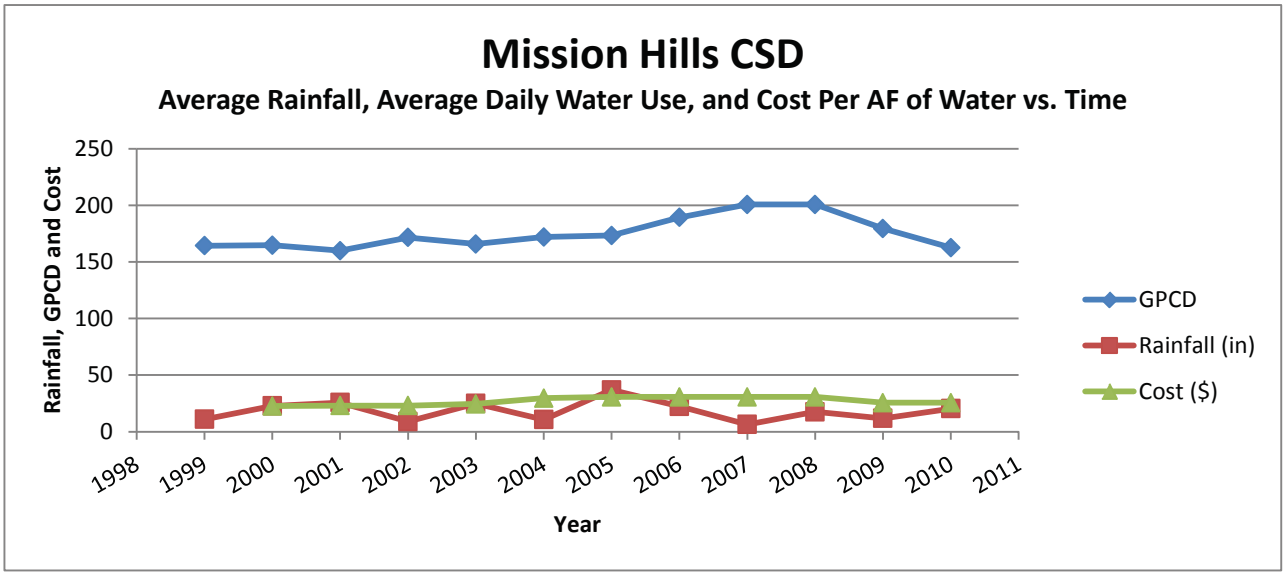

Los Alamos CSD
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
0
5
10
15
20
25
30
35
40
150
160
170
180
190
200
210
220
230
240
250
Average Daily Water Use (GPCD)


Los Alamos CSD
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
$0.00
$5.00
$10.00
$15.00
$20.00
$25.00
$30.00
$35.00
$40.00
$45.00
150
160
170
180
190
200
210
220
230
240
Average Daily Water Use (GPCD)

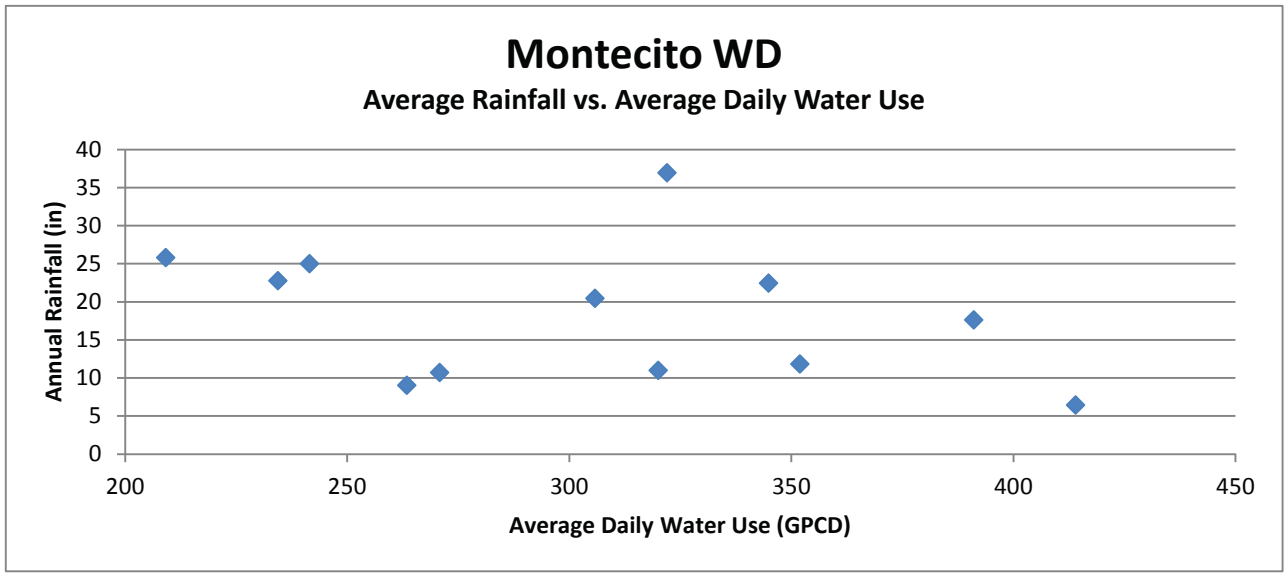

Los Alamos CSD
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
0
50
100
150
200
250
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

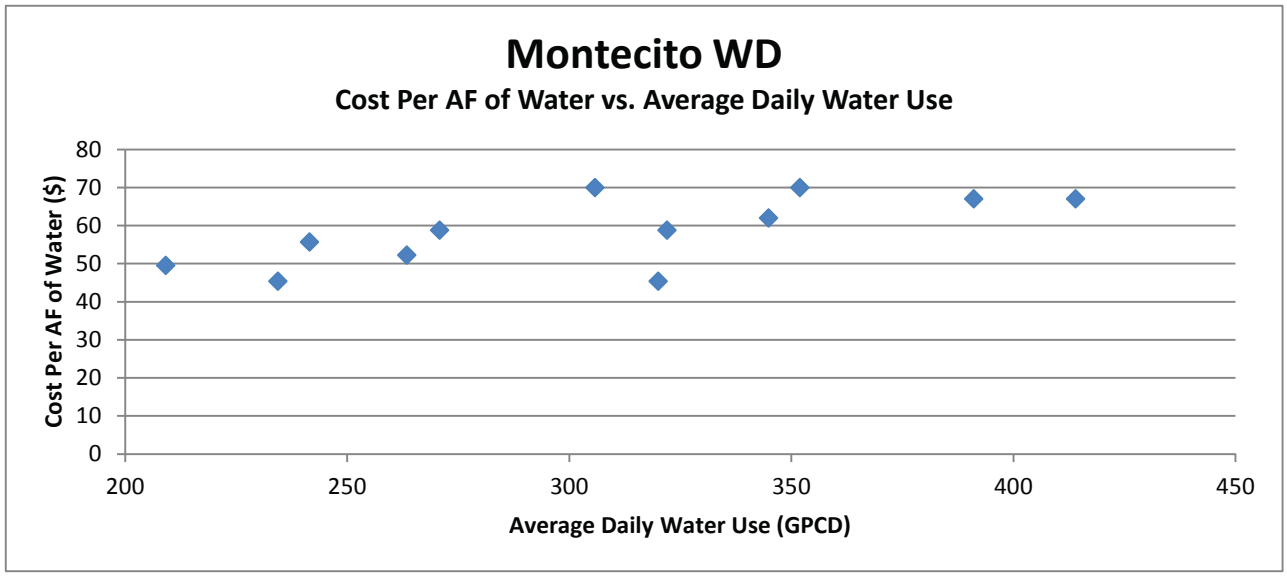


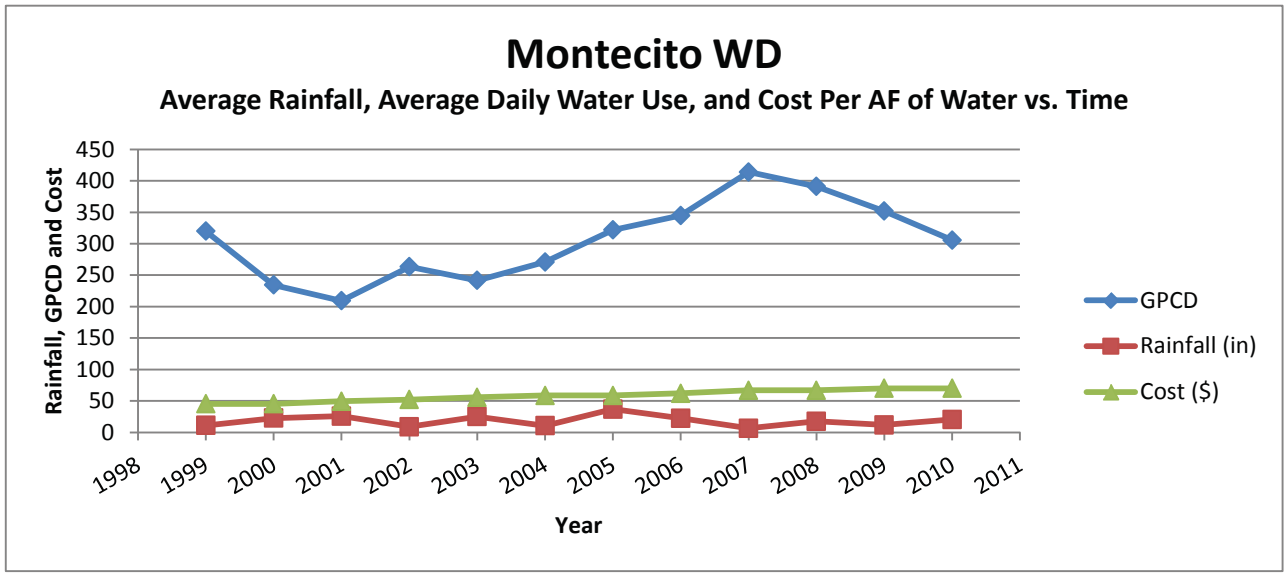




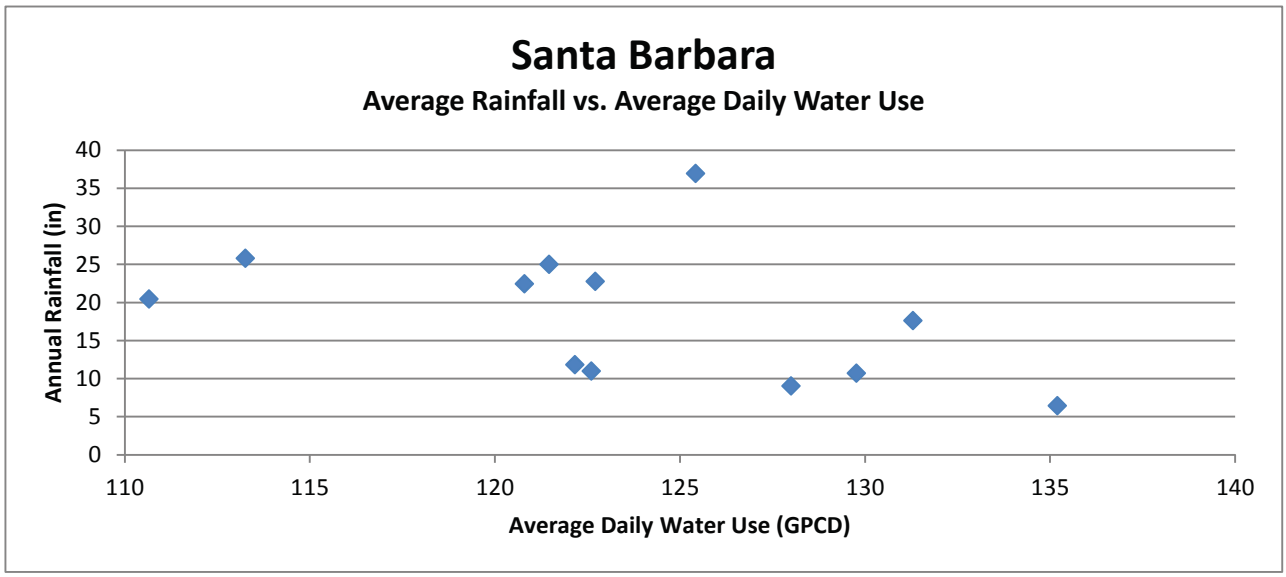
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-10

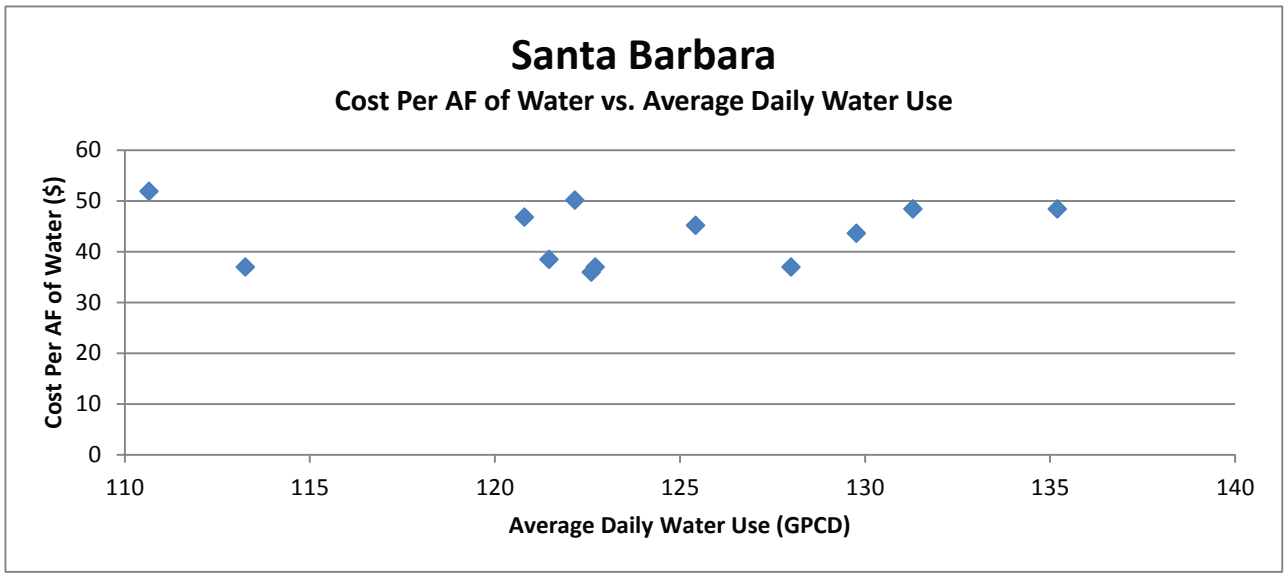


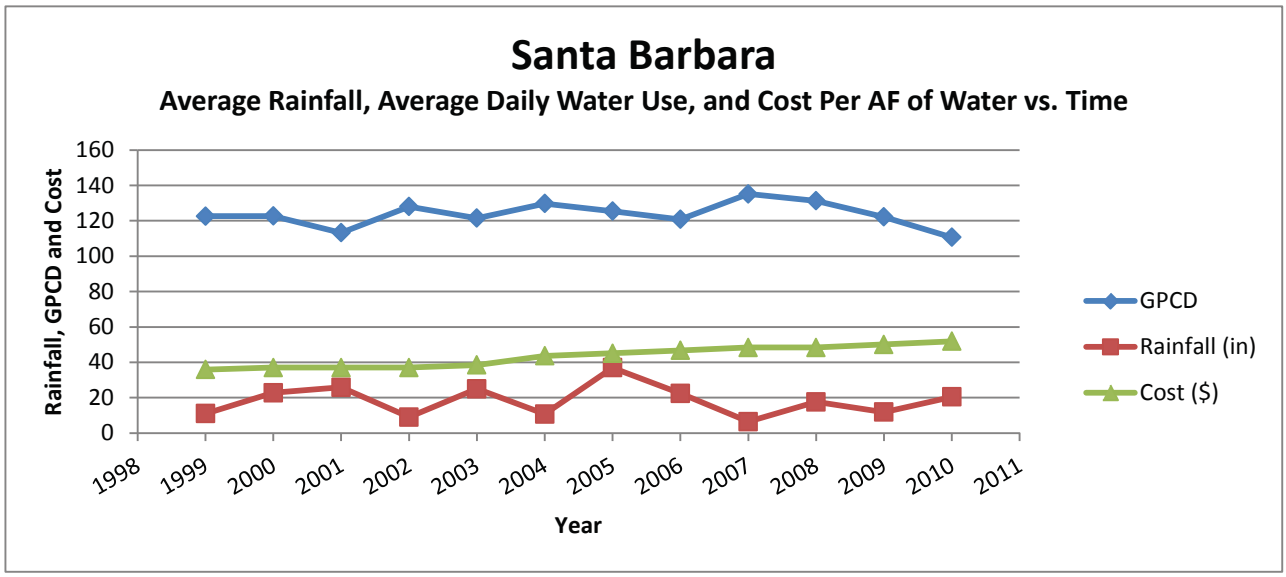




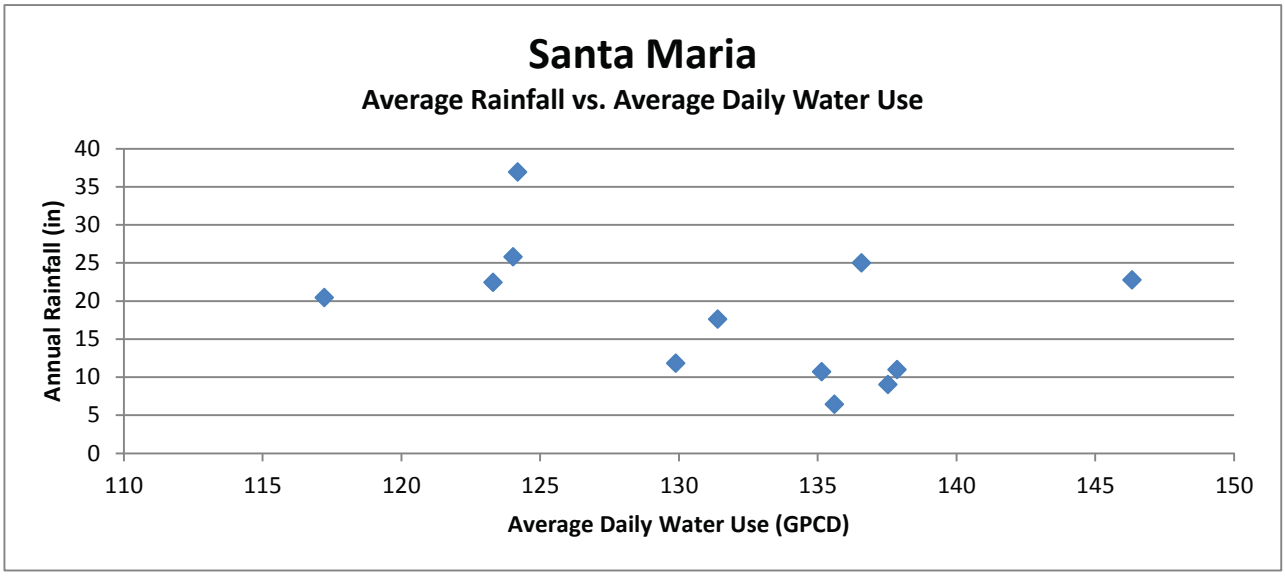
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-11

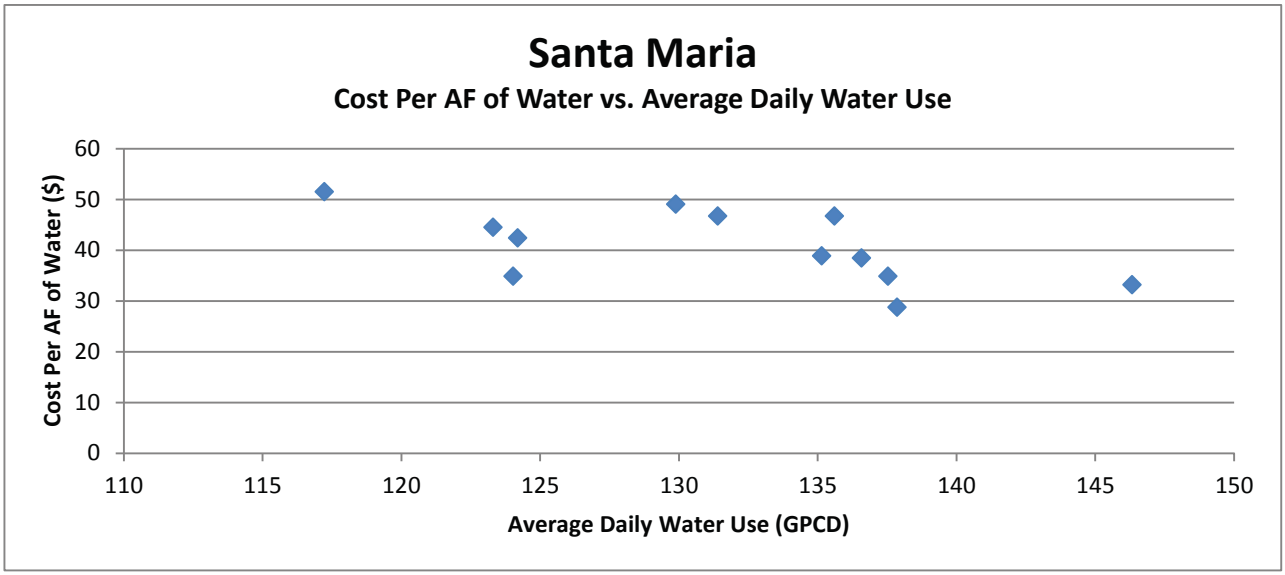


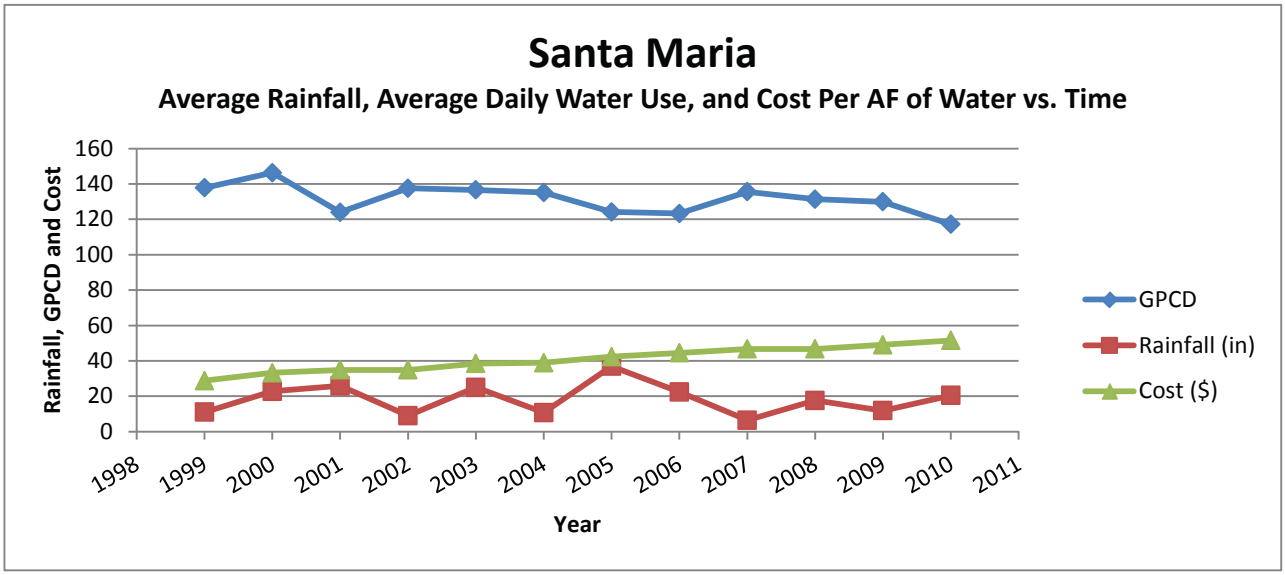




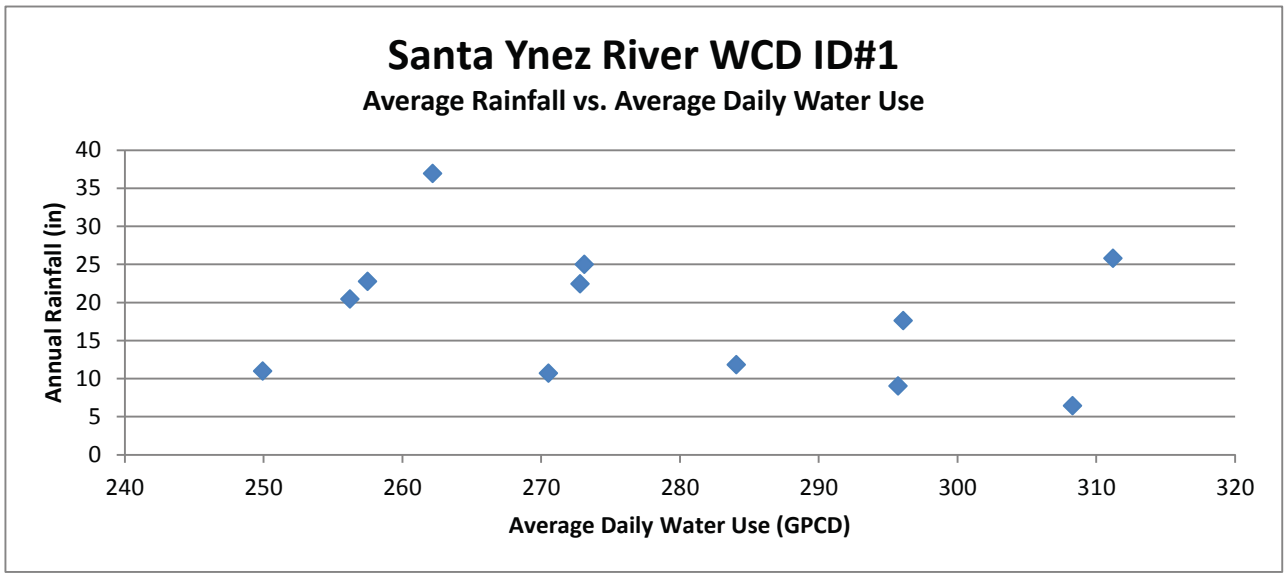
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-12

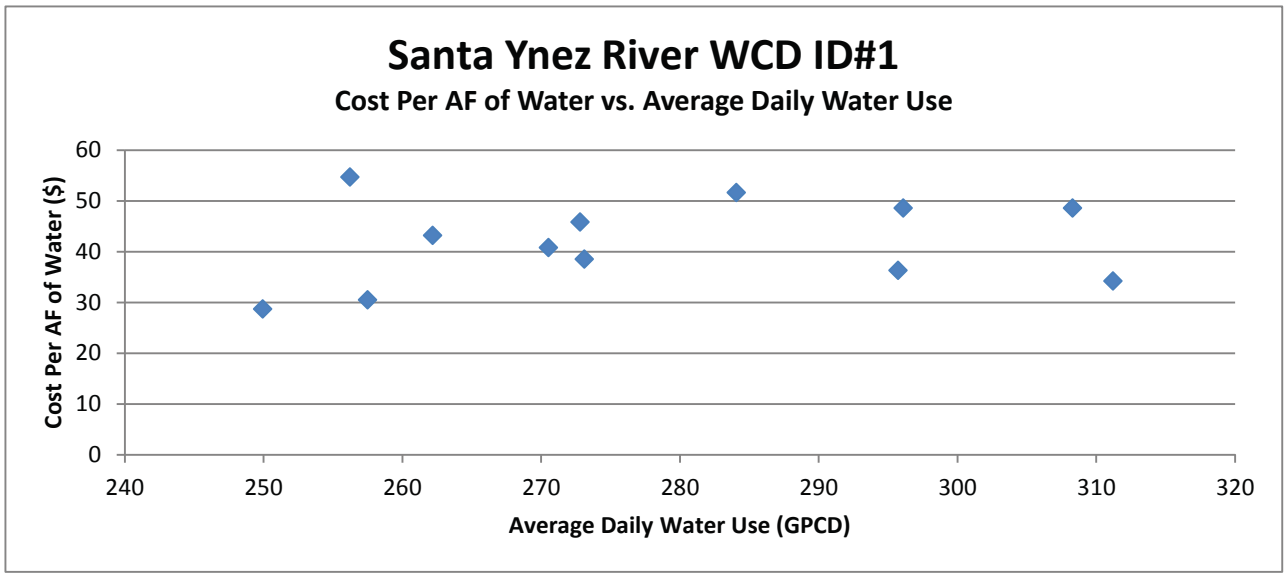


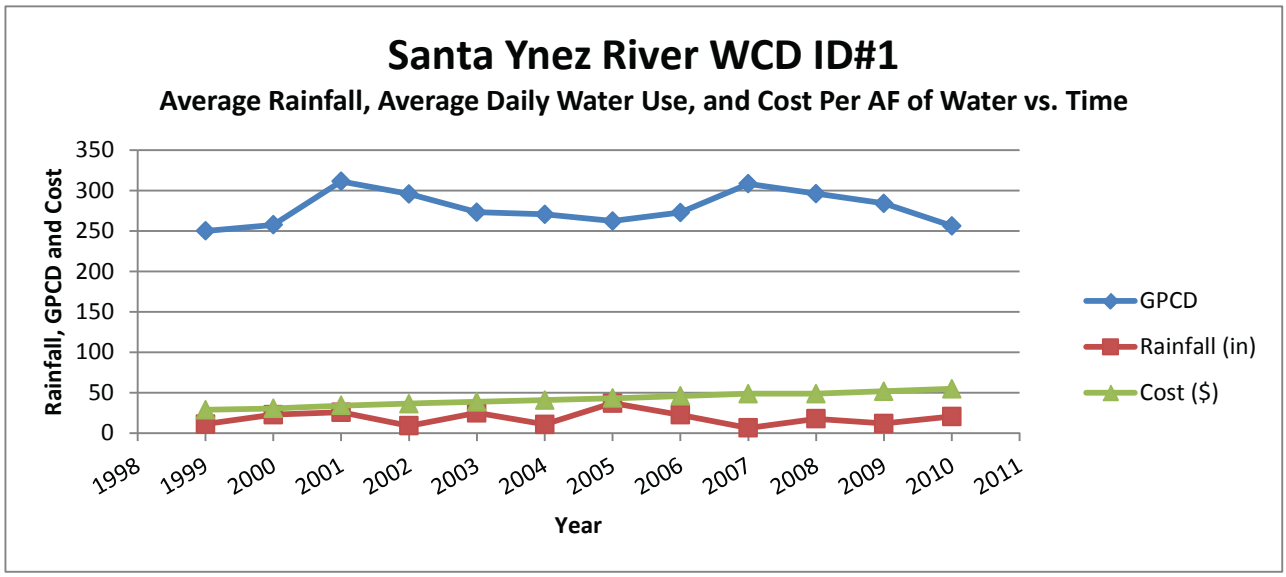




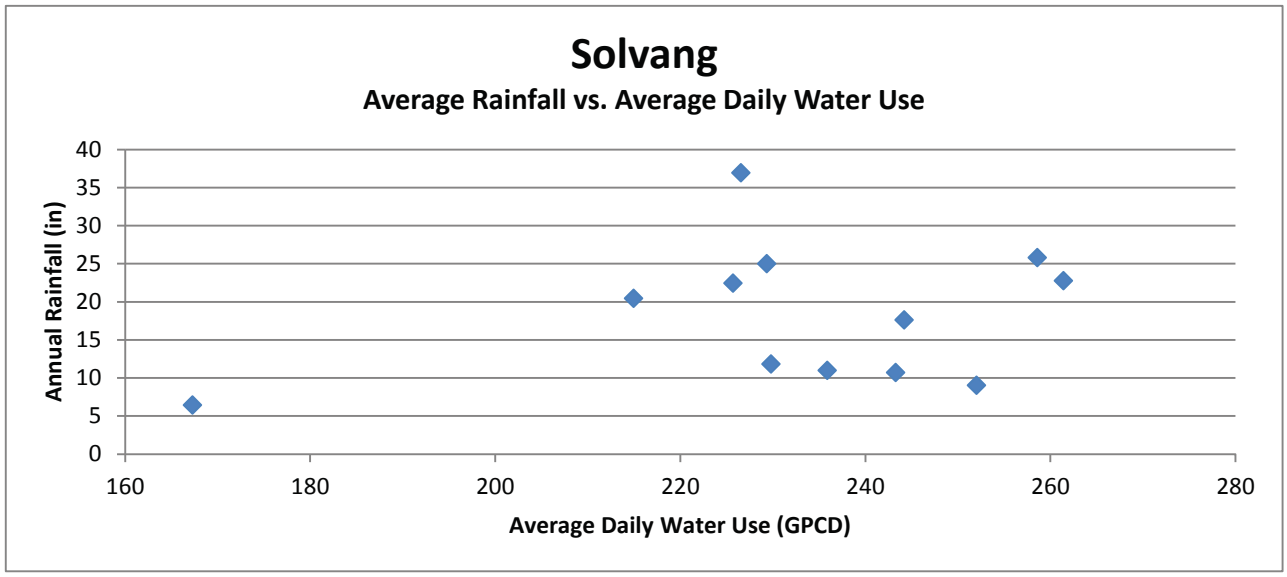
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-13

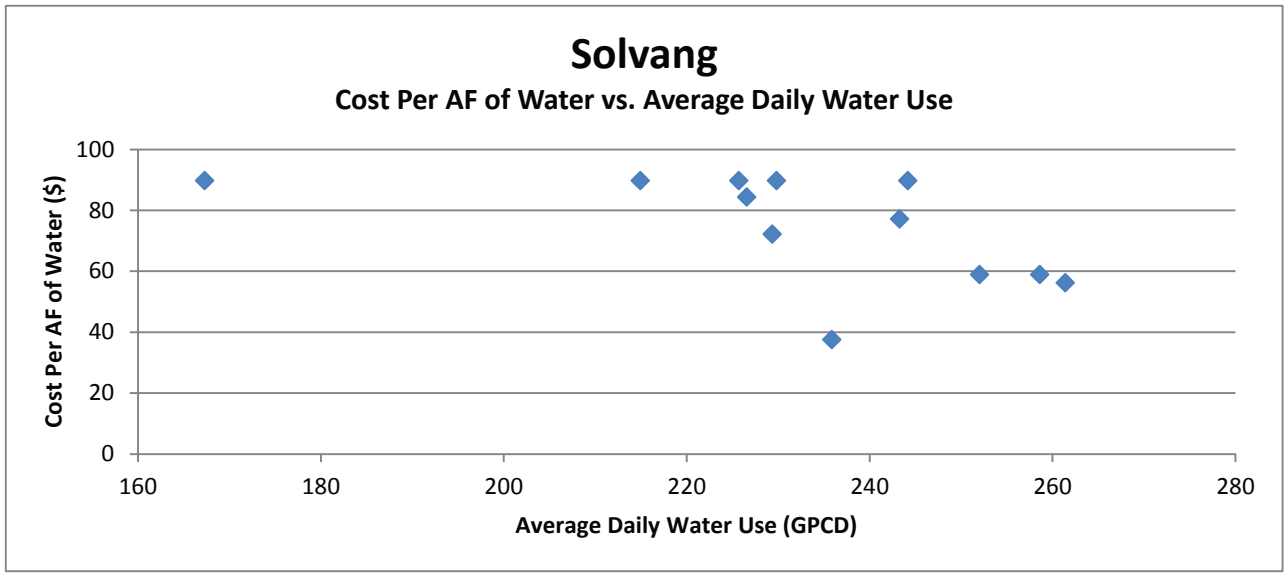


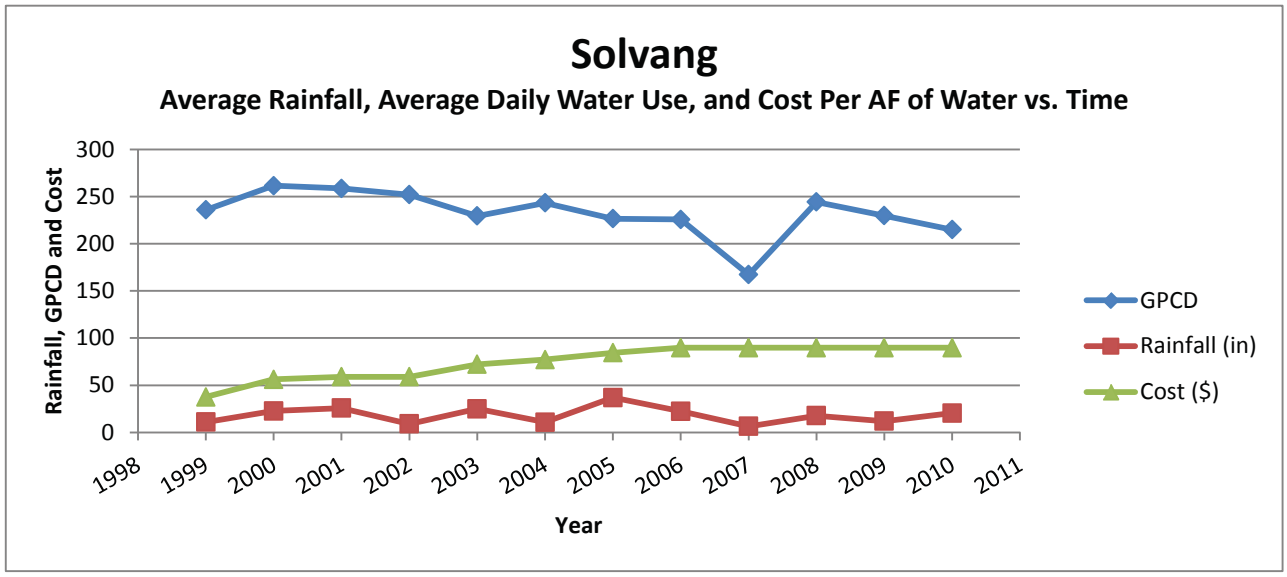




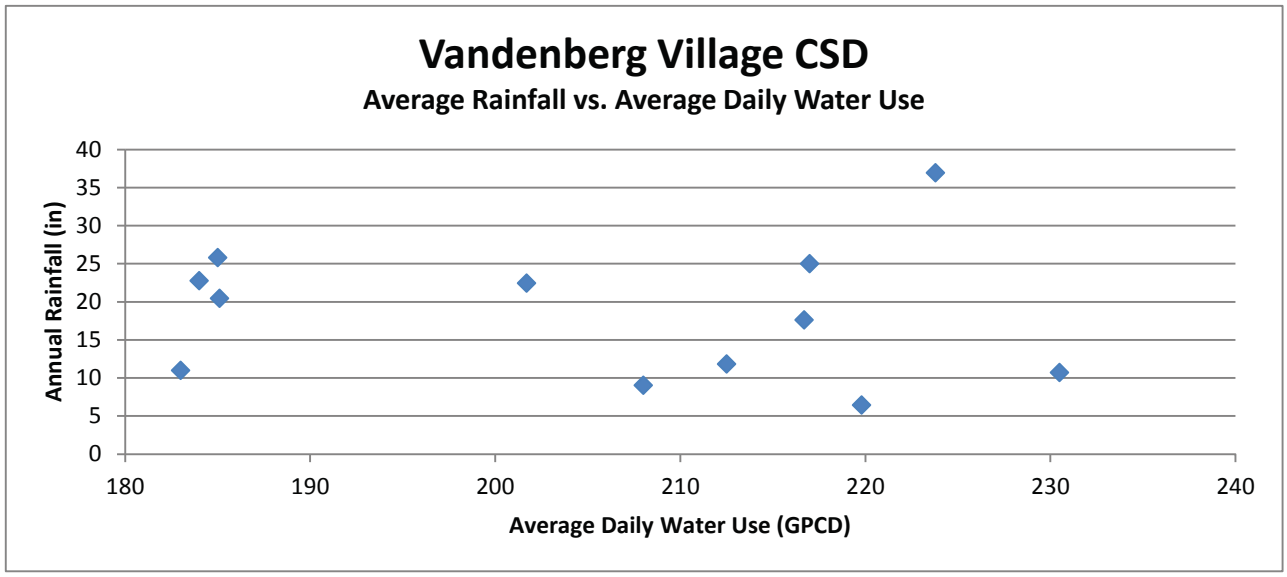
Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-14

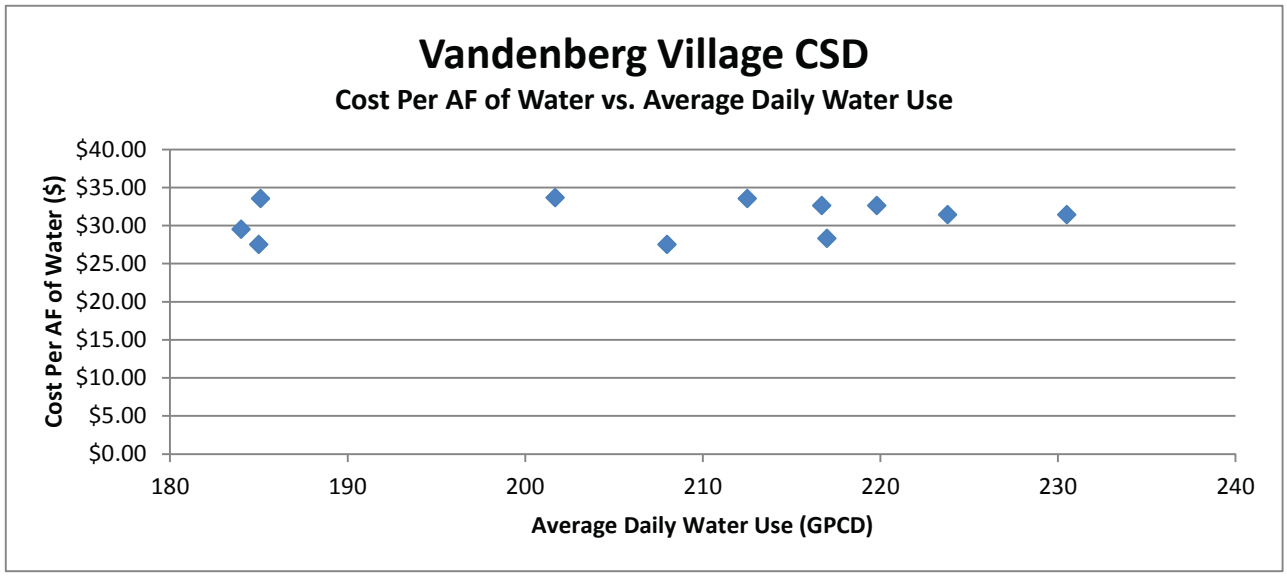


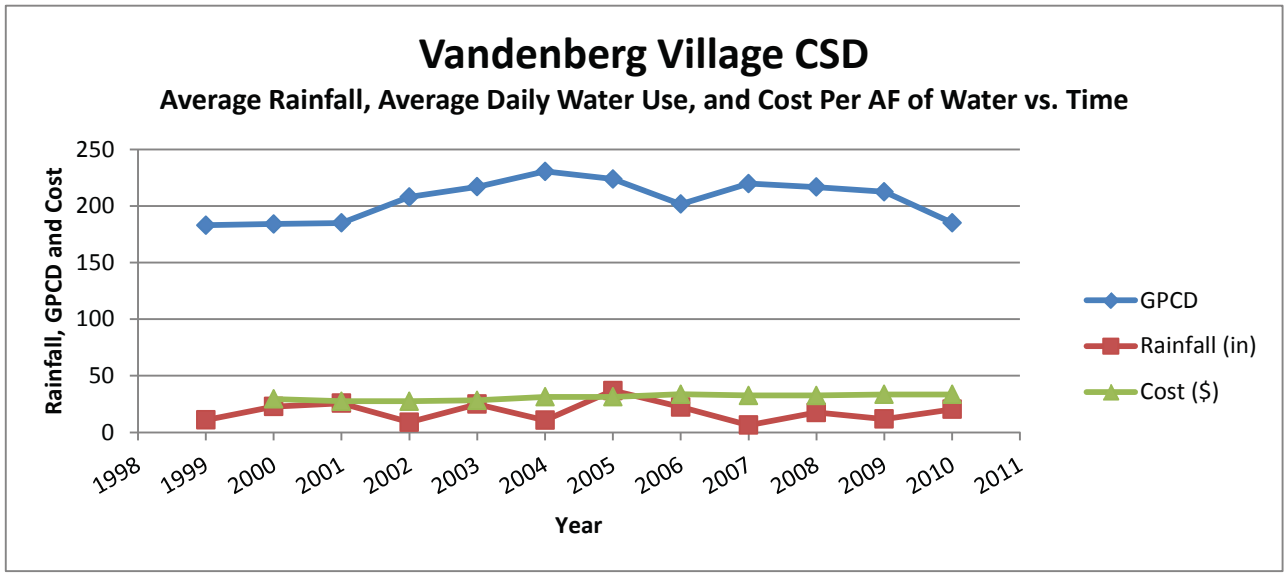




Water Supply and Demand Current Uses and Future Estimates	GEI Consultants Bookman-Edmonston Division	Water Use Analysis
Santa Barbara County Water Agency		September 2012 Figure G-15


Vandenberg Village CSD
Average Rainfall vs. Average Daily Water Use
Annual Rainfall (in)
40
35
30
25
20
15
10
5
0
180
190
200
210
220
230
240
Average Daily Water Use (GPCD)


Vandenberg Village CSD
Cost Per AF of Water vs. Average Daily Water Use
Cost Per AF of Water ($)
$40.00
$35.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$0.00
180
190
200
210
220
230
240
Average Daily Water Use (GPCD)


Vandenberg Village CSD
Average Rainfall, Average Daily Water Use, and Cost Per AF of Water vs. Time
Rainfall, GPCD and Cost
250
200
150
100
50
0
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Year
GPCD
Rainfall (in)
Cost ($)

Appendix 3-B: Santa Barbara County Groundwater Report, Santa Barbara County Water Resources Division, Public Works, 2011

Santa Barbara County
2011 Groundwater Report

Public Works Department
Water Resources Division
Water Agency

123 East Anapamu Street
Santa Barbara, CA 93101
(805) 568-3440

May 1, 2012

A report on the conditions of groundwater and the status of groundwater basins throughout Santa Barbara County during the calendar years 2009-2011

On the cover (clockwise from top right):

Fog over Twitchell Reservoir
Typical groundwater production well
Lettuce being grown in the Cuyama Valley

Santa Barbara County
2011 Groundwater Report

Public Works Department
Water Resources Division
Water Agency

123 East Anapamu Street
Santa Barbara, CA 93101
(805) 568-3440
www.countyofsb.org/pwd/water

May 1, 2012

Board of Supervisors
First District - Salud Carbajal, Vice-Chair
Second District - Janet Wolf
Third District - Doreen Farr, Chair
Fourth District - Joni Gray
Fifth District - Steve Lavagnino

Chandra L. Wallar, County Executive Officer

Report Prepared By
Dennis Gibbs
Senior Hydrologist
Registered Hydrologist 08-H-1828

Assisted By
Fray A. Crease
Senior Program Specialist

Under Direction Of
Matt Naftaly
Water Agency Manager

Forward

This report satisfies requirements of the Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section that was adopted May 24, 1994, and amended November 8, 1994.

Specifically, Conservation Element Goal 4, Policy 4.1, Action 4.1.1 states that:
The County Water Agency shall continue to monitor water levels from existing monitoring wells and, in coordination with the U.C. Cooperative Extension/Farm Advisor, shall request, on a voluntary basis, private and public water purveyors and major private groundwater users, including agricultural users, to provide periodic records of groundwater production. Unless deemed unnecessary by the Water Agency's Board of Directors for any year, the Agency shall compile an annual report on the status of pumping amounts, water levels, overdraft conditions, and other relevant data, and shall submit this report to the Board of Supervisors for its acceptance and possible further action. The annual report to the Board shall include a review of the results of all groundwater quality monitoring conducted in the County.

In 2006 the Board of Supervisors concurred with staff recommendation to change the report from annual to tri-annual since groundwater conditions tend to change little on a year-by-year basis.

Upon completion of this report, the Water Agency will forward it to the County's Planning and Development Department to aid in land use decisions. According to Conservation Element Policy 3.2, "The County shall conduct its land use planning and permitting activities in a manner which promotes and encourages the cooperative management of groundwater resources by local agencies and other affected parties, consistent with the Groundwater Management Act and other applicable law." The tri-annual report is part of that effort but is not intended to be the sole basis for any land use decisions.

In addition, as other local agencies complete groundwater management plans, the Water Agency will review these plans and both forward salient information from those plans to the Planning and Development Department and reflect that information in the next groundwater report update. Conservation Element Policy 3.3 States, "The County shall use groundwater management plans, as accepted by the Board of Supervisors, in its land use planning and permitting decisions and other relevant activities."

The information and conclusions contained in this report reflect data developed by the Water Agency and data contained in documents and reports listed under References on page 95 at the back of this report. The Water Agency recognizes that other individuals/agencies might reach different conclusions based on different sources of data or interpretations. This report draws on the best available information, in some cases referencing conclusions from studies conducted over a decade ago. It is recognized that basin conditions may change with changes to water supply, land use, and other factors. Efforts have been made to consider the validity of the conclusions from the reports referenced and adjustments have been made where appropriate. In addition, information from more recent studies is included where applicable and sources of new information are noted in the text.

As Conservation Element Action 4.1.3 states "The County recognizes the need for more accurate data on all groundwater basins within the County and shall continue to support relevant technical studies, as feasible." As a result, the Water Agency continues to gather water resources data through cooperative programs, and its own collection of data. Finally, as stated in the Conservation Element, "The County recognizes that it has no authority to regulate or manage the use of groundwater except as provided for in the Groundwater Management Act (*Water Code ss 10750. Et seq*.) and other applicable law. Further, the County does not assume any authority under this section to make a determination of the water rights of any person or entity."

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ACRONYMS

AF	Acre-Feet
AFY	Acre-Feet per Year
CCWA	Central Coast Water Authority
CRCD	Cachuma Resource Conservation District
CVWD	Carpinteria Valley Water District
DWR	California Department of Water Resources
GIS	Geographic Information System
GPM	Gallons Per Minute
GWD	Goleta Water District
LCMWC	La Cumbre Mutual Water Company
MAF	Million Acre-Feet
MCL	Maximum Contaminant Level
mg/l	Milligrams Per Liter
MSL	Mean Sea Level
MWD	Montecito Water District
PDO	Pacific Decadal Oscillation
PPM	Parts Per Million
SBCWA	Santa Barbara County Water Agency
SMVWCD	Santa Maria Valley Water Conservation District
SYRWCD	Santa Ynez River Water Conservation District
SYRWCD ID#1	Santa Ynez River Water Conservation District ID #1
SWP	State Water Project
TDS	Total Dissolved Solids
ug/l	Micrograms Per Liter
USBR	United States Bureau of Reclamation
USGS	United States Geologic Survey
VAFB	Vandenberg Air Force Base

Executive Summary

Climate

1. Rainfall during the 2009-2011 period was 112% of average countywide and produced small amounts of recharge to groundwater basins and inflow to reservoirs during the 2009-2010 winter and substantial amounts of recharge during the 2010-2011 winter. The 2008-2009 winter produced only 67% of normal rainfall, the moderate 2009-2010 winter produced 117% of normal and the wet 2010-2011 winter produced 154% of normal precipitation. The period was dominated by the very dry 2008-2009 winter and the extremely wet 2010-2011 winter with the months of December 2010 and March 2011 producing the most precipitation. A detailed description of climate from late 2009 through 2011 is included on pages 15-23.

Status of Groundwater Basins

1. The Cuyama Groundwater Basin is in a state of overdraft of 28,525 Acre-Feet per Year based on a 1992 study. This overdraft pertains to safe yield and not perennial yield. Water levels have fallen significantly but no regional economic or water quality problem has yet been documented. In 2008 the Santa Barbara County Water Agency (SBCWA) initiated a detailed water availability study in conjunction with the United States Geological Survey which will result in a published report in early 2013. For more information on this basin and study please see page 85. For definitions of safe yield and perennial yield see page 4.

2. The Santa Maria Groundwater Basin within Santa Barbara County and also that area within San Luis Obispo County known as the *Oso Flaco* unit has been calculated by the SBCWA to be in overdraft of 2,368 Acre-Feet per Year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield. Water levels have declined since agricultural development of the basin began but no regional economic or water quality problem has yet been documented. In the 2005 litigation *Santa Maria Valley Water Conservation District versus the City of Santa Maria et al.* the court ruled that based on a preponderance of evidence the groundwater basin is not currently in a state of overdraft. No "safe yield" number for groundwater extraction has been decided upon through the adjudication and based on this "tentative" decision, it is the opinion of the SBCWA that no further Santa Barbara County study is warranted at this time. For more information on this basin please see page 74.

3. The San Antonio Groundwater Basin is in a state of overdraft of 9,540 Acre-Feet per Year based on a 2003 study. This overdraft pertains to safe yield and not perennial yield. Water levels have fallen significantly but no regional economic or water quality problem has yet materialized. For more information on this basin please see page 67.

4. The Lompoc Plain Groundwater Basin is basically in equilibrium under State of California Water Resources Control Board decision WR 89-18 and management by the Santa Ynez River Water Conservation District. Natural recharge is augmented with periodic water releases that are made from Cachuma Reservoir to maintain ground water levels in the basin. For more information on this basin please see page 62.

5. The Lompoc Uplands Groundwater Basin has apparently reached equilibrium. Over time, water levels have been lowered to approach the elevation of the Lompoc Plain and Santa Ynez River, which now regulate the water levels in the Uplands Basin. For more information on this basin please see page 63.

6. The Santa Rita Sub-area of the Lompoc Uplands Groundwater Basin is in a state of overdraft of 799 Acre-Feet per Year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield. However, water levels in some parts of this area have declined significantly in recent years and thus in the future some adverse economic effects may be realized as the balance between energy costs and commodity prices fluctuate. For more information on this basin please see pages 63.

7. The Buellton Uplands Groundwater Basin is in a state of surplus of 800 Acre-Feet per Year based on a 1995 study. For more information on this basin please see page 60.

8. The Santa Ynez Uplands Groundwater Basin is in a state of overdraft of 2,028 Acre-Feet per Year based on a 2001 study. This overdraft pertains to safe yield and not perennial yield, thus water levels have declined in many areas but no regional economic or water quality problem has yet materialized. For more information on this basin please see page 51.

9. The South Coast Basins are in equilibrium or surplus through management by local water districts and the Wright Settlement. For more information on these basins please see pages 28-48.

Considerations

1. Santa Barbara County is situated at latitude 34º-35º north in a *semi-arid* climate belt and as such is susceptible to prolonged wet and dry periods such as the wet period 1991-2001 and the droughts of 1945-1951 and 1987-1990. Thus, analysis of groundwater basins must consider long-term climate and cannot be made year by year. For more information please see the Climate and General Hydrologic Trends section on pages 15-23.

2. Recharge from precipitation and stream seepage is the dominant parameter in the calculation of the status of a groundwater basin (surplus, equilibrium, or overdraft). Selection of “base period” of climate (recharge) can substantially alter the outcome of such a calculation. The SBCWA uses the longest period of record available which covers both wet and dry periods when evaluating the status of a groundwater basin.

Introduction

Groundwater supplies about 77% percent of Santa Barbara County's domestic, commercial, industrial and agricultural water. It is also the last line of defense against the periodic droughts that occur in the County. Historic records, combined with tree ring analyses indicate that local drought periods of several years or longer have occurred two to four times per century over the last 460 years (Turner, 1992).

To better understand the supply and limitations of each groundwater basin and aquifer, local, state and federal agencies regularly monitor water quantity and quality. This information about our groundwater resources is essential for a thorough understanding of the condition of the aquifers and thereby can help avoid overuse of aquifers which can lead to depletion, seawater intrusion, diminished storage capacity, lower water quality, or land subsidence within a basin. These potential consequences depend on the characteristics of the aquifer. In areas with low recharge rates, excessive pumping might render portions of an aquifer unusable indefinitely. The lowering of water tables might increase pumping "lifts" which could make pumping economically infeasible for some existing uses. In contrast, with proper management the lowering of groundwater basins can sometimes make them more effective by reducing rejected recharge. Since the consequence of long-term groundwater overuse can include permanent impairment of aquifers, careful evaluation of long-term records of use and groundwater response is essential to successful management of groundwater supplies.

In Santa Barbara County significant changes in groundwater basins generally occur over a period of years, or in some cases decades. In larger basins, trends in groundwater level and groundwater quality are recognizable only by examining data the length of one or more hydrologic (rainfall) cycles. Some factors likely to affect the condition of the basins, such as the importation of supplemental water supplies, the implementation of basin management plans, and climatic influences, may change from year to year.

Because of these concerns and various studies indicating slight to moderate levels of overdraft in several groundwater basins within the County and substantial overdraft in one basin, the County developed a set of goals and policies to protect local groundwater. These goals and policies are contained in the Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section which was formally adopted on November 8, 1994. The effects of County permitted projects which may involve new extractions of water resources are evaluated under the California Environmental Quality Act pursuant to the adopted Environmental Thresholds and Guidelines Manual, 1995, and assessed for consistency with County Land Use Plan policy.

Included in this eleventh groundwater report is a discussion of climate through 2011 and its likely effect on groundwater basin conditions, a general discussion of basin characteristics and current statuses, updated water level data and hydrographs for selected wells, and developments in supplemental supplies and basin management plans.

Groundwater Terms

There are several terms used in this report that warrant definition. **Safe yield** is defined as the maximum amount of water which can be withdrawn from a basin (or aquifer) on an average annual basis without inducing a long-term progressive drop in water level. The traditional concept of safe yield has been widely discredited and is no longer used. It has now been replaced with **sustainable yield.** Sustainable yield depends on the amount of capture, and whether this amount can be accepted as a reasonable compromise between a policy of little or no use, on one extreme, and the sequestration of all natural discharge, on the other extreme. A reasonably conservative estimate of sustainable yield would take all or suitable fractions of deep percolation. **Perennial yield** is defined as the amount of water that can be withdrawn from a basin (or aquifer) on an average annual basis without inducing economic or water quality consequences (Muir, 1964). Perennial yield is also no longer used in current hydrogeologic studies. **Net yield** is the safe yield value with the return flows (see definition below) subtracted. The net yield value refers to consumptive use of water that can be removed (without accounting for return flows) on an average annual basis without causing severe adverse effects. **Acceptable dewatered storage** is the maximum amount of storage that can be removed from a basin without adverse effects. Safe yield, perennial yield and net yield are defined here as they are still utilized in analyses sections of this report where updates using the newer and more accepted terms sustainable yield and acceptable dewatered storage are not yet used. **Return flows** consist of the volume of irrigation water from production wells in excess of evapotranspiration that is re-added to groundwater storage.

Overdraft is defined as the level by which long-term average annual demand exceeds the estimated safe yield of the basin and thus, in the long term, may result in significant negative impacts on environmental, social or economic conditions. A basin in which safe yield is greater than estimated average annual pumpage is defined as being in a state of **surplus**. The term overdraft does not apply to a single year or series of a few years, but to a long-term trend extending over a period of many years that are representative of long-term average rainfall conditions. Thus the estimated overdraft accounts for both periods of drought and heavy rainfall.

Available storage is the volume of water in a particular basin that can be withdrawn economically without substantial environmental effects. This storage value reflects the amount of water in the basin on a long-term basis (a point on a long-term trend line of water levels), not the current storage level in the basin. **Usable storage** or **working storage** of a groundwater basin is defined as the volume of water to the bottom of developed wells.

The term **confined** is used to describe an aquifer, the upper surface of which is overlain by an impermeable layer that prevents any significant upward flow when the aquifer is totally saturated (filled) with water. When this type of aquifer is penetrated by a well the water in the well may rise above ground surface, due to the pressure head exerted on the aquifer, and if so may be described as **artesian**.

Recharge is the sum of water entering the aquifer from direct deep **percolation** of rainfall, **seepage** from streams and rivers, return flows from irrigation, and artificial replenishment. It is rainfall less losses of evaporation, evapotranspiration, diversion and outflow of the basin. It is the dominant parameter in the calculation of the status of a groundwater basin (surplus, equilibrium or overdraft). Data on actual net recharge by stream seepage and deep percolation of rainfall is very limited and thus is usually estimated or prorated from adjacent areas or

historical studies. By utilizing differing “base periods” of climate (recharge) one can easily alter the outcome of the calculation of the status of a particular groundwater basin.

Water year is defined by the County as September through August, whereas it is defined as October through September by the State of California and July through June by the National Oceanic and Atmospheric Association.

Land Surface Datum or **LSD** is the relative elevation of a measuring point assigned by some method of survey; either off topographic map, global positioning system or direct geodetic survey. **Water Surface Elevation** or **WSEL** is the elevation of a water surface or water body above **Mean Sea Level (MSL)** if it is a positive value, or below MSL if it is a negative value.

Well Monitoring and Data Collection

The Santa Barbara County Water Agency (SBCWA) currently monitors 283 wells for depth to groundwater throughout the County in cooperation with the United States Geological Survey (USGS). 27 sites include water quality. Individual water districts monitor many more wells. The illustration below indicates the locations of SBCWA observation wells.

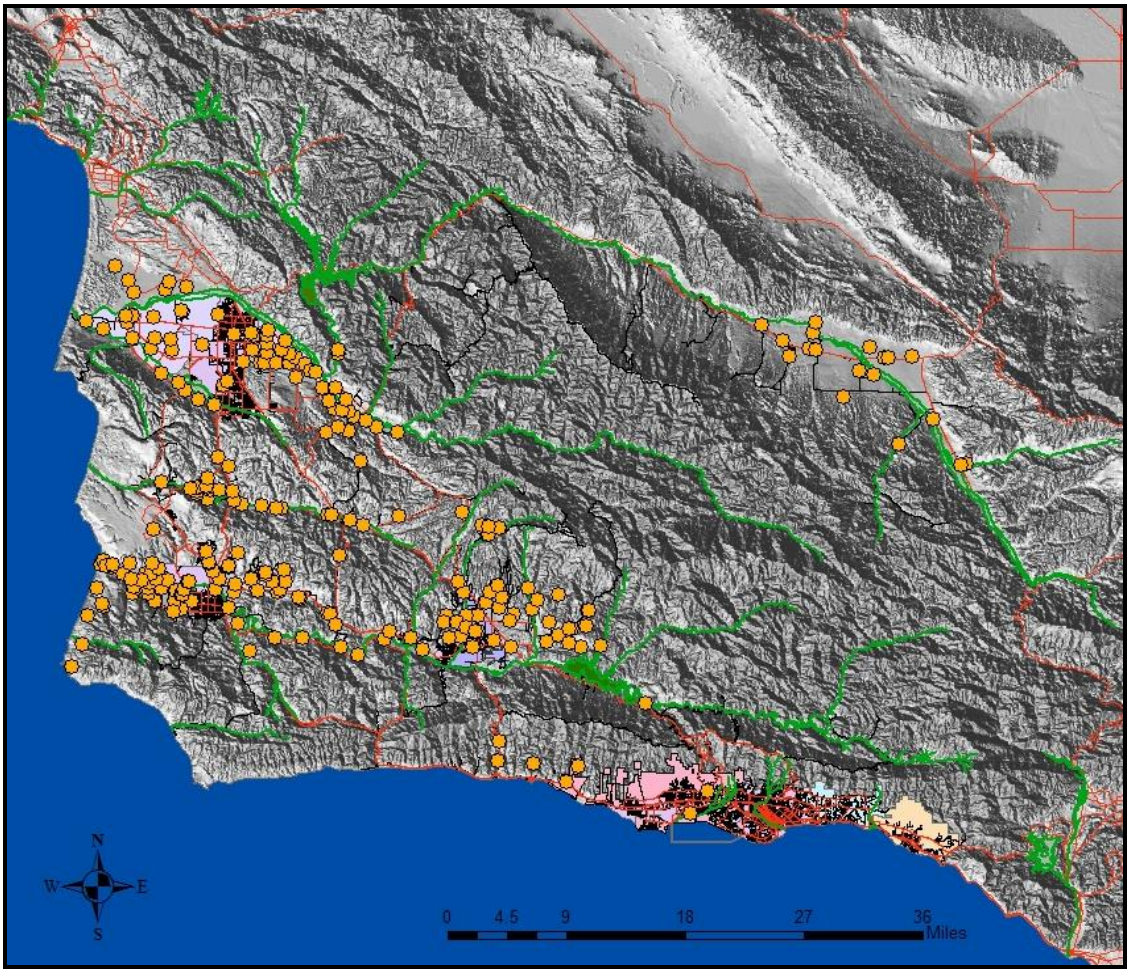


Figure 1: Current SBCWA Groundwater Observation Sites

Appendix A contains a table which cross references State Well ID to the USGS Site ID. Data from any of these monitoring sites may be retrieved at http://nwis.waterdata.usgs.gov/usa/nwis/gwlevels by querying on site ID. Note that nearly all of the SBCWA groundwater monitoring sites exist within the unincorporated areas of Santa Barbara County. Local water districts and municipalities currently monitor or fund monitoring of many sites in addition to those measured by Santa Barbara County. Those include the Carpinteria Valley Water District, the Montecito Water District, the City of Santa Barbara, the Goleta Water District, the Santa Ynez River Water Conservation District ID#1, the United States Bureau of Reclamation, the City of Solvang, the City of Buellton, the City of Lompoc, the Los Alamos Community Service District, the City of Santa Maria, the Santa Maria Valley Water Conservation District, Golden State Water Company, the City of Guadalupe and the New Cuyama Community Services District. For specific information in those areas contact the appropriate Water District or Agency directly.

California Statewide Groundwater Elevation Monitoring

In November, 2009 the California Department of Water Resources (DWR) enacted a new law which directs that groundwater elevations in all basins and sub-basins identified in DWR Bulletin 118 be regularly and systematically monitored: www.water.ca.gov/groundwater/casgem/ The California Statewide Groundwater Elevation Monitoring (CASGEM) program will rely and build on the many established local long-term groundwater monitoring and management programs. DWR's role is to coordinate information collected locally through the CASGEM program and to maintain the collected groundwater elevation data in a readily and widely available public database. Monitoring entities are to provide DWR with a monitoring plan for each of the groundwater basins they are monitoring. Santa Barbara County Water Agency (SBCWA) is working on a monitoring plan for the three basins on which we report; Cuyama, San Antonio and Santa Ynez River. The other groundwater basins within the County will be monitored by various local agencies acting as eligible monitoring entities.

Water Quality Data Collection

Although partially funded through SBCWA programs, groundwater quality data is not collected directly by the SBCWA. Much of the data used in this report comes from the USGS, the Regional Water Quality Control Board, or local water agencies. This report discusses total dissolved solids (TDS) as an indication of general water quality, nitrates as an indication of possible return flow contamination and chlorides as an indication of possible seawater intrusion.

Data Collection Methodology

The majority of the representative wells used to create the hydrographs displayed in this report are currently measured by the SBCWA. For these wells, groundwater depth is measured directly, one or two times per year, using a graduated steel tape. If conditions in a well preclude the use of the steel tape (such as a leaking casing) an electric sounder is used. Under ideal conditions, it has been the experience of SBCWA personnel that the steel tape is accurate to within two or three one hundredths of a foot. The accuracy of the electric sounder used by the SBCWA has been found to be somewhat less, typically five one hundredths of a foot.

Other methods for acquiring well measurements might include water stage (float) recorders that record water depths on graphs or punched tape. Stage recorders most often consist of a float and pulley device inserted into a well. Similarly, airline systems measure the pressure required

to bubble gas out of a tube, the bottom of which is inserted below water in the well. If the precise elevation of the lower end of the tube is known, it is possible to determine the water depth. However, this method might only have an accuracy of plus or minus a foot (or more) depending on the accuracy of the pressure gage. More recently, pressure transducers have been installed on several wells which can relate depth to water by the hydrostatic pressure caused by the column of water above the instrument minus atmospheric pressure.

Geographic Information System

The SBCWA has developed a GIS (geographic information system) to track and record groundwater data, and for analyzing and displaying historical groundwater data. The GIS system serves as an extensive database of all of the water well records as well as a good way to produce maps.

Drinking Water Standards

The following standards are provided for comparison purposes: the California Department of Health Services (DHS) secondary standard for TDS in drinking water is 1,000 milligrams per liter (mg/l), maximum contaminant level (MCL). Secondary standards are applied at the point of delivery to the consumer. The DHS primary standard for nitrates (as NO3) in public drinking water systems is 45 mg/l and the DHS secondary standard for chloride in drinking water is 250 mg/l. DHS is in charge of "Source Water Assessments" and they are required of all "public water supplies" (with over 200 connections). For more information on the Drinking Water Source Assessment and Protection (DWSAP) Program please visit the DHS website at www.dhs.ca.gov/ps/ddwem/dwsap/guidance/index.htm

State Water Project

The State Water Project (SWP) depends on a complex system of dams, reservoirs, power plants, pumping plants, canals, and aqueducts to deliver water from the watersheds of the Sierra Nevada Mountains via the Sacramento-San Joaquin Delta. Although initial transportation facilities were essentially completed in 1973, other facilities have since been built, and still others are either under construction or are planned to be built as needed. The SWP facilities include 28 dams and reservoirs, 26 pumping and generating plants, and approximately 660 miles of aqueducts.

Existing long-term SWP water supply contracts call for a maximum annual allocation of approximately 4.1 million acre-feet (AF). A number of changes have occurred since the long-term water contracts were signed in the 1960s. These changes include population growth variations, differences in local use, local water conservation programs, and conjunctive-use programs. Demands for SWP water are expected to increase as the population of California continues to increase. Water from rainfall and snowmelt runoff is stored in SWP conservation facilities and delivered via SWP transportation facilities to water agencies and districts in Southern California, Central Coastal, San Joaquin Valley, South Bay, North Bay, and Upper Feather River areas.

Figure 2: State Water Project (Courtesy of the California Department of Water Resources)

Santa Barbara County Involvement in the SWP

In 1963, the Santa Barbara County Flood Control and Water Conservation District contracted with the DWR to deliver SWP water. At that time, the County began payments to DWR to retain a share of the SWP yield ("Table A amount")[1] for 57,700 Acre-Feet per Year (AFY), but funds were not allocated to construct the necessary local facilities to deliver water within the County.

In 1979, a bond measure was placed before local voters to secure funds to construct the local delivery system to distribute SWP water throughout the County. Fear of growth, environmental concerns, and opposition to the high water costs caused a majority of voters to vote against this measure. In 1981, the original contract was amended to reduce the County's State Water Table A amount to 45,486 AFY.

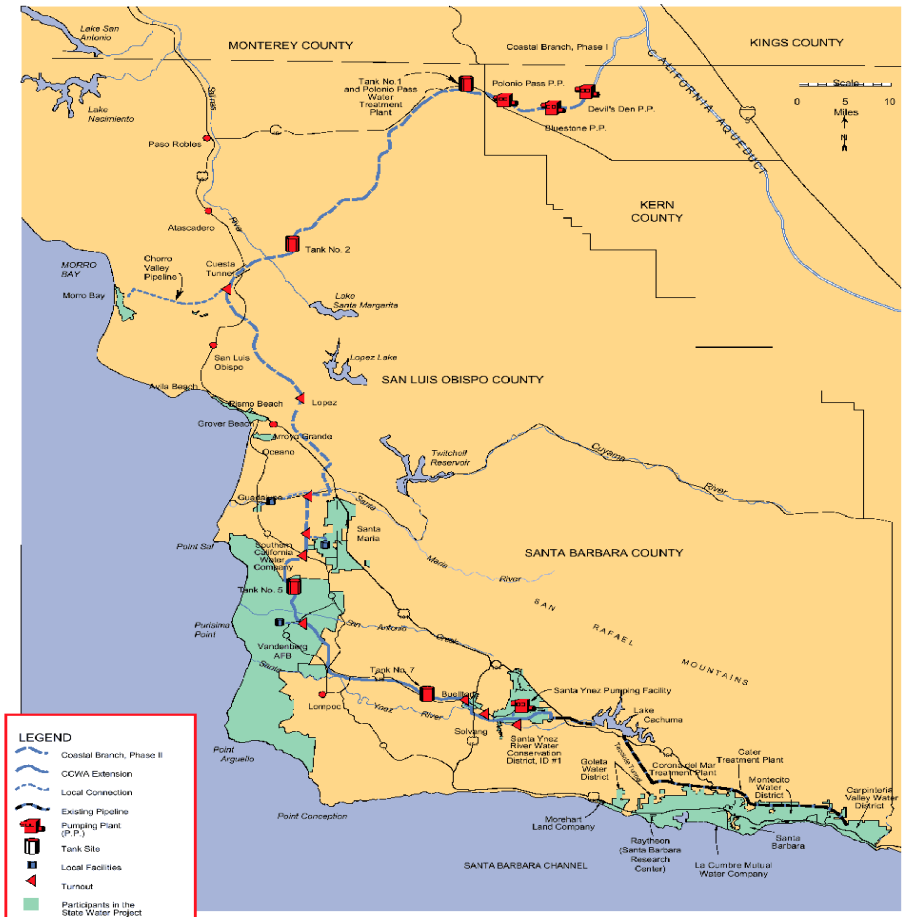


Figure 3: State Water Project, Coastal Branch

[1]SWP contract Article 7b *<u>Maximum Annual Entitlement</u> of Agency. The maximum amount of project water to be made available to the Agency in any one year under this contract shall be that specified in Table A of this contract and in said table designated as the Agencies Maximum Annual Entitlement.*

In 1991, after four years of extremely dry conditions, voters in several service areas in Santa Barbara County voted to import SWP water. This included the communities of Carpinteria, Summerland, Montecito, Santa Barbara, Hope Ranch, Goleta, Buellton, Solvang, Santa Ynez, Orcutt and Guadalupe. The Santa Maria City Council and Vandenberg Air Force Base also decided to participate in the SWP. The communities of Lompoc, Vandenberg Village, and Mission Hills voted not to participate in the SWP.

After the bond elections, water purveyors participating in the SWP formed the Central Coast Water Authority (CCWA) to finance, construct, manage, and operate Santa Barbara County's 42-mile extension of the SWP water pipeline, the State facilities in Santa Barbara and San Luis Obispo Counties, and a regional water treatment plant. The CCWA is made up of eight member agencies, one associate member, and four additional participants. An eight-member Board of Directors that includes a representative from each member agency governs the CCWA.

The table on the following page exhibits the allocated Table A amount of SWP water to each project participant. Existing allocations range from 50 AFY (Raytheon IO) to as high as 16,200 AFY (City of Santa Maria), though actual water deliveries may be less than the Table A amounts in any given year depending on a number of factors, including customer demand, regulatory

restrictions and droughts in northern California. Factors other than drought that may cause short-term delivery reductions of SWP water include equipment failure and natural disasters such as floods and earthquakes.

State Water Allocations in Santa Barbara County (AFY)		
Project Participant	**SWP Allocation**	**Drought Buffer**
City of Santa Maria	16,200	1,620
Golden State Water Company	500	50
City of Guadalupe	550	55
Vandenberg Air Force Base	5,500	550
City of Buellton	578	58
City of Solvang	1,500	0
Santa Ynez River Water Conservation District ID#1	500	200
Raytheon Infrared Operations	50	5
Morehart Land Company	200	20
La Cumbre Mutual Water Company	1,000	100
Goleta Water District**	4,500	450*
City of Santa Barbara	3,000	300
Montecito Water District	3,000	200
Carpinteria Valley Water District	2,000	200
Total:	**39,078**	**3,908**

Table 1: State Water Project Allocations

***Goleta has an additional 2,500 AFY of drought buffer, in addition to its 450 AFY, Drought buffer does not have a pipeline or treatment plant capacity associated with it, thus it serves for increased reliability only*

Project Reliability

Factors that affect the SWP's long-term reliability include timing of additional SWP storage facility construction, ongoing environmental challenges to the SWP, and eventual utilization of full SWP entitlement by other SWP water contractors. Current expectations are that some of the originally conceived SWP facilities will not be constructed so the final overall SWP yield may be reduced. In addition, since recent laws have required that more water than originally planned must be retained in the supply rivers to preserve aquatic and riparian habitats, the overall SWP yield may be reduced still further. According to the CALSIM II SWP yield model developed by DWR, the long-term average SWP deliveries will average approximately 70 percent of the SWP Table A amounts with existing facilities and current operational constraints. Each CCWA participant has a 10% "Drought Buffer" intended to further increase SWP reliability. Therefore,

for its land use planning purposes, the County assumes the long-term average annual deliveries to be 75% of each purveyor's Table A amount.

Santa Barbara County Deliveries

Santa Barbara County SWP deliveries began in 1997. These deliveries have had a significant impact on groundwater conditions in some Santa Barbara County groundwater basins by reducing overdraft and improving groundwater quality. In some areas, State Water has replaced a significant amount of groundwater production and, because the quality of State Water is better than that of most local groundwater sources, return flows to groundwater basins will help improve basin water quality over time.

State Water Project Deliveries[1] 2008-2011 (AF)				
Project Participant	**Calendar Year 2008**	**Calendar Year 2009**	**Calendar Year 2010**	**Calendar Year 2011**
City of Santa Maria	7,792	7,779	10,277	11,785
Golden State Water Company	233	249	246	445
City of Guadalupe	348	39	0	176
Vandenberg Air Force Base	1,899	1,427	904	2,069
City of Buellton	464	251	245	458
City of Solvang[2]	1,167	1,104	984	1,190
Santa Ynez River WCD ID#1[3]	203	182	268	785
Santa Barbara Research Ctr.	19	22	28	44
Morehart Land Company	0	0	0	0
La Cumbre Mutual Water Company	776	1,047	1,260	469
Goleta Water District	1,656	1,384	1,103	1,126
City of Santa Barbara	621	451	734	751
Montecito Water District	2,680	1,214	1,234	1,251
Carpinteria Valley Water District	533	303	492	501
Total:	**18,391**	**15,452**	**17,775**	**21,050**

Table 2: State Water Project Deliveries 2008-2011

1 *This table reflects actual deliveries which are less than Table A amounts in many cases*.

2 *The City of Solvang gets its State Water through a contractual arrangement with Santa Ynez River Water Conservation District ID #1 (SYRWCD ID#1); it does not hold a direct allocation to the State Water Project.*

3 *SYRWCD ID#1 actually receives more water than is listed, in exchange for Cachuma Project Water. The Goleta Water District, the City of Santa Barbara, Montecito Water District and Carpinteria Valley Water District get the Cachuma Project Water allotted to SYRWCD ID#1 as part of the "exchange program".* ***This table reflects actual amounts delivered to the system and then to individual agencies from the State Water Project****.*

Annual State Water deliveries vary based on local demand, availability of SWP water due to snow-pack and runoff in the SWP watersheds, and environmental factors. Total statewide requests for delivery may exceed the system's ability to deliver in certain years. See reliability section above. Therefore, historic deliveries listed in Table 2 on the previous page may not accurately reflect delivery capability in all years, but drought buffer programs, exchanges, transfers, offsite storage and conjunctive use programs increase the reliability of State Water deliveries.

For the above mentioned reasons the amount of State Water offsetting groundwater consumption and the amount returning to groundwater basins is not fully known and thus in the short term, it is difficult to determine to what extent existing overdraft of groundwater supplies may be alleviated. However, for basins in which the use of State Water supplies is substantial compared to the use of groundwater, the benefit is likely to be significant.

Table 2 on the previous page shows the deliveries of State Water which local entities have received during the 2008-2011 period.

Cloudseeding

The SBCWA conducts a weather modification program better known as "cloudseeding" to augment rainfall and runoff in watersheds behind the major water reservoirs; Lake Cachuma and Gibraltar Dam on the Santa Ynez River and Twitchell Reservoir near Santa Maria. For the Twitchell Reservoir component of the program only the Huasna and Alamo watersheds are seeded, not the rain shadowed area of the Cuyama River drainage.

The operational program has been in existence since 1981 and follows research conducted between 1957 and 1974 that indicated significant increases in rainfall could be achieved by seeding convective bands embedded in winter storms that move through the area. Sponsors of the research programs included the National Science Foundation, Naval Weapons Center China Lake, U.S. Weather Bureau, U.S. Forest Service, State of California, University of California, Santa Barbara County and Ventura County. Research programs dating back to the 1950s were the result of pioneering work done in the field of weather modification in the late 1940s by Dr. Vincent Schaefer and Dr. Bernard Vonnegut.

The SBCWA splits the cost of the current operational program with local water purveyors under a matching funds program where the Water Agency matches funds provided by local water purveyors on a year by year basis. The design of the program changes year by year to reflect watershed and hydrologic conditions. For example, if wildfire affects a watershed that watershed may not be seeded until it has recovered, as in the recent Zaca Fire. If reservoirs are filled the program may be curtailed and funds carried over to the next season. Not all storms are seeded – weak storms many times do not have the super-cooled water vapor content or proper wind field to promote significant results from seeding and very strong storms may not be seeded due to potential flooding in urban areas and perception of use of the program. No urban areas are targeted, just backcountry areas behind major reservoirs.

Figure 4 on the following page depicts Santa Barbara County terrain as well as the Cloudseeding Target Areas and ground sites from which cloudseeding operations are conducted.

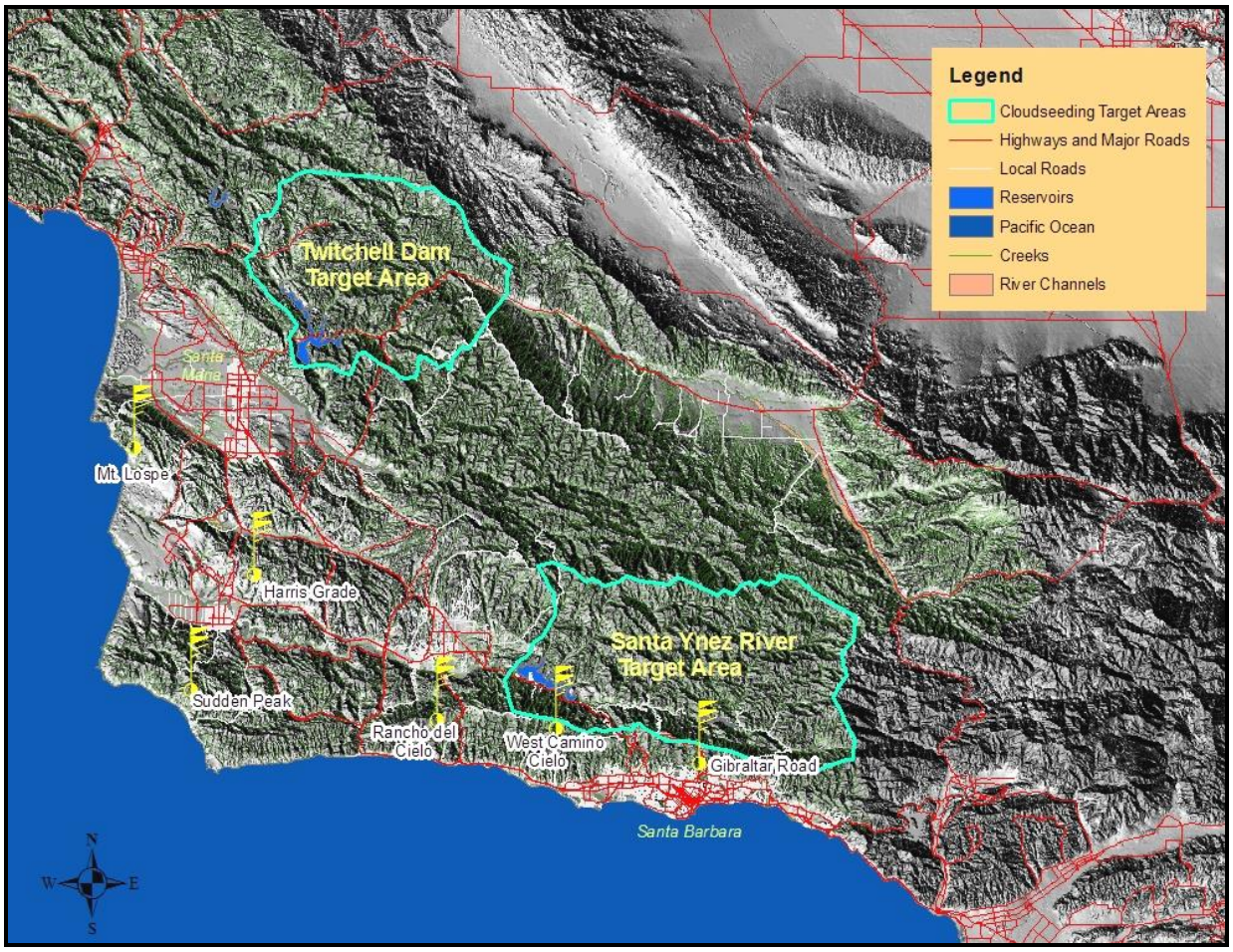


Figure 4: Santa Barbara County Cloudseeding Program Target Areas

Most storms that arrive in Santa Barbara County are abundant in moisture but limited in condensation nuclei. Water droplets or ice particles form on microscopic condensation nuclei, extremely small particles of dust or dirt in the atmosphere. Research has shown that many of these storms have embedded convective bands with super-cooled water vapor. Super-cooled water vapor is water vapor existing below the freezing point but does not freeze due to extremely low atmospheric pressure. By identifying these embedded convective bands and injecting artificial hydroscopic material into the cloud mass, cloudseeding provides a mechanism to move the moisture from the cloud mass to the surface of the earth where it is needed. Seeding is accomplished by both ground and aircraft. In some instances it is more cost effective to seed from the ground and in others with aircraft. Currently six land based sites are utilized, from north to south they are: Mt. Lospe, Harris Grade, Sudden Peak, Refugio Pass, West Camino Cielo and Gibraltar Road.

Cloudseeding programs are conducted throughout California and are common throughout the world. The SBCWA recognizes cloudseeding as a very safe and cost effective means of promoting adequate water supplies. The California Department of Water Resources labels cloudseeding a “safe and effective means of augmenting local water supplies.” The American Society of Civil Engineers recognizes cloudseeding and has produced an operations guidelines manual. The Bureau of Reclamation has done several studies on effects and repeatedly found

no negative impacts. The Weather Modification Association has a statement on silver toxicity which indicates no harmful effects. Santa Barbara's program is in compliance with the California Environmental Quality Act and conducted in accordance with all applicable laws and licensing.

The cloudseeding program plays a valuable role in protecting groundwater resources by increasing rainfall in seeded storms by 18-22% (Solak, et al., 1996). Increased runoff captured by Gibraltar Dam and Lake Cachuma on the Santa Ynez River is used for a variety of purposes including municipal and industrial, direct irrigation of agriculture, recharge to the Santa Ynez River alluvial aquifer and Lompoc Groundwater basins and supplement of freshwater habitat. Increased runoff captured by Twitchell Reservoir is released slowly in the late spring and summer months in order to percolate into the heavily utilized Santa Maria Groundwater Basin.

Groundwater Basin Management Plans

Several cities and water districts have prepared groundwater management plans in accordance with State Assembly Bill AB 3030. Enacted in 1992, the Bill allows local agencies, with public involvement, to prepare, adopt, and enforce groundwater management plans for the protection of groundwater. The table below lists agencies that have adopted plans, as well as those subject to court actions. To view the individual plans please contact the appropriate agency listed.

Groundwater Management Plan Status			
Basin	**Public Agency Participants[1]**	**Status**	**Year**
Buellton Uplands	Santa Ynez River WCD, City of Buellton	Plan Adopted	1995
Carpinteria	Carpinteria Valley WD	Plan Adopted	1996
Foothill	City of Santa Barbara	Plan Adopted	1994
Goleta	Goleta WD	Court Action[2]	1989
Lompoc	City of Lompoc	Plan in Progress	-----
Montecito	Montecito WD	Plan Adopted	1998
Santa Barbara	City of Santa Barbara	Plan Adopted	1994
Santa Maria Valley	City of Santa Maria, Santa Maria Valley WCD, Cal Cities	Plan Adopted	1995
Santa Maria Valley	City of Santa Maria, Santa Maria Valley WCD, Cal Cities	Court Action[3]	2005

Table 3: Groundwater Management Plans

1 *Other participants include private water companies and overlying property owners*

2 *The "Wright Suit" Settlement stipulates management actions in the North and Central Sub-basins*

3 *Stipulation Agreement, California Superior Court, County of Santa Clara requires annual reporting on the conditions of the Santa Maria Valley Management Area*

Climate and General Hydrologic Trends

Terrain

Like most of Southern California, Santa Barbara County is very mountainous. The steep Santa Ynez Mountains bound the coastal communities of Goleta, Santa Barbara, Montecito and Carpinteria; farther north the San Rafael Mountains rise to the highest elevations in the County. The Sierra Madre Mountains occupy the northeast portion of the County. In summation, 65% of Santa Barbara County's 2,745 square miles is hilly or mountainous. Most of the remaining 35% of the land consists of valleys and plains including the Cuyama Valley, Santa Maria Valley, Santa Ynez Valley, Lompoc Plain and Santa Barbara Coastal Plain. These are the areas that serve as groundwater basins or extraction areas. The five principal drainage areas of the County are the Cuyama Watershed at 1,132 square miles, the Santa Maria Watershed at 713 square miles, the San Antonio Watershed at 165 square miles, the Santa Ynez River Watershed at 900 square miles and the South Coast Watersheds which cover 416 square miles.

Overview

Santa Barbara County has a Mediterranean type climate encompassing several microclimatic regions. The County is unique in its physical orientation, having a series of east-west trending transverse mountain ranges which produce a significant orographic effect when a storm approaches the County from the Pacific Ocean.

Rainfall amounts can be quite variable from location to location. Most precipitation occurs between November and March with the exception of some far inland mountain areas that receive sporadic thundershowers during the summer months. Moist air from the Pacific Ocean moderates temperatures in the coastal areas; somewhat lower winter minimums and higher summer maximums prevail in inland valleys behind the coastal hills and mountains. Average seasonal precipitation varies from seven to nine inches near Cuyama to a maximum of approximately 36 inches at the uppermost elevations of the San Rafael Mountains. Precipitation amounts vary greatly year to year; in Santa Barbara the lowest seasonal total is 4.49 inches recorded in water year 1876-1877 and the highest seasonal total is 46.97 inches recorded in water year 1997-1998. Figure 5 on the following page depicts seasonal rainfall at Gibraltar Dam, San Marcos Pass, Los Alamos, and Twitchell Reservoir through water year 2010-2011. These stations were selected as representative indicators for rainfall and runoff of the County's major watersheds.

Santa Barbara County is subject to some of the highest short duration rainfall intensities in California. Intensities of 1.15 inches for a 15 minute period were recorded in 1993 at the Buellton Fire Station and 14.09 inches were recorded for a 24 hour period in 1969 at Juncal Dam nestled behind the Santa Ynez Mountains at an elevation of 2,075 feet above sea level. Generally, the Santa Barbara County area receives only one or two storms per season that produce rainfall intensities of 3/4 of an inch per hour or greater.

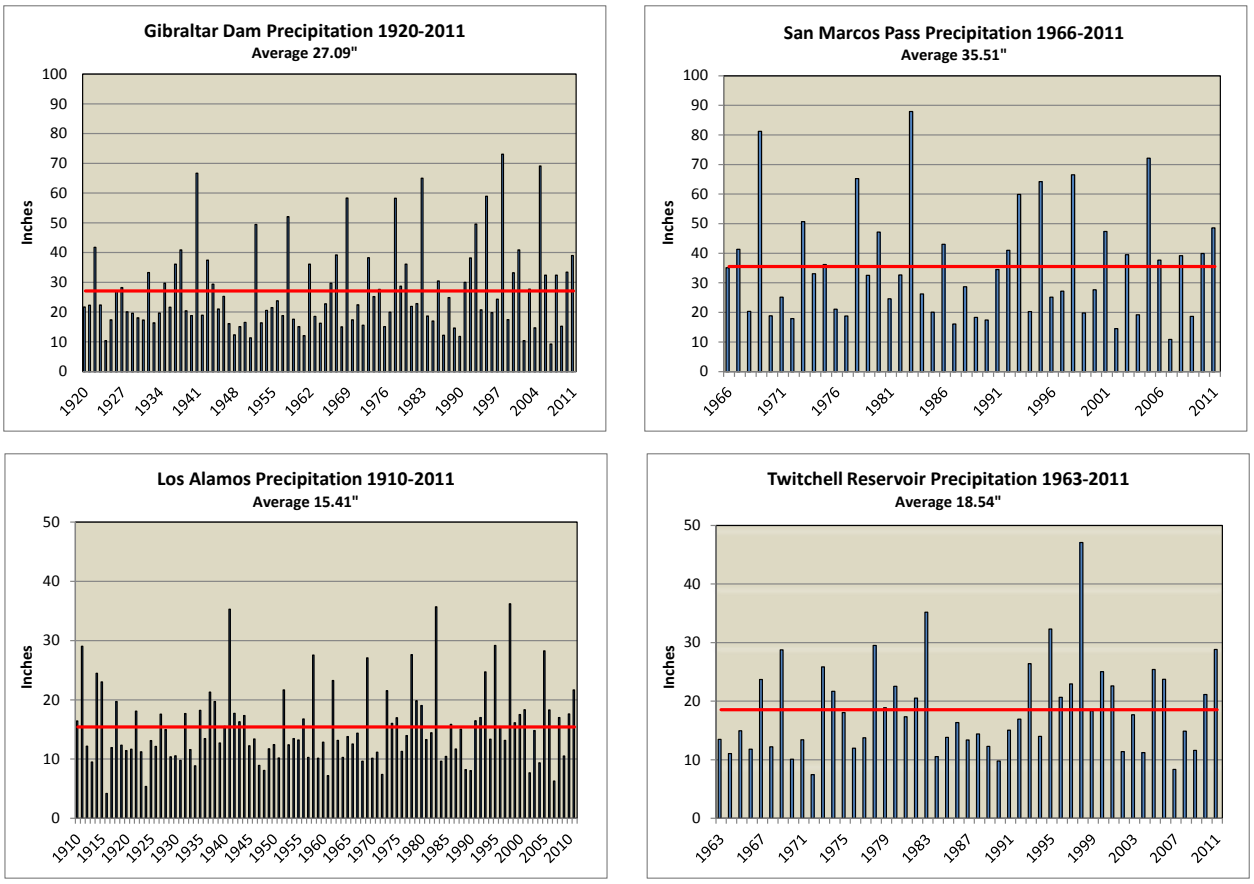


Figure 5: Seasonal Precipitation Through 2011

Santa Barbara County's weather is controlled mainly by the Pacific High Pressure System. Uncommon warm type storms originating in the Southeast Pacific Ocean and more common winter cold type storms from the Gulf of Alaska comprise the scope of the County's precipitation. In the dry season between the months of May through September the Pacific High Pressure usually occupies the area northeast of Hawaii keeping the storm track far away from the local area. During the winter months it is weaker and positioned further south allowing storm systems that form off the coast of Asia to move toward the Aleutian low pressure zone. There, these storms frequently gain strength and continue their movement southeast along the West Coast of the United States. During this southward movement the storms usually weaken and in most cases Santa Barbara County receives relatively gentle but steady rain as an occluded cold front, formed when cold air overtakes warm air, trails past the area. Occasionally a cold storm maintains its strength until it reaches Southern California, at which time the County may experience precipitation of high intensity. At times the persistence of the Pacific High at latitude farther north during the winter months keeps the Pacific storm track farther to the north. This "blocking high" results in either no precipitation for California or at most only light amounts. This climatological scenario is the reason for most of California's dryer than normal winters including the 1976-1977 and 1989-1990 seasons.

Precipitation and Recharge Patterns during the 2009-2011 Period

Rainfall during the 2009-2011 period was 112% of average County-wide and as such produced intermediate amounts of recharge to groundwater basins and inflow to reservoirs. The dry 2008-2009 winter produced 67% of normal rainfall, the 2009-2010 winter produced 117% of normal and the notable 2010-2011 winter produced 154% of normal precipitation which ranked the second most over the past ten years, only surpassed by water year 2004-2005. It is important to note that average rainfall does not typically produce significant recharge.

The 2009 winter was characterized by a less than average rainfall year producing only 67% of normal rainfall. The significant storms with moderate rainfall intensities that occurred in mid-December and February yielded the majority of the rain recorded for the year. Nearly half of the year's total rainfall occurred in February with monthly totals of 6.18 inches in Carpinteria, 7.22 inches at Gibraltar Dam, 5.16 inches in Los Alamos and 5.01 inches at Twitchell Reservoir as compared to normal February totals of 4.41, 6.21, 3.30 and 3.67 inches, respectively.

At 117% of County-wide normal rainfall the 2009-2010 water year ranked as the third wettest year for the past ten years. The 2009-2010 winter was characterized by near average rainfall, low to moderate intensity rainfall and an unusual mid-October high volume rain event that resulted in near record setting rainfall for that month. Near average amount of rain throughout the winter resulted in full or near-full surface reservoirs, and limited groundwater recharge.

Water year 2010-2011 produced 154% of normal precipitation including a much higher than normal and record setting December rainfall and a significant storm event in March. January through mid-February had much lower than normal rainfall. The higher than average rainfall throughout the winter resulted in full to spilling surface reservoirs, and significant groundwater recharge.

Figure 6 on the following page depicts rainfall for selected locations throughout the County during the 2009-2011 period compared to average seasonal rainfall.

Effects of Recent Climate on Santa Barbara County Groundwater Basins

Many of the monitoring wells discussed in this report exhibit pronounced water level fluctuations as a result of the varying weather patterns of the area's semi-arid climate. Note that in most years the area receives below average rainfall.

Well response to precipitation depends on many factors including the percolation time required for recharge to reach water tables. Deep aquifers respond slowly, often having a lag time of two or more years (see the hydrograph in the Santa Ynez Uplands Groundwater Basin section). Shallow aquifers such as those near creeks and rivers and those located in relatively shallow basins with surface material of high porosity tend to respond more quickly to variations in precipitation and stream flow. Therefore, in such areas there has been a strong correlation between well measurements for a particular year and that season's precipitation typified by Well 6N/31W-2K1 located adjacent to Alamo Pintado Creek south of Ballard.

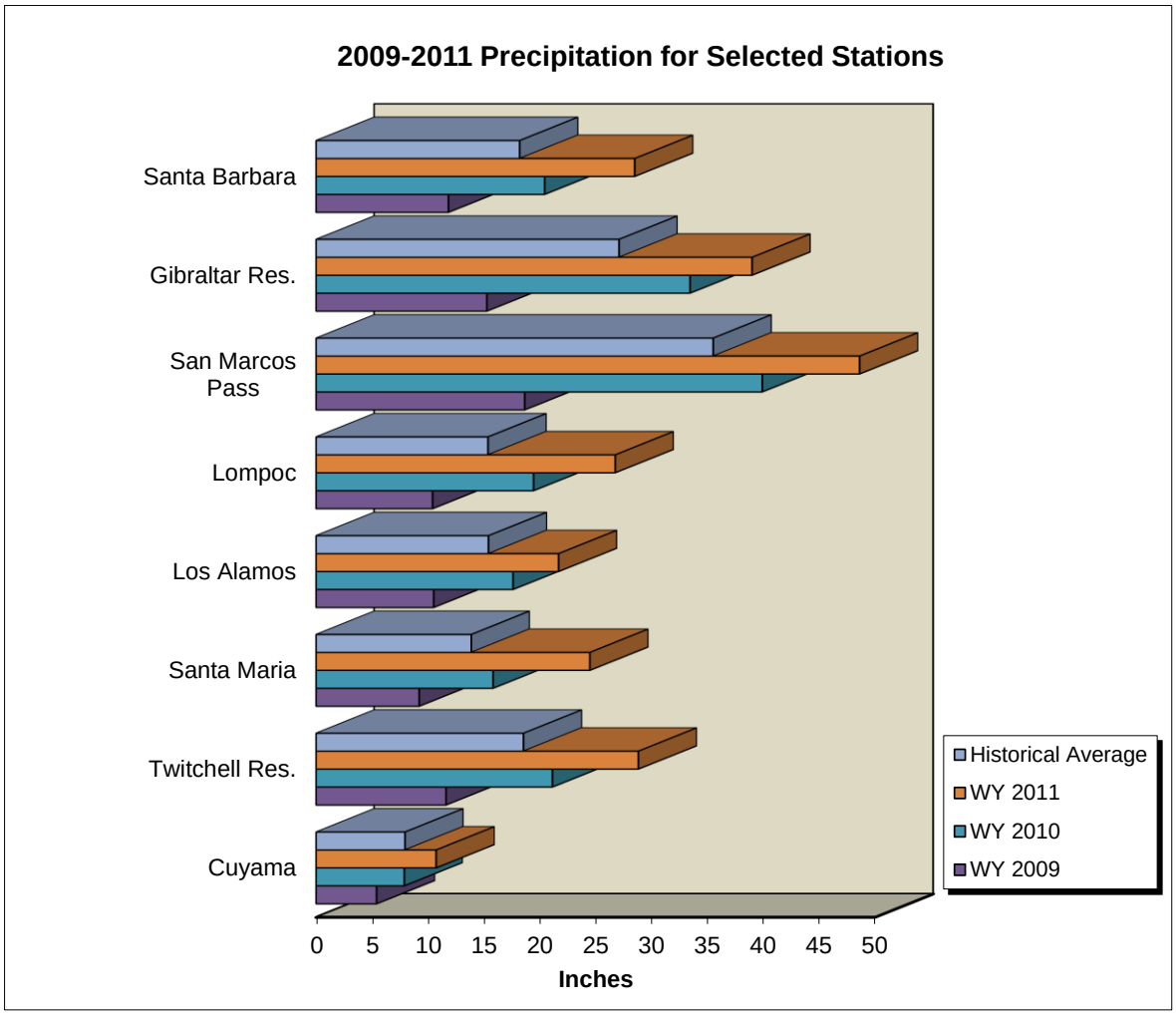


Figure 6: Precipitation for Selected Stations 2009-2011

The drought of 1987 to 1991 led to significant declines in water levels (see the hydrograph in the Santa Maria Groundwater Basin section). Following the 1990-1991 season, seven out of nine water years produced above average rainfall, and as a result of this wet period groundwater levels throughout Santa Barbara County in 1999-2002 were generally the highest since the mid-1940s and, in some areas, since the 1920s. The historic winter of 1997-1998, which produced some of the largest rainfall amounts of record, caused shallow wells to rise sharply during that year, and deeper wells to rise for up to four years afterwards. Water year 2000-2001 produced copious rainfall amounts throughout Santa Barbara County and Lake Cachuma filled and spilled. Rainfall during the 1998-1999 and 1999-2000 winters was near average and did not produce significant runoff or recharge to groundwater basins. Water year 2002-2003 rainfall was above average but was spread throughout the season allowing it to be taken up by the vegetation which reduced potential recharge amounts. Rainfall during the 2001-2002 and 2003-2004 winters was near only 50% of average. Water year 2004-2005 rainfall was 188% of normal and was the most recent season to noticeably produce substantial runoff to reservoirs and recharge to groundwater basins. Alluvial and shallow wells received an immediate response which was reflected in the 2005 groundwater measurements, while the deeper wells exhibited rise from this recharge through 2008. Most recently, a relatively dry water year 2008-2009 did not contribute to groundwater levels and the average 2009-2010 winter

produced a limited amount of recharge. Water year 2010-2011 was a much wetter than normal winter. Therefore, positive recharge responses in subsequent groundwater measurements have been realized in shallower aquifers and are expected in deeper aquifers.

Figure 7 below describes the long-term fluctuation of the local area. It is a cumulative deviation or 'departure' from mean chart which illustrates multi-year trends in the area. When rising, the graph line represents a wet trend and when falling represents a dry trend. The figure exhibits long-term trends that affect groundwater levels and storage within the County. The late part of the 19th century shows a dry trend lasting through 1904, after which there was an extremely wet trend lasting through 1918. The recent wet trend of 1991 to 2005 is one of the wettest periods on record, second only to that of 1905-1918. The noteworthy long-term dry period as shown on the graph is 1946-1977, although that varies somewhat at different rainfall gauging stations throughout the County. The graph shows recent fluctuations potentially near the end of an average to wetter than normal period.

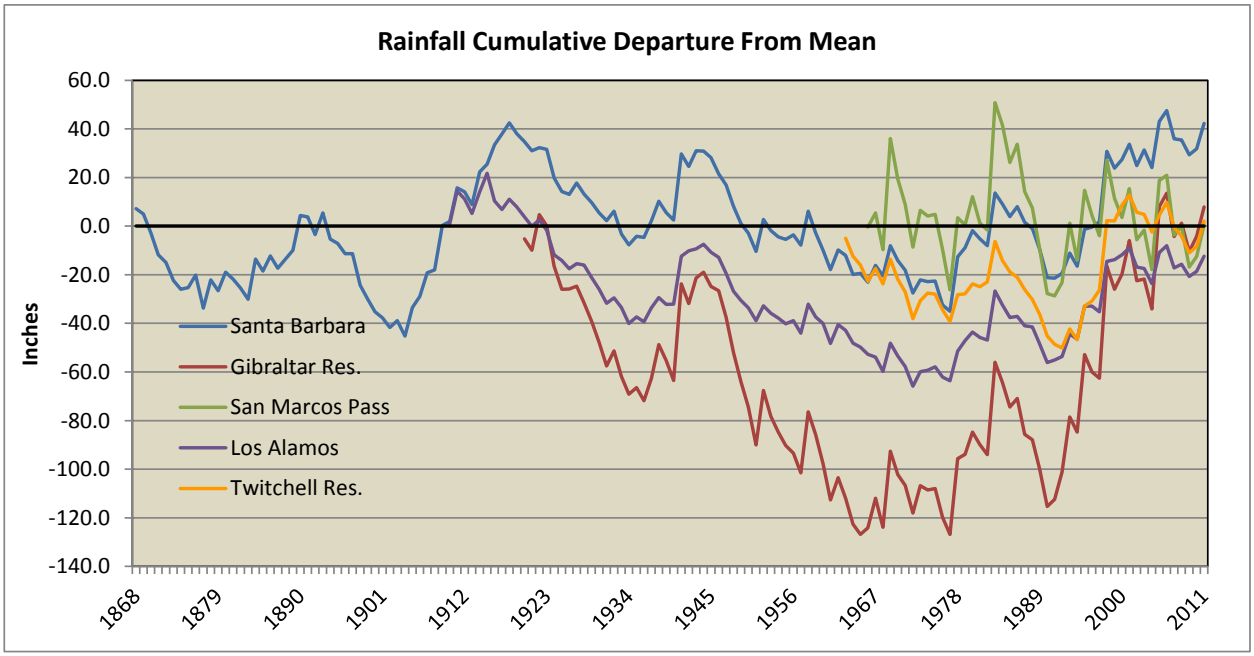


Figure 7: Rainfall Cumulative Departure from Mean

It is important to note that localized influences such as variations in pumping can obscure general groundwater level trends thus every effort is made to use well data collected during periods of no local pumping. Factors affecting trends displayed by well hydrographs include length of record, proximity to sources of recharge and active wells, and short-term climatic variations. As a result of these factors, in the Santa Barbara County region single year or short term groundwater trends are of limited value in assessing overall basin conditions due to annual rainfall fluctuations.

Another effective way to examine the hydrologic condition of the area is to look at a time series chart of the storage in Lake Cachuma and Twitchell Reservoir. When storage is high it generally corresponds to a recent or current wet period and when storage is low it generally corresponds to the opposite. Examination of Figure 8 on the following page reveals that following the drought of 1987-1990 Lake Cachuma was extremely low, then high in the mid to late 1990s due to above average rainfall during the period 1992-1998. The lake then dropped through the period

late 2001 through 2004 due to below average or near average rainfall but then recovered during the extreme rain events of the 2004-2005 winter. In 1995 the lake was kept at a lower than normal operating level due to seismic strengthening work on the Dam. The “spikes” from 1995 were caused by exceptionally large January 10 and March 10 storms that delivered a large amount of water to the facility. The lake was immediately and intentionally lowered right after the storms to continue with the seismic strengthening work. The “spike” in 1998 was from the February 23rd storm during which the lake was intentionally surcharged to hold back floodwaters and protect downstream interests. The blue line represents the “full” lake at elevation 750 feet msl (mean sea level). When water is stored above that elevation the lake is said to be “surcharged.”

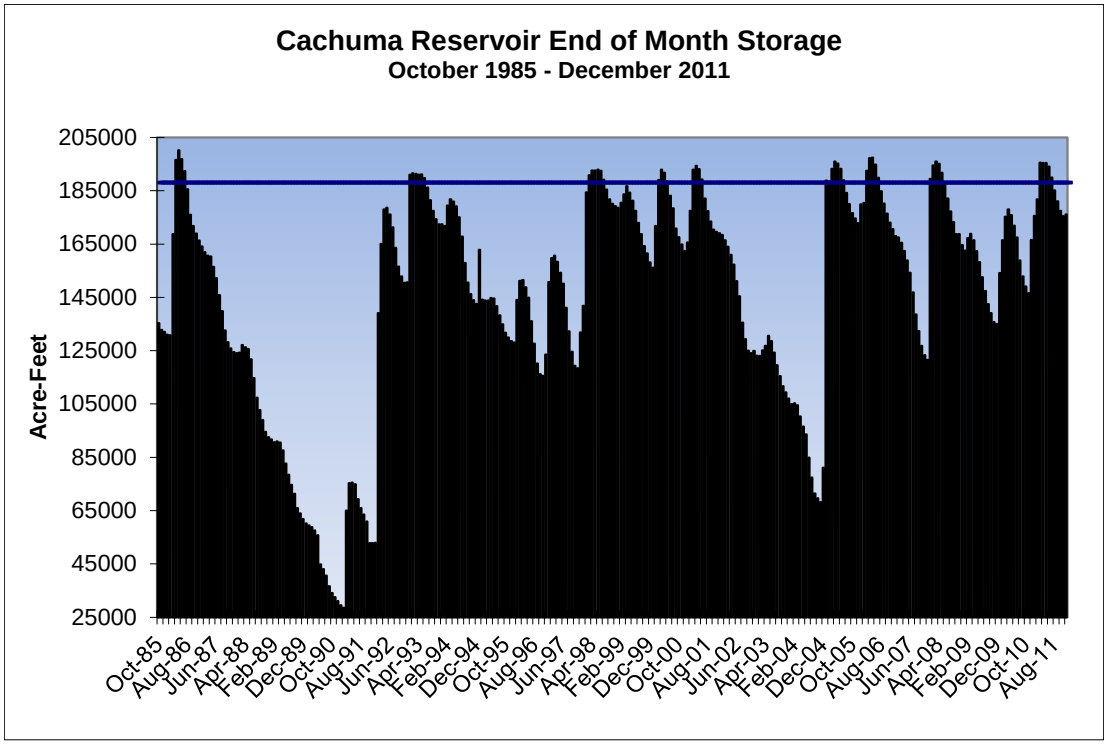


Figure 8: Cachuma Reservoir Storage from 1985 to 2011

Figure 9 on the following page charts the storage in Twitchell Reservoir. This reservoir provides recharge to the Santa Maria Valley Groundwater Basin. The objective is to intentionally release water from storage as quickly as it can be percolated into the basin. Therefore Twitchell Reservoir is empty much of the time but its storage still demonstrates periods of drought or runoff from the Cuyama watershed which exhibit similar climate patterns as those of Lake Cachuma.

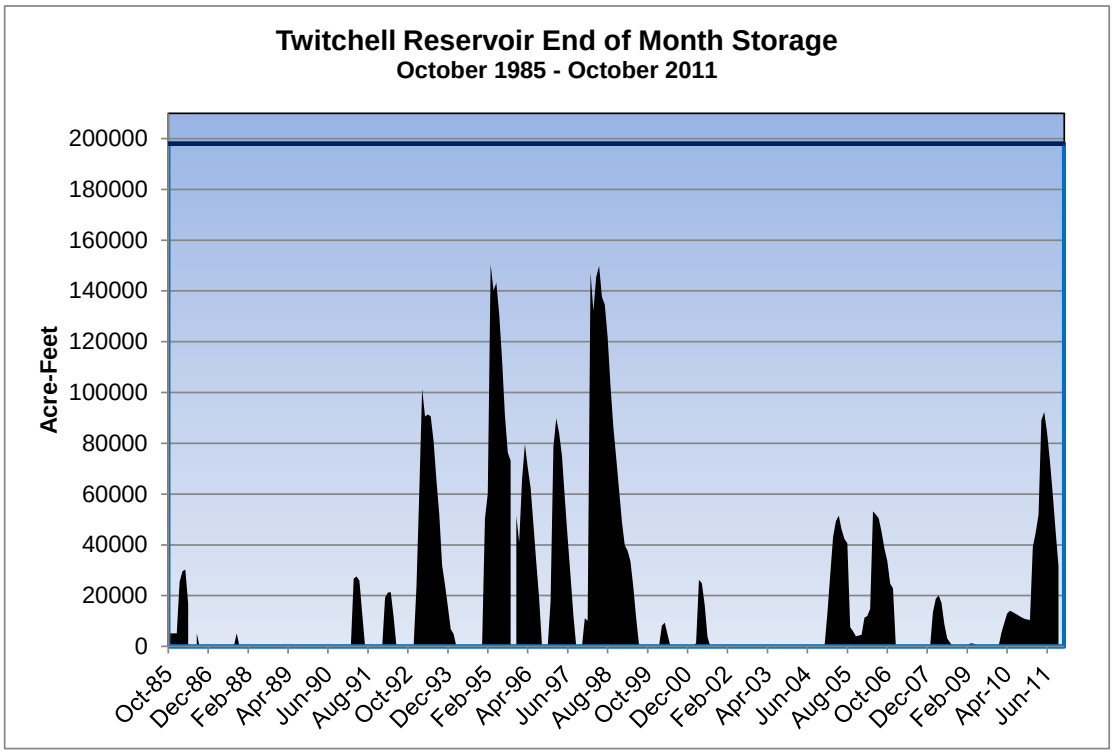


Figure 9: Twitchell Reservoir Storage from 1985 to 2011

Effects of Wildland Fire on Runoff and Recharge Patterns

The recent Zaca, Gap, Tea, Jesusita and La Brea Fires denuded the hillsides of vegetation and in many areas made the soil hydrophobic or water repellent. The thick chaparral vegetation usually intercepts much of the rainfall before it gets to the ground. Thus, runoff from the burn areas, where vegetation is denuded, is greatly accelerated. In areas like the South Coast this can be extremely problematic for the Flood Control District, cities and property owners who need to avoid excessive and accelerated runoff. However, in the larger watersheds of the Santa Ynez and Sisquoc Rivers the accelerated runoff may help to fill reservoirs and groundwater basins with less rainfall then would have occurred under unburned conditions. Conversely, runoff from recently burned watersheds may be of poor quality and carry greatly increased sediment into the reservoirs resulting in the need for extreme levels of water treatment and accelerated loss of reservoir capacity. The burn areas have experienced several winter rain seasons of vegetative recovery since the fires.

Climatic Indicators

The yield of water supply facilities and groundwater basins is commonly determined by modeling based on previously recorded hydrologic data. Critical to this method is the assumption that future climate will be similar to that recorded since the mid 1800's. Thus long term climatic fluctuations not reflected in modern records or newly introduced climatic factors such as those associated with anthropogenic climate change may decrease the accuracy of projections. Many climatic indicators are commonly used in attempting to make seasonal or multi seasonal forecasts of water availability. El Niño, the Pacific Decadal Oscillation and Dendrochronology, otherwise known as tree ring analysis, are the most common.

El Niño

El Niño is the most well-known and publicized climatic indicator. El Niño is an oscillation of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe. El Niño is defined by sustained differences in Pacific-Ocean surface temperatures when compared with the average value. The accepted definition is a warming (El Niño) or cooling (La Niña) of at least 0.5°C (0.9°F) averaged over the east-central tropical Pacific Ocean. When this happens for less than five months, it is classified as El Niño or La Niña conditions; if the anomaly persists for five months or longer, it is called an El Niño or La Niña "episode." Typically, this happens at irregular intervals of two to seven years and lasts nine months to two years. The first signs of an El Niño are:

- Surface air pressure rises over the Indian Ocean, Indonesia, and Australia
- Air pressure drops over Tahiti and the rest of the central and eastern Pacific Ocean
- Trade winds in the south Pacific weaken or head east
- Warm air rises near Peru, causing rain in the northern Peruvian deserts
- Warm water spreads from the west Pacific and the Indian Ocean to the east Pacific. It takes the rain with it, causing extensive drought in the western Pacific and rainfall in the normally dry eastern Pacific.

El Niño's warm current of nutrient-poor tropical water, heated by its eastward passage in the Equatorial Current, replaces the cold, nutrient-rich surface water of the Humboldt Current. When El Niño conditions last for many months, extensive ocean warming occurs and its economic impact to local fishing for an international market can be significant. For Santa Barbara County, the main impact of El Niño is increased seasonal rainfall. Recent El Niño years include the wet seasons of 1982-1983, 1985-1986, 1991-1992 and 1997-1998.

Pacific Decadal Oscillation

The Pacific Decadal Oscillation (PDO) is a long-term ocean fluctuation of the Pacific Ocean. The PDO waxes and wanes approximately every 20 to 30 years. The PDO (like El Niño) is characterized by changes in sea surface temperature, sea level pressure, and wind patterns. The PDO Index is calculated by spatially averaging the monthly sea surface temperatures of the Pacific Ocean north of 20^0N. The PDO is described as being in one of two phases: a warm phase and a cool phase. During the 20th century, each PDO phase typically lasted for 20-30 years. Studies indicate that the PDO was in a cool phase from approximately 1890 to 1925 and 1945 to 1977. Warm phase PDO regimes existed from 1925-1946 and from 1977 to 1998. Pacific climate changes in the late 1990s have, in many respects, suggested another reversal in the PDO from warm to cool. However, a lack of PDO understanding makes it impossible to determine true PDO reversals soon after they occur. Note that there appears to be strong correlation of Santa Barbara County rainfall with the PDO. From the Cumulative Departure from Mean chart on page 19 it can be deduced that while the PDO is in a cool phase our seasonal rainfall volume is declining and while the PDO is in a warm phase our seasonal rainfall volume is increasing. Figure 10 on the following page illustrates the historic PDO index which has most recently shifted between cool and warm periods. For more information on the PDO visit the University of Washington website http://cses.washington.edu/cig/pnwc/aboutpdo.shtml.

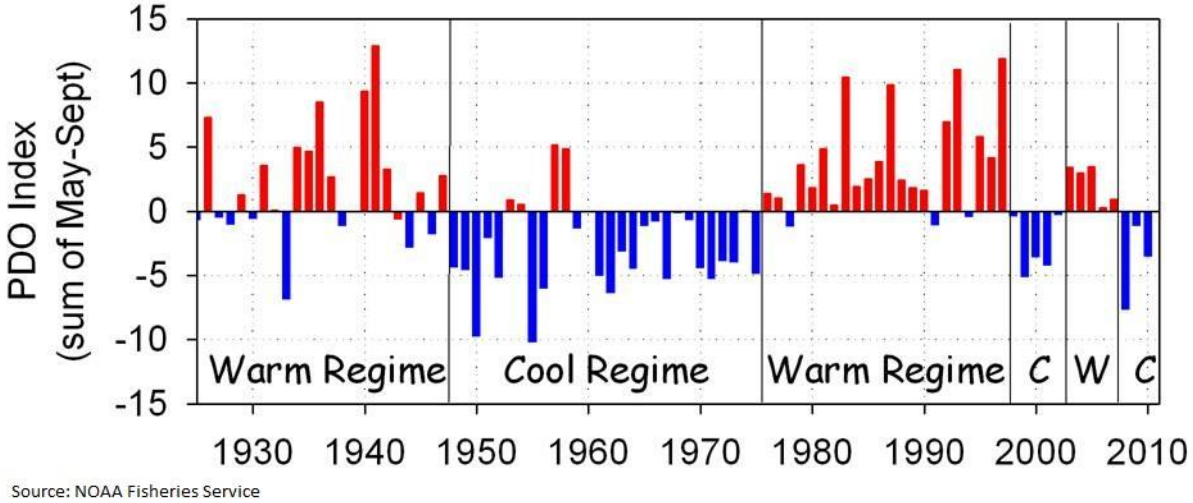


Figure 10: Historic PDO Index

Dendrochronology

Dendrochronology, or tree ring analysis, is the dating of past climatic changes through the study of tree ring growth. Botanists, foresters and archaeologists began using this technique during the early part of the 20th century. Dendrochronology was discovered by A.E. Douglass, who noted that the wide rings of certain species of trees were produced during wet years and, inversely, narrow rings during dry seasons. Each year a tree adds a layer of wood to its trunk and branches thus creating the annual rings we see when viewing a cross section. New wood grows from the cambium layer between the old wood and the bark. In the spring, when moisture is plentiful, the tree devotes its energy to producing new growth cells. These first new cells are large, but as the summer progresses their size decreases until, in the fall, growth stops and cells die, with no new growth appearing until the next spring. The contrast between these smaller old cells and next year's larger new cells is enough to establish a ring, making counting possible. Thus, rainfall patterns can be deduced from examining tree rings. In the Southwestern United States, tree rings provide a time series that is similar to rainfall and runoff. Tree ring analysis and reconstruction of climate has been done for the Santa Ynez River Watershed (Michaelsen and Haston, 1988) and indicates that since 1537 there have been major fluctuations in precipitation variability including changes in the frequency of extremes and rare events that have not occurred in modern records. One such rare event was an extremely dry period from 1621 to 1637 in which there was a 33% decline in water supply. As previously mentioned in this report the critical parameter in evaluation of a groundwater basin is the base period used to project climate and recharge to the basin, thus analyses can be faulty when selecting an unusually wet or dry period.

Geologic Setting

Santa Barbara County is situated entirely on the Pacific Plate, the tectonic plate beneath the main portion of the Pacific Ocean. The local geography was originally formed as a product of subduction of the Pacific Plate beneath the western boundary of North America. The formation of the Santa Ynez, San Rafael, and Sierra Madre Mountains including the Channel Islands are a result of these ongoing plate interactions. Santa Barbara County is relatively young geologically-speaking. The oldest rocks, found on Santa Cruz Island, date back to 150 million years ago (mya). About 15 mya the plate motion became more oblique and subduction transitioned to transform and compressional faulting. Today the plate boundary between the North American Plate and the Pacific Plate is defined by the San Andreas Fault located to the northeast of the County. Movement of this portion of the Pacific Plate is one to two inches per year to the northwest as the result of seafloor spreading, colliding with and sliding laterally along the North American Plate. The County's mountain ranges are part of California's Transverse Ranges. They derive this name due to their east-west orientation, created by a bend in the San Andreas Fault, making them transverse to the general north-south orientation of most of California's coastal mountains. This unique positioning has important influences on the County's climate (see Climate and General Hydrologic Trends section).

The majority of the Santa Barbara County mainland consists of marine sedimentary rock; originally loose sand, soft mud or gravel deposited on the sea floor. These sediments were laid down in the late Cretaceous to early Tertiary Period (150-65 mya). Over the last 10 million years, these beds have been compressed, raised, and folded into their current configuration above sea level. Marine terraces created by wave erosion were also elevated and exposed on the mainland. The landscape in Santa Barbara County continues to evolve as the process of tectonic uplift outpaces erosion as evidenced by our coastal cliffs and narrow beaches.

The groundwater resources of Santa Barbara County are a direct result of these geologic processes. Water bearing formations typically consist of unconsolidated clay, silt, sand and gravel either marine or fluvial in origin ranging in age from the Pliocene Epoch (5.0–1.8 mya), the Pleistocene Epoch (1.8-.01 mya), to the Holocene Epoch (< .01 mya).

Along the South Coast, primary water bearing rocks consist of Holocene and Pleistocene alluvium, underlain by Pleistocene terrestrial deposits (Carpinteria Formation, Casitas Formation), and the late Pliocene, early Pleistocene Santa Barbara Formation, which is composed of massive unconsolidated marine deposits.

North of the Santa Ynez Mountains, groundwater is found in Holocene alluvium and dune sand, Pleistocene terrace deposits (Orcutt Formation, Paso Robles Formation), and Pliocene formations of loosely consolidated marine sand and silt (Careaga Sand). In the Cuyama Valley groundwater is found in Holocene alluvium, underlain by Pleistocene terrace deposits, and the Pliocene Cuyama or Morales Formation consisting of terrestrial deposits of poorly consolidated clay, silt, and gravel.

Major Water Bearing Geologic Formations of Santa Barbara County

This section provides a summary of the major water bearing formations of Santa Barbara County that are discussed in this report (in order of their geologic age from oldest to youngest). All of the formations listed are from the Pliocene, Pleistocene, or Recent Geologic Epochs. These correspond to 5 million, 1.8 million, and 10,000 years before present, respectively.

Careaga Sand

The Careaga Sand of late Pliocene age is a predominately marine formation that is part of the Santa Maria, San Antonio, Santa Ynez Uplands and Lompoc Groundwater Basins. It consists of two distinct members, the upper or Graciosa member and the lower or Cebada member (Woodring and Bramlette, 1950). It is a loosely consolidated sand containing some silt and abundant well rounded pebbles in the upper part. It is typically grey white to yellow in appearance and can yield moderate amounts of water to wells. Reports of wells yielding several hundred gallons per minute from this formation are not uncommon. The Careaga Sand contains much silt and fine sand and has a reputation of sanding up water wells tapping it, thus care must be taken in construction of wells that are to tap this formation.

Paso Robles Formation.

The Paso Robles Formation of Quaternary and Tertiary age is a continental formation that is part of the Santa Maria, San Antonio, Santa Ynez Uplands and Lompoc Groundwater Basins. It is the most widespread producer of water of all the groundwater basins in Santa Barbara County. It consists of unconsolidated to poorly consolidated coarse sand and gravel, as well as finer sand, silt, and clay. The lower part of the formation contains occasional beds of fresh water limestone that formed from deposition in floodplains and small lakes ranging in thickness from one to 30 feet. Yields from the Paso Robles Formation are typically between 500 to 1,200 gallons per minute.

Morales Formation

The Morales Formation of Pliocene to Pleistocene age is a continental formation that is part of the Cuyama Groundwater Basin. It consists predominantly of large and extensive bodies of poorly consolidated clay, silt, sand and gravel. This formation has not been studied extensively and thus not much is known about the hydraulic properties of the aquifer. It is known that wells tapping this formation can yield in excess of 1,000 gallons per minute. The SBCWA is currently conducting a study of the Cuyama Groundwater Basin in cooperation with the USGS and as part of the study properties of the Morales Formation will be explored.

Santa Barbara Formation

The Santa Barbara Formation is a marine formation of Pleistocene age that is part of all the South Coast Groundwater Basins: Goleta, Santa Barbara, Montecito and Carpinteria. It is comprised of sand, silt and clay and is up to 2,000 feet thick in some areas. It is more prevalent in the Goleta and Santa Barbara Groundwater Basins than the Montecito and Carpinteria Groundwater Basins. Typical yields of the Santa Barbara Formation are between 250 gallons per minute (Carpinteria Groundwater Basin) to over 1,000 gallons per minute (Goleta Groundwater Basin).

Casitas Formation

The Casitas Formation of Pleistocene age is a continental formation that serves as the principal aquifer for the Carpinteria and Montecito Groundwater Basins. It is comprised of unconsolidated clay, silt, sand and also gravel in areas close to the base of the Santa Ynez Mountains. Its appearance is red to buff in color. It lies unconformably upon most if not all of the Santa Barbara Formation. Typical yields from the Casitas Formation are 500 to 1,000 gallons per minute.

Orcutt Formation

The Orcutt Formation of middle to late Pleistocene age is a continental formation that rests unconformably primarily on the Paso Robles Formation and is part of the Santa Maria, San Antonio and Lompoc Groundwater Basins. It is generally only 50 to 200 feet in thickness. This formation is composed of two members, an upper fine grained member and a lower coarse grained member. The upper member is mostly a loosely compacted massive medium grained clean sand, stained reddish brown by a ferruginous cement and interstratified with lenses of clay. The lower member is a loosely compacted coarse grey to white gravel and sand. In many areas the Orcutt Formation is above the water table, but in areas where it is not it can yield water in appreciable quantities.

Older Alluvium

The Older Alluvium of late Pleistocene age consists of unconsolidated clay, silt, sand and gravel and is partly continental and partly marine in origin, dependent upon location. The deposits rest unconformably on the Casitas Formation, the Santa Barbara Formation, the Paso Robles Formation and the Morales Formation in Santa Barbara County. The Older Alluvium is typically up to 250 feet in thickness and can yield moderate amounts of water to wells.

Terrace Deposits

Terrace Deposits of the late Pleistocene age reside in most groundwater basins in Santa Barbara County as they are created by lateral erosion of streams and wave erosion during high stands of the sea. They consist of unconsolidated clay, silt, sand and gravel and are partly alluvial and party marine in origin. At most places the deposits are above the water table and too thin or inextensive to contain groundwater, although a few domestic wells do tap the Terrace Deposits.

Younger Alluvium

The Younger Alluvium of recent geologic age is a continental formation that has formed due to fluvial events of the recent past and is found in all groundwater basins of Santa Barbara County. It consists of unconsolidated clay, silt and sand, with minor amounts of gravel. It is typically 10 to 100 feet thick, dependent upon location. Generally this formation yields water only moderately readily and cannot support sustained pumping from wells. In many areas it is above the water table.

Santa Barbara County Groundwater Basins

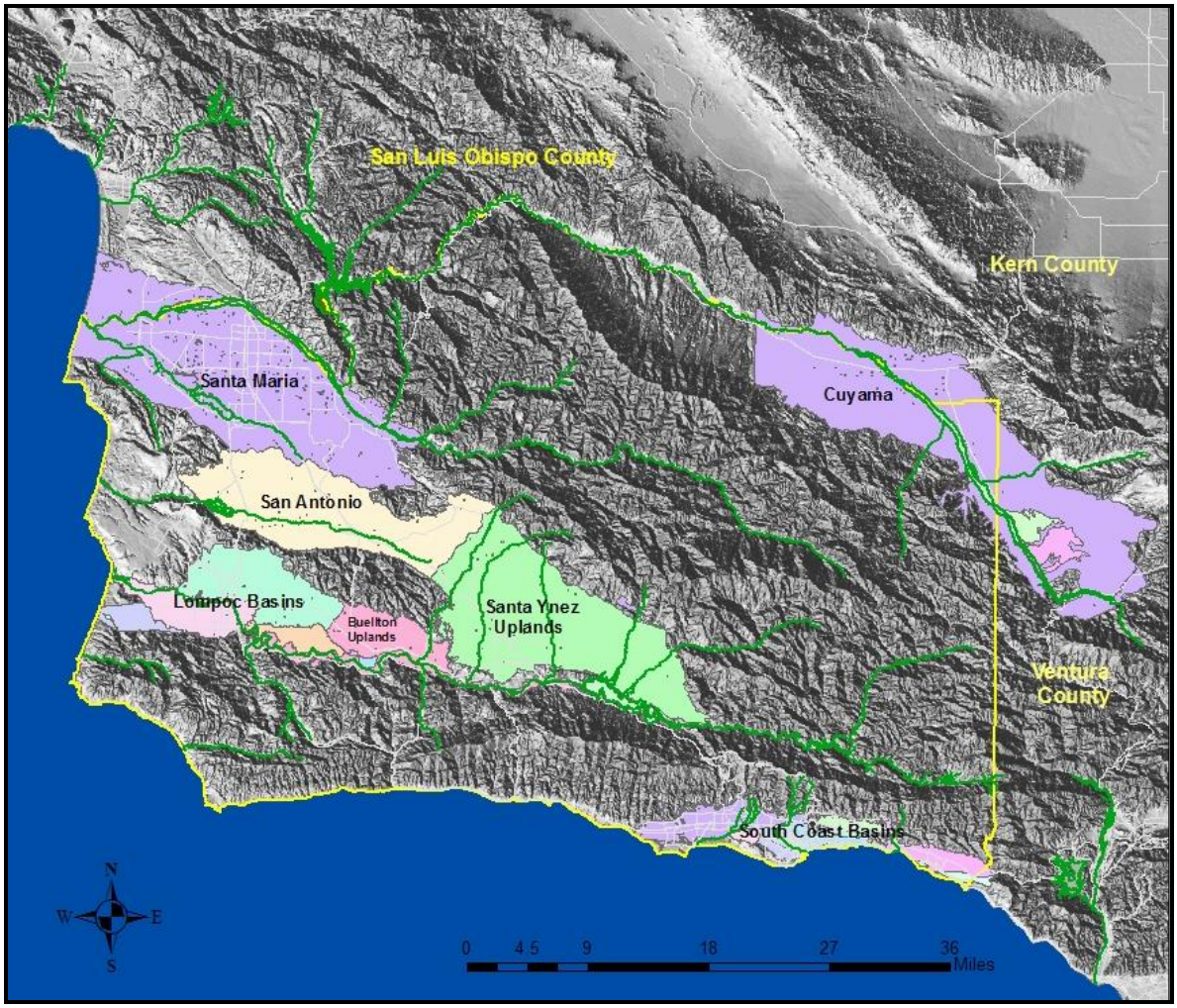


Figure 11: Santa Barbara County Groundwater Basins

1. South Coast Groundwater Basins:
    - Carpinteria
    - Montecito
    - Santa Barbara
    - Foothill
    - Goleta
2. The Santa Ynez River Watershed:
    - Santa Ynez Uplands
    - Santa Ynez Alluvial
    - Buellton Uplands
    - Lompoc Groundwater Basins
3. The North Coastal Groundwater Basins:
    - San Antonio
    - Santa Maria
4. The Cuyama Groundwater Basin

South Coast Groundwater Basins

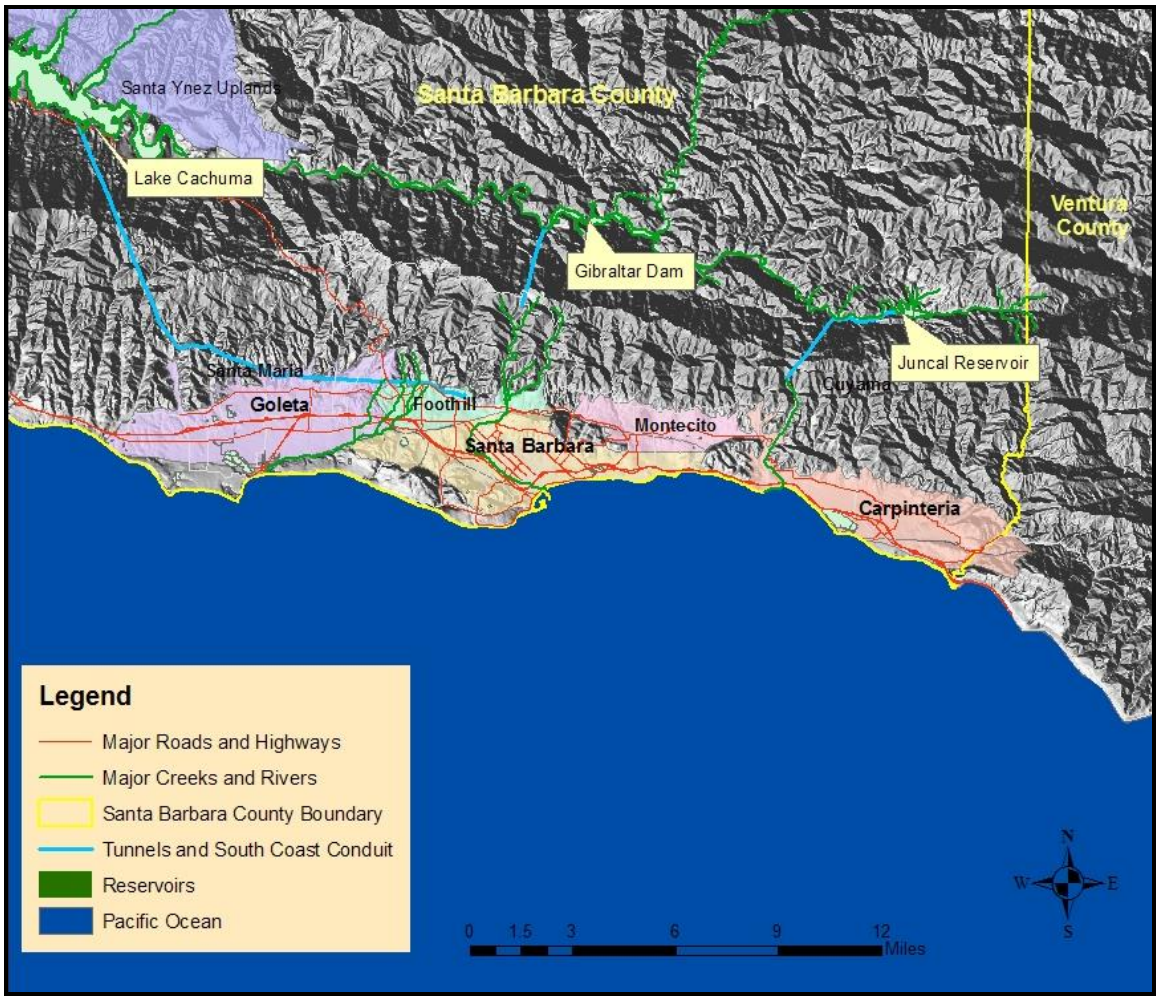


Figure 12: South Coast Groundwater Basins

The South Coast basins are located between the Santa Ynez Mountains and the Pacific Ocean. In general, these basins are composed of the unconsolidated material that accumulated as a result of the uplift and erosion of the ancestral Santa Ynez Mountains. Several of the basins are generally differentiated from each other where faulting or impermeable geologic formations limit the hydrologic connection between the aquifers. Faults, impermeable bedrock, inferred lithologic barriers, or arbitrary (administrative) boundaries separate the major groundwater basins (Carpinteria, Montecito, Santa Barbara, Foothill and Goleta) from each other. Inferred barriers exist where pronounced changes in water depth and/or water quality exist but where there is no other direct physical evidence of faulting or other physical barriers. It is important to note that basin and sub-basin boundaries might change as more is learned about the geologic and hydrologic relationships between the aquifer units.

Carpinteria Groundwater Basin

Physical Description

The Carpinteria Groundwater Basin underlies approximately 12 square miles in the Carpinteria Valley and extends east of the Santa Barbara County line into Ventura County. The basin contains two groundwater storage units (Geotechnical Consultants, Inc., 1976). Storage Unit No. 1 is located north of the Rincon Creek thrust fault and Storage Unit No. 2 is located south of the Rincon Creek thrust fault. The fault acts as a barrier to groundwater flow between the two storage units. Both groundwater storage units contain a component of groundwater in storage offshore. Based on historic records of groundwater pumped from each storage unit over the last 50 years, the useable volume of groundwater in Storage Unit No. 1 is on the order of 15,000 AF. The useable volume of groundwater in Storage Unit No. 2 is much smaller, likely on the order of 1,000 AF.

The Toro Canyon Sub-basin forms the most westerly part of the greater Carpinteria groundwater basin, and is included in the Montecito Water District (MWD) service area instead of the Carpinteria Valley Water District (CVWD) service area. The Toro Canyon area occupies a small extension of Storage Unit No. 1.

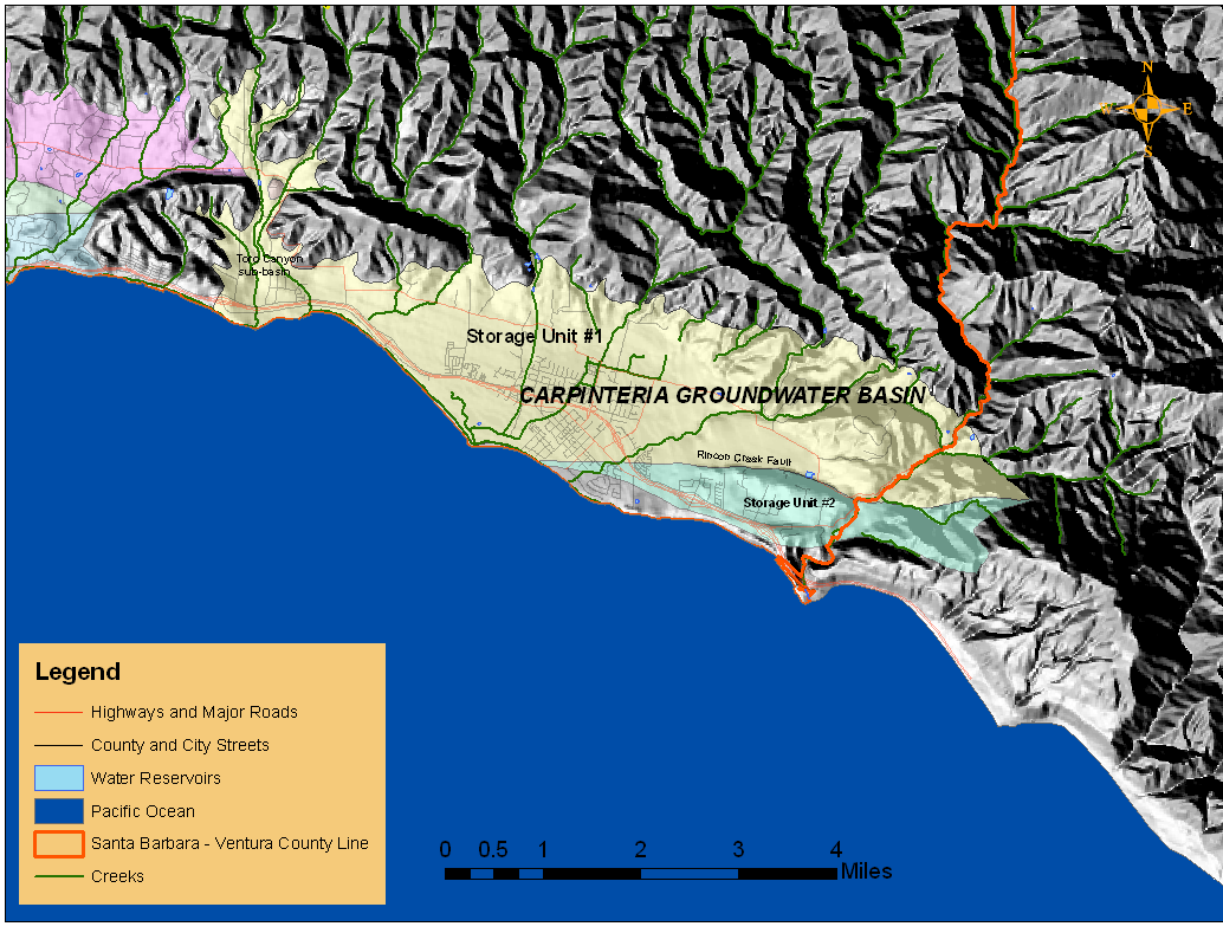


Figure 13: Carpinteria Groundwater Basin

The primary water-bearing deposits or aquifers in the Carpinteria basin are contained in the Casitas Formation, which is composed of lenticular deposits of poorly sorted clay, silt, sand and gravel, interspersed by cobbles and boulders (Upson and Thomasson, 1951). Storage Unit No. 1 for the most part consists of the Casitas Formation. Wells which produce groundwater from the Casitas Formation often display yields in the range of 500 to 1,000 gallons per minute (gpm). Aquifers in Storage Unit No. 2 consist of marine sand layers of the Santa Barbara Formation. Wells in this aquifer have yields in the range of 250 gpm. In addition, alluvial deposits locally overly the Casitas Formation, and provide a shallow water body that can yield moderate amounts of water.

Precipitation in the basin varies with elevation and averages about 16.6 inches per year near the coast but increases to about 24 inches per year on the south flank of the Santa Ynez Mountains. The primary drainages through which surface water empties into the Pacific Ocean are Rincon Creek, Carpinteria Creek, Franklin Creek, Santa Monica Creek, and Toro Canyon Creek (Fugro, 2009).

History and Analyses

The history of groundwater development and use in the Carpinteria Groundwater Basin is best described by Upson and Thomasson (1951), Geotechnical Consultants Inc. (1976) and the SBCWA (1977). Current conditions of groundwater use including water level data, groundwater production, and groundwater quality are contained in annual reports the CVWD prepares in accordance with its adopted Assembly Bill (AB) 3030 Groundwater Management Plan. The most recent annual report was prepared by Fugro Consultants, Inc. (2011) which documents groundwater conditions and use for the calendar year 2010. The internet link to this report on the CVWD website is provided below:
http://www.cvwd.net/pdfs/2010_CVWD_GW_Report_Fugro_complete.pdf

The total volume of groundwater in the Carpinteria Basin is estimated to be 700,000 AF and of this total, approximately 575,000 AF is contained in Storage Unit No. 1, and about 75,000 AF contained in Storage Unit No. 2. Some small component of groundwater is also contained in storage offshore. Useable groundwater in storage is much less than the total volume of groundwater in storage. Based on a water balance mathematical model of the basin contained in the Geotechnical Consultants, Inc. report (1976), useable groundwater in storage in Storage Unit No. 1 is on the order of 15,000 AF and perhaps on the order of 1,000 AF for Storage Unit No. 2. The estimates are based on the observed historical range of water level variations and groundwater pumped annually from each storage unit over the 1933 to 1973 base period.

The safe yield of the basin (for gross pumpage) is estimated to be 5,000 AFY. Most recent pumpage information contained in Fugro (2011) indicate that from about 1998 groundwater pumpage from the basin has been on the order of 3,600 AFY. Of this amount, CVWD pumpage has been on the order of about 1,100 AFY. The balance of groundwater pumpage has been by private landowners for agricultural purposes. During this period, water levels in the basin have varied according to seasonal variations in precipitation and recharge, and the amounts of groundwater pumped. Groundwater levels in most of the basin, based on springtime measurements of water levels in qualified wells, are above sea level. A pumping depression exists in the central portion of the basin, with water levels as deep as about 15 feet below sea level and several feet below sea level at the coast, a condition that could allow sea water intrusion; however, there has been no documented evidence of seawater intrusion in the basin.

The DWR analyzed the basin in 1999 and calculated a surplus of 126 AFY based on a base period of 1988-1996 using a “specific yield” method. In 1992, the SBCWA calculated a surplus in the groundwater basin of 56 AFY. Based on current data (Fugro, 2011), and CVWD’s ability to conjunctively use imported surface water from the Central Coast Water Authority (i.e., State Water Project), and local surface water from Lake Cachuma, annual groundwater demand is, on average, about 1,400 AFY less than the estimated safe yield of 5,000 AFY.

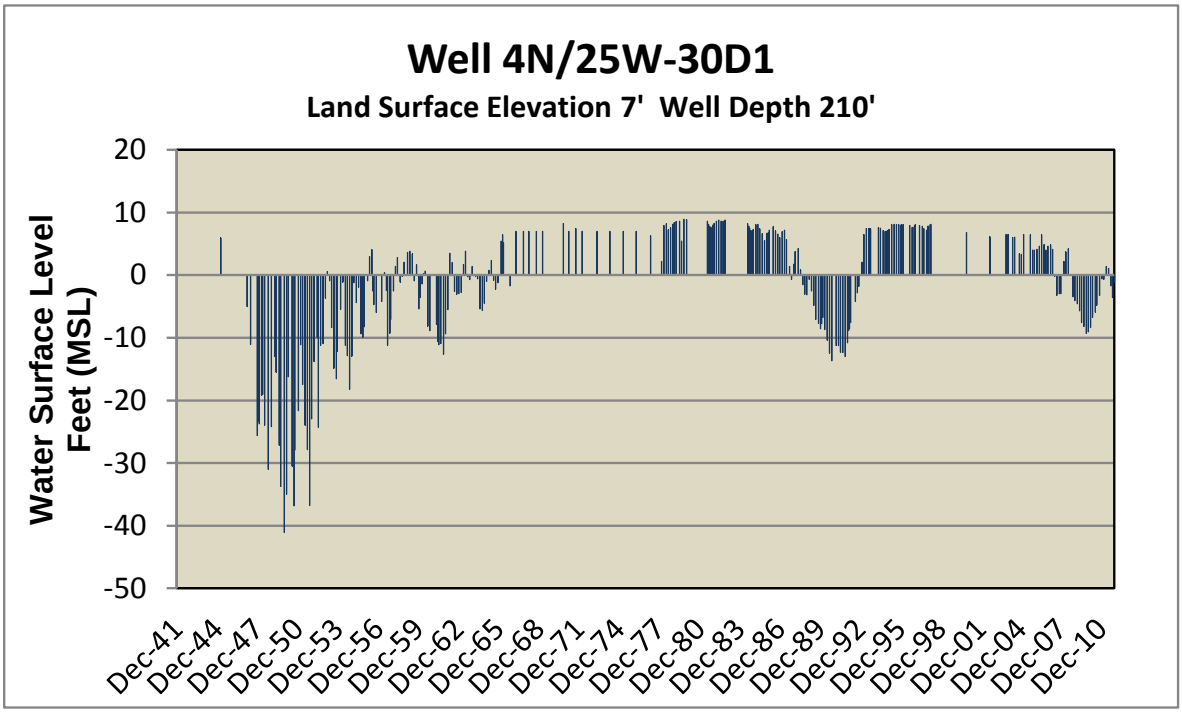


Figure 14: Hydrograph for State Well 4N/25W-30D1

As mentioned, two other sources of water are available within the basin: the Cachuma Project and the State Water Project (SWP). CVWD receives approximately 2,800 AFY from Lake Cachuma and, excluding up to 200 AF of drought buffer allotment, holds a maximum allotment of up to 2,000 AFY in the SWP. In 2010 CVWD received 533 AF of State Water (see State Water Project section, page 7). Total water supply available to the Carpinteria Basin area (inside Santa Barbara County and excluding Toro Canyon) is approximately 8,800 AFY. Since 1988 CVWD has pumped an average of 1,100 AFY and it is estimated from land use surveys that private pumping within the basin has averaged about 2,500 AFY resulting in a total average pumpage of 3,600 AFY. The average annual demand in the entire basin is about 7,400 AFY based on a County study (Baca, 1991) which accounted for all current and estimated future water demands in the basin. Based on calendar year 2010 data (Fugro, 2011), total basin demand was estimated at 6,097 AF. Of this amount, 3,157 AF was CVWD purchased water, 742 AF of CVWD pumped groundwater, and 2,198 AF of privately pumped groundwater.

In summary, the Cachuma supply to the Carpinteria Groundwater Basin is 2,800 AFY and estimated groundwater safe yield is 5,000 AFY, equaling 7,800 AFY. With an inferred average annual water demand of 7,400 AFY, this leaves a surplus of 400 AFY, in addition to water supplied through the SWP in dry years.

As mentioned, agricultural demand is met primarily by groundwater. Agriculture consists mostly of avocados, citrus and floriculture. Urban demand is met by Cachuma, groundwater and, mainly as a back-up, SWP water.

In 2007 the CVWD applied for and received a grant from the DWR under the Local Groundwater Assistance Act. The grant provided funding to perform an updated water balance of the basin and develop a numerical groundwater flow model for purposes of assessing various basin management objectives, including aquifer storage and recovery options. An updated water balance from this effort may result in a refinement of the estimated safe yield of the basin. The report that documents the outcome of this work is to be made available sometime in early 2012.

Water Quality

Water quality is monitored routinely in as many as a dozen wells in the basin as part of the District's AB 3030 program (Fugro, 2011). Since the initial USGS study on the basin (Upson and Worts, 1951), total dissolved solids (TDS) concentrations within the basin have remained stable, typically being on the order of 800 milligrams per liter (mg/l). This value can vary widely depending on location, well depth, and time of year sampled. Recent groundwater analyses conducted in 2010 indicate nitrate levels in groundwater in the basin are generally below the State maximum contaminant level of 45 mg/l for public water systems. There is no evidence of seawater intrusion into the basin. It is believed that the Rincon Creek and Carpinteria Faults act as barriers to seawater intrusion, as do clay layers (aquitards) overlying the basin near the Carpinteria Slough.

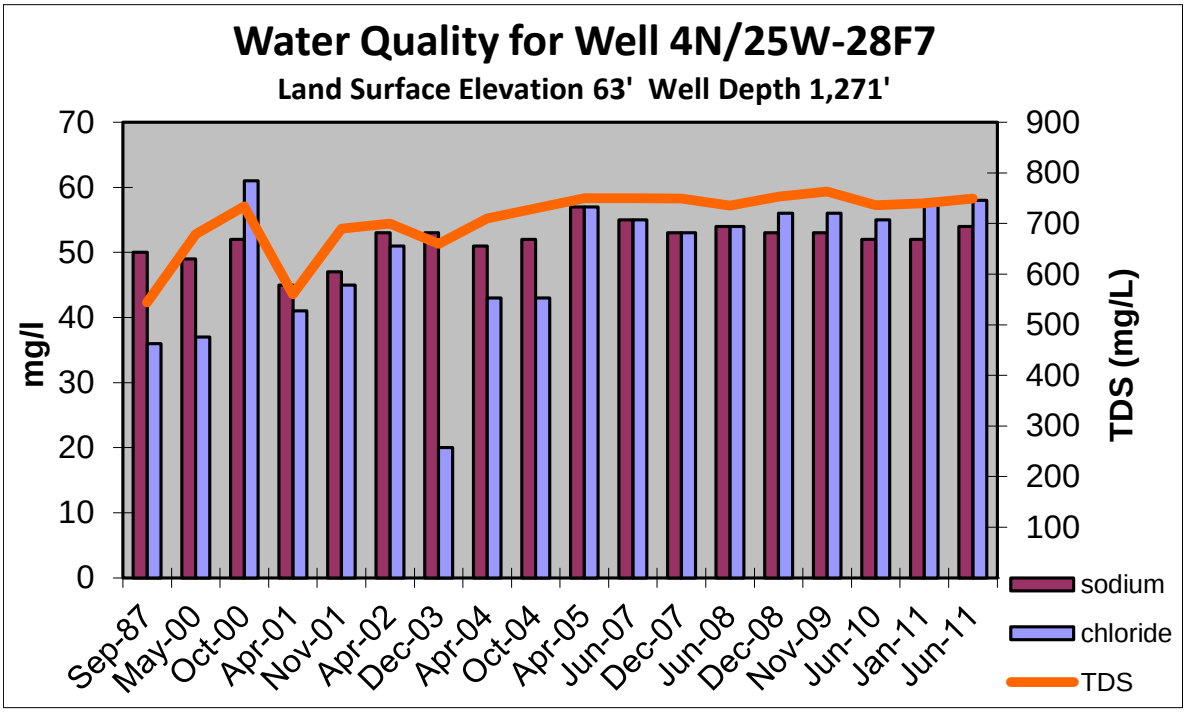


Figure 15: Water Quality Graph for State Well 4N/25W-28F7

2009-2011 Trends

Rainfall during the 2009 through 2011 period was near average in the Carpinteria area with an average for the three year period of 19.28 inches versus a long term average of 19.89 inches. As is so common for Southern California one of the three water years was far below average, 2008-2009 at 13.19 inches, one was near average, 2009-2010 at 19.75 inches and one was above average at 24.89 inches. If not for the wet February of 2009 which saw 6.18 inches the 2008-2009 water year would have ended extremely dry. The rains of December, late February and March of 2011 led the 2010-2011 water year to be the wettest of the period.

Figure 14 is a representative water well hydrograph from the Carpinteria Groundwater Basin. Water levels are lowest in the 40s and early 50s when total pumpage of the basin averaged 4,400 AFY. After Cachuma deliveries began in the mid-50s pumping of the basin declined and water levels recovered. Water levels also declined during the 1987-90 drought. The downward trend during the last decade is a result of a period of slightly deficient rainfall recharge combined with relatively consistent levels of pumping averaging 3,600 AFY; the net result of which was a gradual depletion of groundwater in storage. Recent recharge to the Carpinteria Groundwater Basin was not realized until the 2010-2011 water year.

Montecito Groundwater Basin

Physical Description

The Montecito Groundwater Basin encompasses about 6.7 square miles between the Santa Ynez Mountains and the Pacific Ocean. It is separated from the Carpinteria Groundwater Basin to the east by faults and bedrock and from the Santa Barbara Groundwater Basin to the west by a topographical divide and to the south by the Montecito Fault. The basin had been divided into three storage units on the basis of east-west trending faults that act as barriers to groundwater movement. The northern unit is bounded on the south by the Arroyo Parida Fault, the central unit by the Montecito Fault and the southern unit by the Rincon Creek Fault. These storage units are numbered 1, 2, and 3, respectively (Geotechnical Consultants, 1974). The Montecito Fault and Rincon Creek Fault are approximate in location and may not act as complete barriers to water movement thus in this report unit three is considered to be part of the Santa Barbara Groundwater Basin, although in the Montecito Water District Service area. The Toro Canyon Sub-basin, formally storage unit four, is included in the section on the Carpinteria Groundwater Basin because it is contiguous with that aquifer. However, the Toro Canyon Sub-basin is also within the Montecito Water District (MWD) service area.

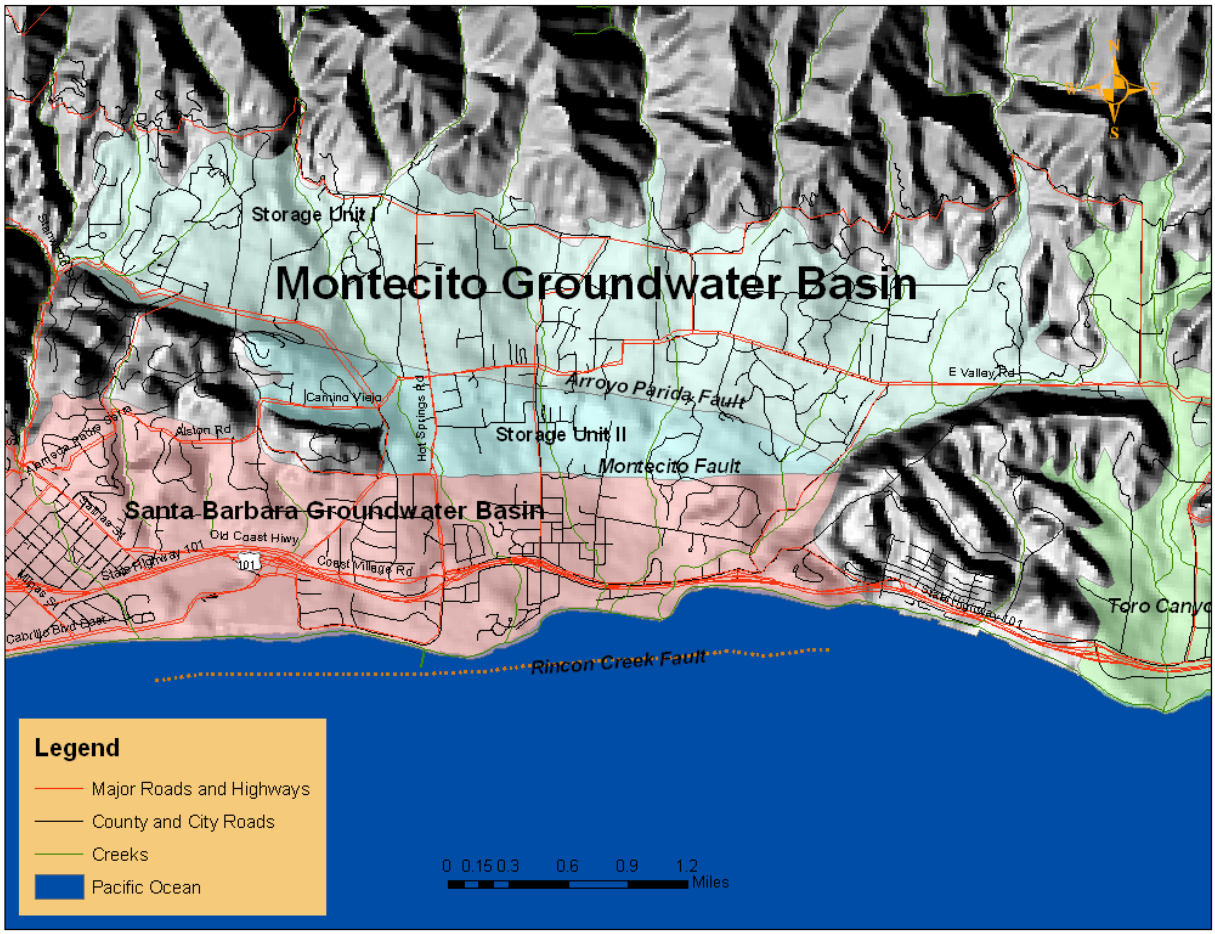


Figure 16: Montecito Groundwater Basin

Surface drainage occurs via several small creeks that flow from the Santa Ynez Mountains south to the Pacific Ocean: Cold Springs, Hot Springs, San Ysidro and Romero. Average precipitation within the basin ranges from about 18 inches per year near the coast to about 25 inches per year in the foothills of the Santa Ynez Mountains. The major water bearing geologic formations of the Montecito Groundwater Basin include the Casitas Formation and older alluvium. The Santa Barbara Formation is tapped by a few wells on the southeast fringe of the basin. Some wells along the northern margin tap the consolidated Sespe Formation, but only for domestic purposes (Hoover, 1980).

History and Analyses

The Montecito Groundwater Basin has been studied in detail, and is best described by reports prepared by Muir (1968), Geotechnical Consultants (1974), Brown and Caldwell (1978), Hoover and Associates (1980) and Slade (1991).

There are three main storage units in the Montecito Groundwater Basin (known as Storage Unit Nos. 1, 2 and 3) and one additional storage unit (Toro Canyon Storage Unit) which lies in the Carpinteria Groundwater Basin (Slade 1991).

The maximum usable groundwater storage for the four basins is estimated to be 16,110 AF. However, the groundwater basin has a maximum safe yield of only 1,650 AFY (Hoover 1980). Table 4 below identifies the safe yield for each storage unit.

Storage Unit	Safe Yield (AFY)
Unit 1	550
Unit 2	100
Unit 3	700
Toro Canyon	300
TOTAL	**1,650**

Table 4: Montecito Basin Annual Safe Yield by Storage Unit

The MWD pumps 250 to 450 AF of groundwater per year from the Montecito Groundwater Basin. This groundwater is used to serve both agricultural and potable water customers. Entitlements to groundwater in the basin have not been adjudicated, and the other groundwater users in the basin consist of several hundred private well owners. The amount of groundwater pumped by each of these private well owners is not accurately known by the MWD; however, the MWD is the State appointed groundwater basin manager and has prepared a Groundwater Basin Management Plan which includes the bi-annual monitoring of groundwater elevations throughout the District's service boundary. The management plan provides for a collaborative relationship between the MWD and a select number of well operators that provides data for determining the groundwater supply condition compared to those conditions in times of drought. Based on well data collected during the 2011 monitoring program, the MWD is of the opinion that the aggregate pumping (including MWD pumping) is within the basin's calculated safe annual yield.

The MWD's long-term available water supply, for planning purposes, assumes that water consumption levels will be held at about 5,800 AF per year. The 5,800 AF consumption level requires a minimum water supply of about 6,500 AF annually. The MWD currently purchases

additional water supplies from State Water contractors with the supplemental supplies stored for use during reoccurring droughts. Table 5 below shows available supplies.

Supply Source	AF
Cachuma Lake Project Water	2,651
Jameson Lake, Fox and Alder Creeks	1,800
Doulton Tunnel	350
Groundwater Basin	380
State Water Project (40% allocation)	1,320
Water Production (w/o supplemental supplies)	**6,500**

Table 5: Montecito Basin Estimated Long Term Water Supply

In 2011, the MWD obtained approximately 82% of its water from the Santa Ynez River System, 4% from the State Water Project, 11% from Doulton Tunnel intrusion and relied on the Montecito Groundwater Basin for 3% of its yearly production needs.

Water demand in the Montecito area had been steadily increasing since the end of the last declared drought from 1987 through 1991. The 1987-1991 drought was the leading factor leading to the 1991 “yes vote” on importing State Water to the South Coast. Water demand by customers began to increase sharply beginning in the calendar year 2000 leading to a customer demand level of 6,500 AF in the 2007/08 fiscal year which was well outside the MWD’s long term reliable water supply.

This high customer demand led to the adoption of a new multi-tier conservation rate structure that went into effect October 2008. Since the adoption of the conservation block rate structure in October 2008, customer usage has steadily declined, as shown in Table 6.

Fiscal Year (July – June)	Customer Usage (AF)
2006-07	6,333
2007-08	6,518
2008-09	5,963
2009-10	5,274
2010-11	4,715

Table 6: Montecito Basin Customer Usage

Water Quality

Water quality in the basin generally is suitable for agricultural and domestic use. Some wells near fault zones or coastal areas yield groundwater with elevated levels of TDS and other constituents. Some of the MWD wells have minute amounts of iron and manganese which is treated and removed prior to distribution to customers.

In accordance with the requirements of the California Department of Public Health, MWD collects and analyzes water samples from its potable water production wells every three years. Review of water quality for recently tested MWD wells shows no quality degradation when compared to previous years. Studies also indicate that seawater intrusion is not a significant problem in the basin. It is thought that deeper aquifers of the basin are protected from seawater intrusion by an impermeable offshore fault. However, some encroachment of seawater might occur in shallower aquifers during periods of heavy pumping such as during the early 1960s.

2009-2011 Trends

Rainfall during the 2009 through 2011 period was slightly above average in the Montecito area with an average for the three year period of 21.48 inches versus a long term average of 20.41 inches. Similar to other South Coast Basins one of the three water years was far below average, 2008-2009 at 12.05 inches, one was near average, 2009-2010 at 21.62 inches and one was highly above average at 30.78 inches. If not for the wet February of 2009 which saw 5.43 inches the 2008-2009 water year would have ended extremely dry. The rains of December, late February and March of 2011 led the 2010-2011 water year to be the wettest of the period.

Due to these precipitation patterns, recharge to the Montecito Groundwater Basin was not realized in the 2008-2009 water year, but a small amount of recharge did occur in 2009-2010 and a significant amount of recharge occurred in the 2010-2011 water year, especially in late February and March. Thus, in most areas of the basin groundwater levels declined during the 2008-2009 water year and recovered in the 2010-2011 water year.

The Montecito Water District maintains a groundwater monitoring network of about 70 sites to track water level changes. The groundwater levels at these locations are typically checked twice per year, once in the fall and once in the spring. Figure 17 of State Well 4N/26W-8P3 is a typical water well hydrograph from the Montecito Groundwater Basin that shows recent trends.

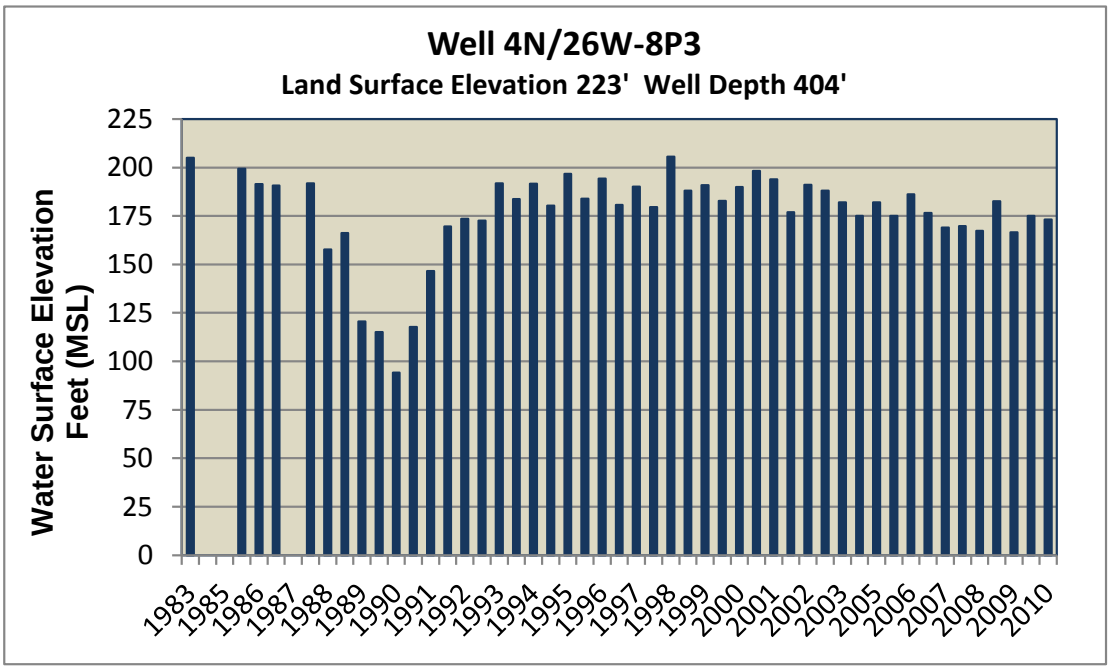


Figure 17: Hydrograph for State Well 4N/26W-8P3

Santa Barbara Groundwater Basin

Physical Description

The Santa Barbara Groundwater Basin underlies an area of about nine square miles nestled between the Montecito Groundwater Basin and the Foothill Groundwater Basin. It is defined by geologic faults that impede the flow of groundwater on its north, northwest and southwest sides, and the Pacific Ocean to the south. The basin includes two hydrologic units: Storage Unit No. 1 northeast of the Mesa Fault (approximately 7 square miles) and Storage Unit No. 3 southwest of the Mesa Fault (approximately 2.5 square miles). The boundary to the northeast is an approximate fault boundary mapped as the Montecito Fault first by Geotechnical Consultants in 1974. The separate Foothill Groundwater Basin discussed in the following section encompasses the hydrologic unit which includes the formerly designated Storage Unit No. 2 of the Santa Barbara Basin and the former "East Sub-basin" of the Goleta Groundwater Basin (Freckleton, 1989).

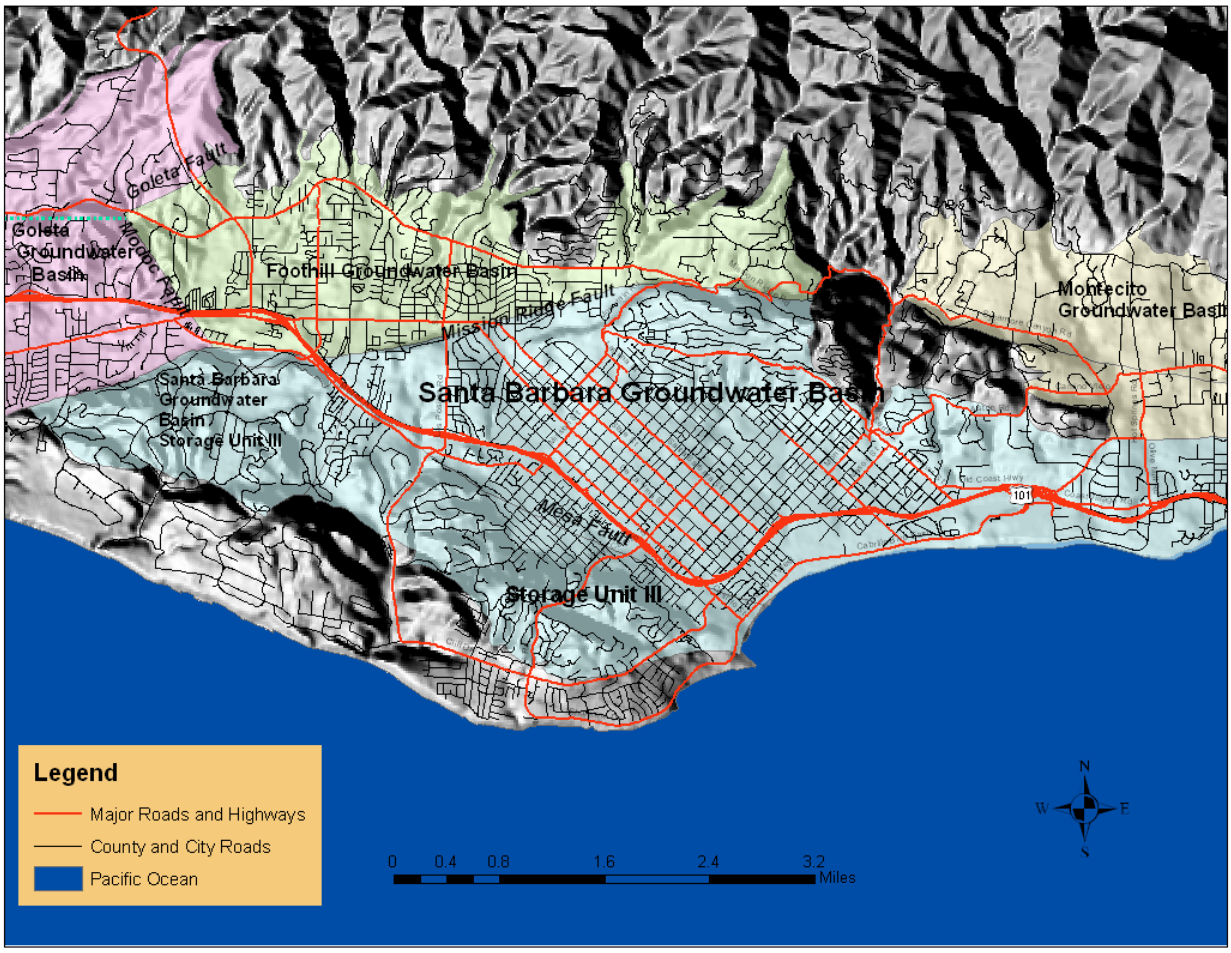


Figure 18: Santa Barbara Groundwater Basin

The basin is divided into different depth zones based on the geohydrologic characteristics of permeability and transmissivity: the shallow zone, the upper producing zone, the middle zone, the lower producing zone and the deep zone (Martin, 1984). Annual rainfall within the Santa Barbara Basin varies with altitude and averages about 18 inches near the coast and up to about 21 inches in the higher elevations of the foothills of the Santa Ynez Mountains. The basin is drained by Sycamore, Mission, San Roque and Arroyo Burro Creeks. All of these creeks flow intermittently in their lower reaches where they lose water to the unconsolidated deposits.

The major water bearing formation of the basin is the Santa Barbara Formation, consisting primarily of fine to coarse sand, silt and clay, with sporadic layers of gravel. The overlying older and younger alluvium consists of clay, silt, sand and gravel. Younger alluvium comprises major parts of the alluvial plain in the Santa Barbara area, extends along stream channels, and tongues into adjoining stream canyons (Freckleton et al., 1998).

History and Analyses

The basin is best described by Muir (1968), Brown and Caldwell (1973), SBCWA (1977), Martin (1984) and Freckleton (1989 and 1998). The capacity of the Santa Barbara Groundwater Basin is estimated to be 23,000 AF (Brown and Caldwell, 1973). The water balance of the Santa Barbara Basin has been analyzed by the County on the basis of the overall water supply and demand within the City of Santa Barbara (City). Water supplies available to the City include the groundwater basin safe yield (from Storage Unit No. 1 and the Foothill Basin) of 1,300 AFY (Freckleton, 1992), a State Water Project yield of up to 3,300 AFY, 8,277 AFY from Lake Cachuma, up to 5,000 AFY from Gibraltar Dam, 1,100 from Mission Tunnel seepage, approximately 800 AFY from the recycled water program, and 3,125 AFY of desalination should the need arise. When operated according to the City's 2011 Long-Term Water Supply Plan, these supplies are managed to meet a water supply target of 15,400 AFY, including 14,000 AFY of projected demand, plus 10% safety margin. An additional 100 AFY of safe yield is available from Storage Unit No. 3, but is of inferior quality and not planned for use.

Water demand has averaged 14,495 AFY, including 682 AFY of recycled water, over the period of 2009-2011. Groundwater historically constituted about 7% to 10% of the water supply for the City. For 2009-2011, average groundwater usage was 946 AF, or about 7% of the demand. Although groundwater in the basin is utilized by a few private businesses and homeowners, the City of Santa Barbara is the predominant groundwater user. This allows the City to manage the storage and pumpage from the basin. The City is currently managing the basin as an underground storage reservoir as part of an overall plan for the conjunctive use of the various City water resources, with most groundwater usage reserved for periods of depleted surface water.

Water Quality

TDS concentrations within the two basin units range anywhere from about 530 mg/l to over 2,000 mg/l. Some isolated wells exhibited higher TDS concentrations due to upwelling from Tertiary rocks that underlie the shallow zone in the coastal part of Storage Unit No. 3 (Martin, 1984). Seawater intrusion occurred in some areas of the south basin where heavy pumping from municipal wells caused groundwater levels to drop as much as 100 feet in the late 1970s. More recently, samples with chloride concentrations greater than 1,000 mg/l taken from coastal wells have confirmed the presence of seawater intrusion. Groundwater pumping within the Santa Barbara Groundwater Basin has been required at much reduced levels compared to

1991. Effective pumping practices, together with groundwater injection programs have restored the previously existing gradient thereby reversing the trend of seawater intrusion.

2009-2011 Trends

Rainfall during the 2009 through 2011 period was slightly above average in Santa Barbara with an average for the three year period of 20.25 inches versus a long term average of 18.20 inches. Similar to other South Coast Basins one of the three water years was far below average, 2008-2009 at 11.83 inches, one was slightly above average, 2009-2010 at 20.44 inches and one was highly above average at 28.49 inches. If not for the wet February of 2009 which saw 5.03 inches the 2008-2009 water year would have ended extremely dry. The rains of December, late February and March of 2011 led the 2010-2011 water year to be the wettest of the period.

Due to these precipitation patterns, recharge to the Santa Barbara and Foothill Groundwater Basins was not realized in the 2008-2009 water year, but a small amount of recharge did occur in 2009-2010 and a significant amount of recharge occurred in the 2010-2011 water year, especially in late February and March. Thus, in most areas of the basin groundwater levels declined during the 2008-2009 water year and recovered in the 2010-2011 water year.

The City of Santa Barbara maintains a groundwater monitoring network in conjunction with the USGS to track water level and quality changes within the basin. The network currently consists of about 70 sites. Figure 19 below of State Well 4N/27W-15E1 (located at Alice Keck Park Memorial Gardens) is a typical water well hydrograph from the Santa Barbara Groundwater Basin that shows these trends.

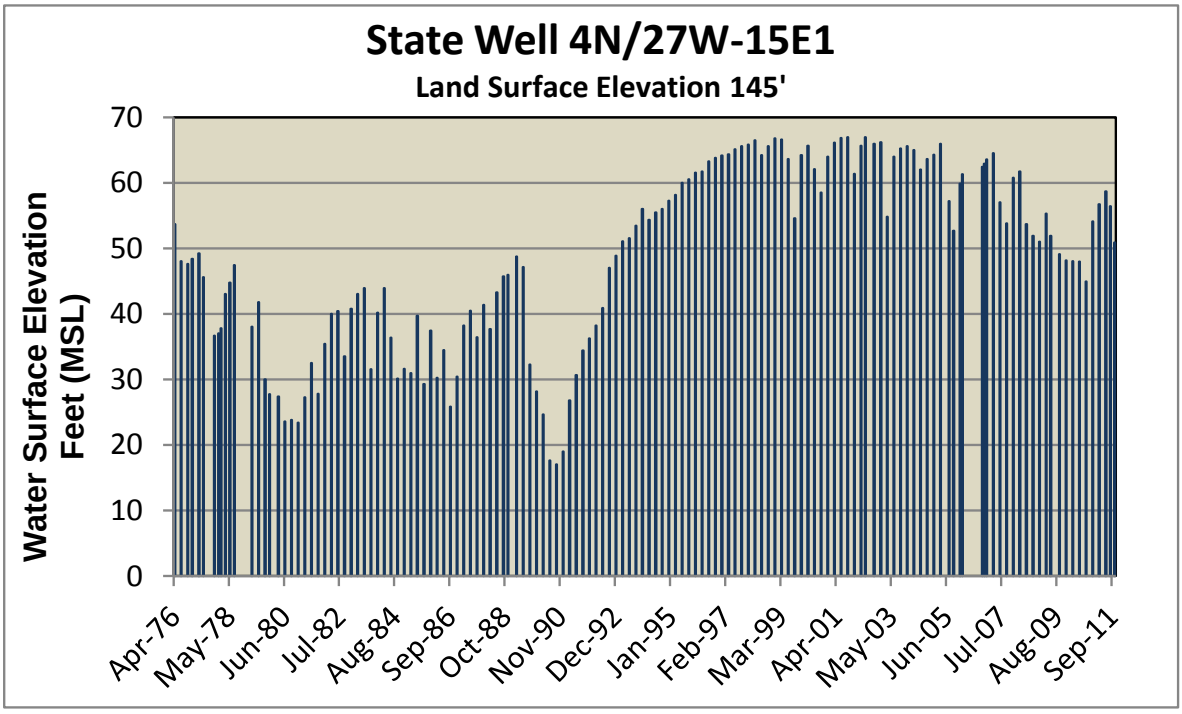


Figure 19: Hydrograph for State Well 4N/27W-15E1

Foothill Groundwater Basin

Physical Description

The Foothill Groundwater Basin is comprised of unconsolidated alluvial sediments which have accumulated along the base of the Santa Ynez Mountains in the northwest Santa Barbara and northeast Goleta areas. This basin encompasses about 4.5 square miles and extends from the outcrops of the underlying tertiary bedrock formations on the north to the Modoc Fault and Goleta Fault on the west, the More Ranch and the Mission Ridge Faults on the south and bedrock on the east. The main drainages that traverse the basin are Cieneguitas, Arroyo Burro and San Rogue Creeks. This groundwater basin consists of younger alluvium, older alluvium and terrace deposits, and the Santa Barbara Formation. The Santa Barbara Formation is the principal aquifer of the basin and consists mainly of marine sand, silt and clay with a maximum thickness of about 400 feet (Freckleton, 1989). Prior to the late 1980s the Foothill Groundwater Basin was designated as Storage Unit #II of the Santa Barbara Groundwater Basin and the former "East Sub-basin" of the Goleta Groundwater Basin. The basin was later re-designated as a separate hydrologic unit after geohydrologic data showed that the above mentioned faults impede groundwater exchange between the adjacent Santa Barbara and Goleta Groundwater Basins.

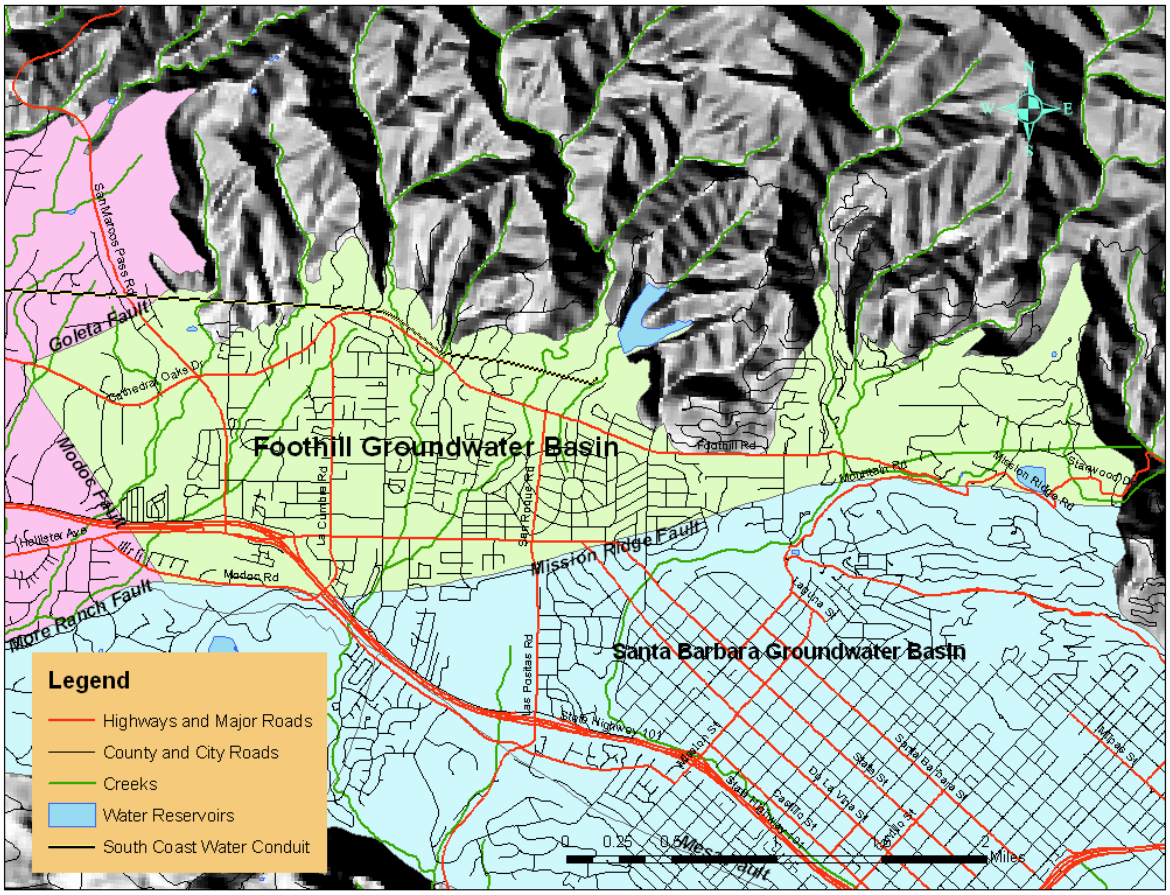


Figure 20: Foothill Groundwater Basin

History and Analyses

The Foothill Groundwater Basin is best described by Freckleton (1989). Safe yield is estimated to be 953 AFY (gross pumpage) based on a 1989 USGS study. Available storage of the Foothill Basin is estimated to be 5,000 AF. Demand on the basin falls into three categories: pumpage by the City of Santa Barbara (City), pumpage by the La Cumbre Mutual Water Company (LCMWC) and extractions by private landowners. Pumpage of the basin was at its maximum around 1950 at 2,400 AFY and during that time the basin water levels dropped substantially but have since recovered with the introduction of other water sources. The City has historically injected and stored surface water in the basin but has reduced the practice in recent years.

The supply/demand status of this basin has been analyzed by the County (Baca, 1993). Pumpage of the basin, including commitments to approved projects was estimated to be 945 AFY. This estimate accounts for a City/LCMWC agreement through which the City treats and delivers the LCMWC's contracted State Water Project amount of up to 1,000 AFY (plus 100 AF drought buffer). As part of the agreement, LCMWC limits their groundwater extraction from the Foothill Basin to 300 AFY on a five year running average. The City and LCMWC account for about 80% of basin pumpage and with the active management of the basin by the City and LCMWC, the Foothill Basin is considered not to be in overdraft.

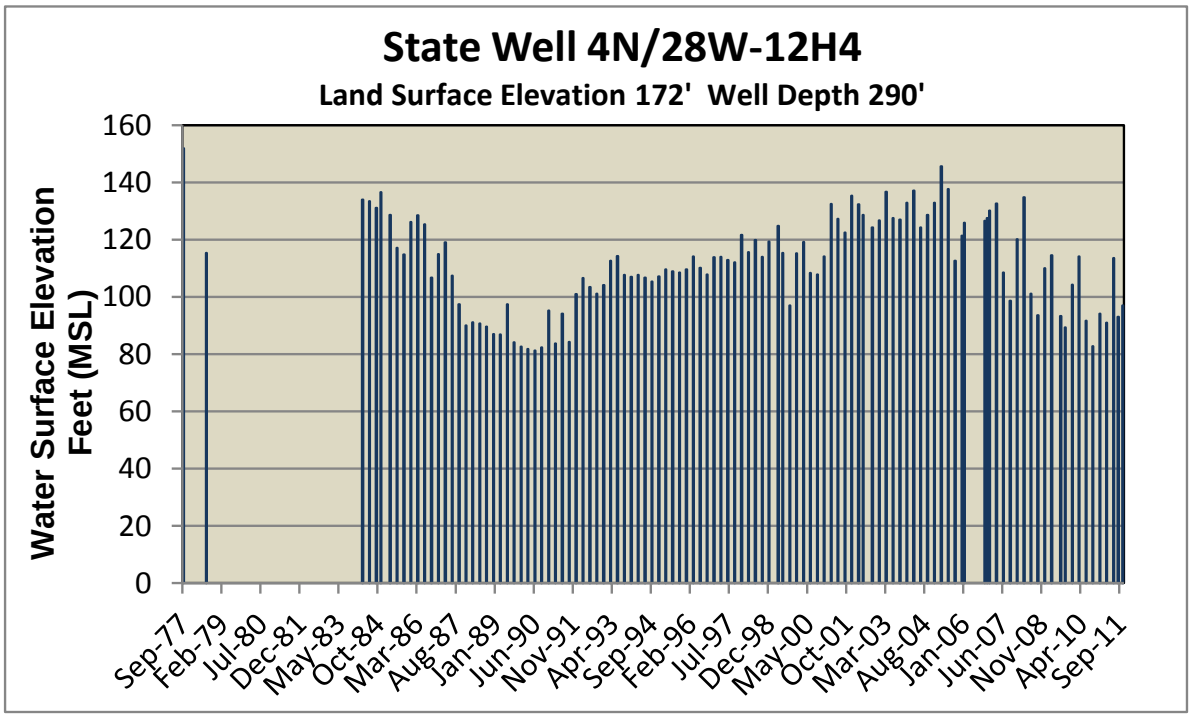


Figure 21: Hydrograph for State Well 4N/28W-12H4

Water Quality

Eight wells were sampled for water quality as part of the 1989 USGS study. Analyses of water from these wells indicated general water quality to be classified as very hard with dissolved solids, chloride, sodium, and sulfate all equaling or exceeding secondary standards in most wells sampled. Nitrate (reported as nitrate plus nitrite or total nitrogen) exceeded primary drinking water standards in two of the eight wells sampled. TDS concentrations were relatively high, ranging from 610 to 1,000 ppm in seven wells sampled in the basin. Chloride concentrations in this basin were relatively low (44 to 130 ppm) in the seven wells (Freckleton, 1989). Figure 22 below illustrates water quality trends for the past 15 years at State Well 4N/27W-8M5 which is located in the southern central portion of the basin. Note that an eighth well was sampled in the USGS study from which poor quality water (TDS 1,900 ppm, chloride 360 ppm) was recovered. This well, however, is known to produce water from bedrock aquifers below the sediments that comprise the Foothill Basin.

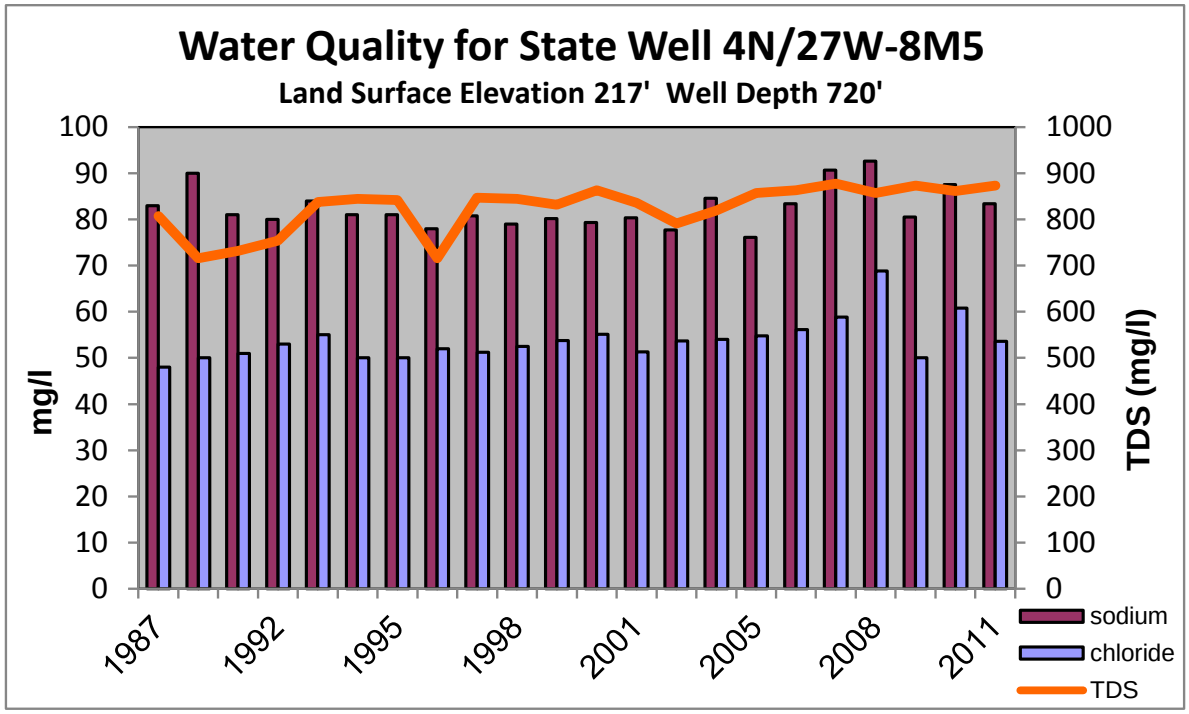


Figure 22: Water Quality Graph for State Well 4N/27W-8M5

2009-2011 Trends

Rainfall during the 2009 through 2011 period was slightly above average in Santa Barbara with an average for the three year period of 20.25 inches versus a long term average of 18.20 inches. Similar to other South Coast Basins one of the three water years was far below average, 2008-2009 at 11.83 inches, one was slightly above average, 2009-2010 at 20.44 inches and one was highly above average at 28.49 inches. If not for the wet February of 2009 which saw 5.03 inches the 2008-2009 water year would have ended extremely dry. The rains of December, late February and March of 2011 led the 2010-2011 water year to be the wettest of the period.

Due to these precipitation patterns, recharge to the Santa Barbara and Foothill Groundwater Basins was not realized in the 2008-2009 water year, but a small amount of recharge did occur in 2009-2010 and a significant amount of recharge occurred in the 2010-2011 water year, especially in late February and March. Thus, in most areas of the basin, groundwater levels declined during the 2008-2009 water year and recovered in the 2010-2011 water year except for seasonal variations reflecting pumping schedules.

The City maintains a groundwater monitoring network in conjunction with the USGS to track water level and quality changes within the basin. The network currently consists of about 70 sites. Figure 21 on page 42 of State Well 4N/28W-12H4 (located at the medical clinic on Pesetas Lane) is a typical water well hydrograph from the Santa Barbara Groundwater Basin that shows these trends.

Goleta Groundwater Basin

Physical Description

The Goleta Groundwater Basin lies directly west of the Santa Barbara and Foothill Groundwater Basins on Santa Barbara County's South Coast. It is about eight miles long and three miles wide including the hydraulically connected alluvial materials extending into the drainages along the northern border. The Goleta Groundwater Basin is divided into three Sub-basins: the Central Sub-basin, the West Sub-basin and the North Sub-basin. The Central and West Sub-basins are separated by an inferred low permeability barrier that separates areas of differing water quality. The North Sub-basin is separated from the Central Sub-basin by a fault that appears to form a partial hydraulic impediment to groundwater flow (URS, 2005). Both the Central Sub-basin and the West Sub-basin are bordered on the south by the More Ranch Fault. Although originally defined as portions of a larger basin, these three hydrologic units are distinct and have been analyzed and described in planning and legal documents as separate basins.

Goleta is an alluvial plain, bordered by the Santa Ynez Mountains to the north and the Pacific Ocean to the south. Average rainfall within the basin ranges from about 16 inches per year at the coast to about 20 inches per year at the basin's highest elevation in the foothills of the Santa Ynez Mountains. Surface drainage is to the south toward the Goleta Slough through several creeks which empty into the ocean including Atascadero, Maria Ygnacio, San Jose, Tecolotito, and San Pedro.

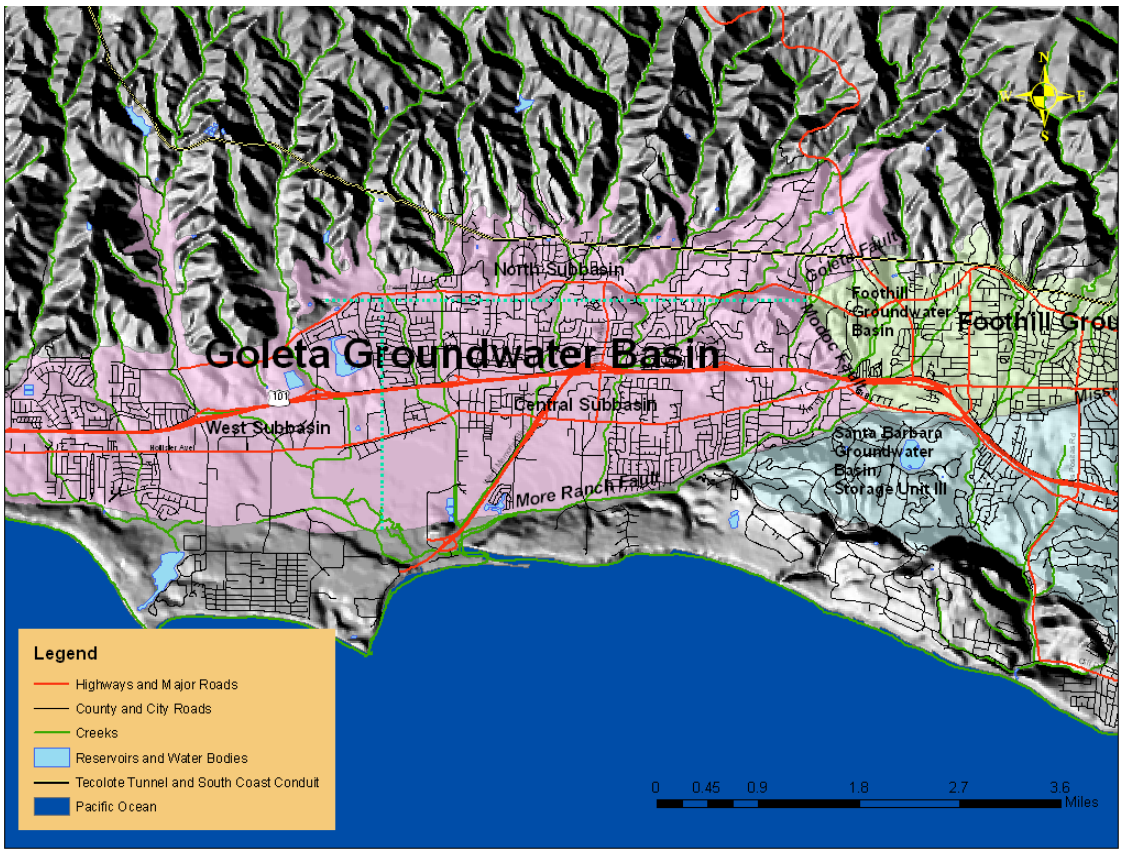


Figure 23: Goleta Groundwater Basin

History and Analyses

The Goleta Groundwater Basin is best described by Upson (1951), Evenson et al., (1962), Mann (1976), SBCWA (1977), Hoover (1980, 1981) and CH2MHILL (2005). In 2010, the Goleta Water District (GWD) adopted a comprehensive Groundwater Management Plan (GWD 2010) to set Basin Management Objectives, describe the local policy environment, and update basin data. Total storage in the basin is estimated to be about 400,000 AF. Total storage available for the Central and North Sub-basins is about 200,000 AF. Useable or "working" storage, defined as between historical high and low water levels is estimated to be 40,000 to 80,000 AF (GWD 2010). Perennial yield of the Central and North Sub-basins is estimated to be somewhat less than 3,700 AFY (GWD 2010). The safe yield established by the Wright Judgment is 3,410 AFY (Wright Judgment, 1989). The perennial yield of the West Sub-basin is estimated to be 500 AFY (SBCWA, 1992).

Historically, this basin was in a state of overdraft. Prior to the construction of the Cachuma Project in 1959, groundwater served as the sole source of water for the Goleta area. Pumping patterns through the 1985 peak of over 8,500 AFY, led to some of the lowest recorded water level readings in the basin (see Figure 24). In some areas, these lasted through the 1987-1990 droughts. The state of overdraft resulted in lengthy legal proceedings and a long-term moratorium on new water connections within the GWD. The Wright Judgment in 1989 served to adjudicate the water resources of this basin and assigned quantities of the basin safe yield to various parties, resulting in 2,350 AFY available to the GWD as of 2011 and 1,000 AFY on a 10 year running average to the La Cumbre Mutual Water Company (LCMWC). The judgment also ordered the GWD to bring the North and Central Basin into a state of hydrologic balance by 1998. The GWD has achieved compliance with this order through the importation of State Water Project, authorized by voters through the SAFE Water Supplies Ordinance (SAFE Ordinance), and the development of recycled water. These supplemental supplies have offset the court mandated reduction in pumpage from the basin. Since 1993 pumping has generally averaged about 1,000 AFY and groundwater levels have dramatically risen. Given that the basin has been adjudicated and the court decision controls pumpage, overdraft is not foreseeable in the North and Central Sub-basins.

Available storage of the Goleta West Sub-basin is estimated to be around 7,000 AF. Perennial yield is estimated to be 500 AFY (Baca et al., 1992). Pumpage in the Goleta West Sub-basin is approximately 232 AFY (GWD, 1992) and is entirely attributable to private landowners. Thus, based on the most recent analysis the West Sub-basin has a surplus of 268 AFY. This state of surplus is anticipated to extend for many years into the future, given the availability of high quality supplies from the GWD and the generally poor quality of the water in this hydrologic unit.

The overall water supply available to GWD customers is approximately 16,622 AFY, including groundwater and the available surface water sources. This figure includes 9,322 AFY from the Cachuma Project, 3,800 AFY of State Water, GWD's adjudicated portion of the Central and North Sub-basin safe yield (2,350 AFY) and recycling of about 1,150 AFY. Estimated current water demand in the Goleta area is approximately 15,000 AFY.

Water Quality

Areal differences in groundwater are one of the primary reasons for originally dividing the Goleta Groundwater Basin into separate sub-basins. The Central Sub-basin, from which most water is extracted, contains the lowest TDS concentrations, averaging about 770 mg/l. The Central Sub-

basin also has lower amounts of chloride averaging 65 mg/l to 80 mg/l as compared to over 200 mg/l in the West Sub-basin. Chloride concentrations are a particular problem in low lying areas of the basin near tidal marshes. While high chloride concentrations are one indication of seawater intrusion, observation wells near the Goleta Slough area also exhibited correspondingly high concentrations of sulfate, a mineral not normally found in significant quantities in seawater (SBCWA, 1977). There is currently no evidence of seawater intrusion. In addition, seawater intrusion is not likely to have occurred at any time due to the rock formations and the More Ranch Fault along the coast which act as barriers to groundwater migration. Near-surface, low permeability sediments cause the southern portion of the Central, North and West Sub-basins to be under confined conditions. These sediments provide a barrier to potential surface sources of water quality degradation such as agricultural return flow or infiltration of brackish water in the overlying Goleta Slough. In some areas high TDS perched water is present in shallow aquifers above the confining layers. This water is not in general use. Water quality in the North and Central Sub-basins is sufficient for many agricultural uses but might require treatment for domestic uses. The significant water quality issue for drinking water in the Central Sub-basin is the presence of iron and manganese, with most wells above the secondary drinking water standard. These elevated constituents require treatment of groundwater prior to serving the water to customers. Water in the West Sub-basin requires treatment for domestic use and may be used for irrigation of only a limited variety of crops.

2009-2011 Trends

Rainfall during the 2009 through 2011 period was slightly above average in the Goleta area with an average for the three year period of 20.68 inches versus a long term average of 17.87 inches. Similar to other South Coast basins one of the three water years was far below average, 2008-2009 at 11.04 inches, one was slightly above average, 2009-2010 at 20.72 inches and one was highly above average at 30.29 inches. If not for the wet February of 2009 which saw 4.27 inches the 2008-2009 water year would have ended extremely dry. The rains of December, late February and March of 2011 led the 2010-2011 water year to be the wettest of the period.

Due to these precipitation patterns, recharge to the Goleta Groundwater Basin was not realized in the 2008-2009 water year, but a small amount of recharge did occur in 2009-2010 and a significant amount of recharge occurred in the 2010-2011 water year, especially in late February and March. Thus, in most areas of the basin groundwater levels declined during the 2008-2009 water year and recovered in the 2010-2011 water year.

The GWD maintains a groundwater monitoring network in conjunction with the USGS to track water level changes within the basin. The network currently consists of 47 sites. The 2010 Groundwater Management Plan adopted seven of these wells as Index Wells that are used for determination of SAFE Ordinance 1972 groundwater elevations. The graph shown in Figure 24 on the following page is the composite elevation of the seven Index Wells in the Central Sub-basin, depicting water level fluctuations over time. The substantial decline in basin water levels reached its minimum during the 1987-1990 drought. The water level significantly recovered over the next twenty years, with the wet years of 1992, 1993, 1995, 1998 and 2005, reaching the highest elevation in 2007. Water levels continue to remain high through the current period.

Figure 24: Goleta Basin Index Wells Composite Elevation Through 2011

Groundwater Basins of the Santa Ynez River Watershed

The groundwater basins of the Santa Ynez River Watershed lie between the San Rafael Mountains to the north and east, the Purisima Hills to the northwest and the Santa Ynez Mountains to the south. East-west oriented folds and faults of the region control the shape and location of these basins. In addition, formation of the basins has been influenced by the former stages and flow of the Santa Ynez River, creating the terraces and uplands that comprise some of the primary aquifers.

Investigations on the water resources of the drainage basin have been conducted by the Bureau of Reclamation, USGS, DWR, as well as local agencies such as the SBCWA, SYRWCD and local water purveyors. The SYRWCD, formed in 1939 to protect the water rights of users, produces an annual report on the conditions of the water resources within the drainage basin. During dry periods the SYRWCD may call for water releases from Lake Cachuma to recharge downstream groundwater in accordance with Water Rights Order 89-18.

The SYRWCD ID#1 serves water to the areas of Santa Ynez, Solvang, Los Olivos, Ballard and the Santa Ynez Band of Chumash Indians in a portion of the Santa Ynez Uplands Groundwater Basin. SYRWCD ID#1 has studied the basin extensively and employs a conjunctive use strategy utilizing all of its supplies (State Water, Cachuma Project Water, groundwater from the Santa Ynez Uplands Groundwater Basin and groundwater from the Santa Ynez River Alluvial Basin) to provide reliability in a wide range of hydrologic conditions.

Other water purveyors in the watershed include the City of Solvang, the City of Buellton, the City of Lompoc, Vandenberg Village Community Services District, Mission Hills Community Service District and many smaller mutual water companies. Each relies on groundwater to some extent as its source of supply. Vandenberg Air Force Base and the Federal Prison lie partly within the watershed but rely on State Water and groundwater from the San Antonio Groundwater Basin.

Following is a discussion of the Groundwater Basins of the Santa Ynez River Watershed from east to west (upstream to downstream) as well as the Santa Ynez River Riparian Groundwater Basin. Figure 25 on the following page shows the groundwater basins within the Santa Ynez River Watershed and their relationship to the boundaries of the SYRWCD and the SYRWCD ID#1.

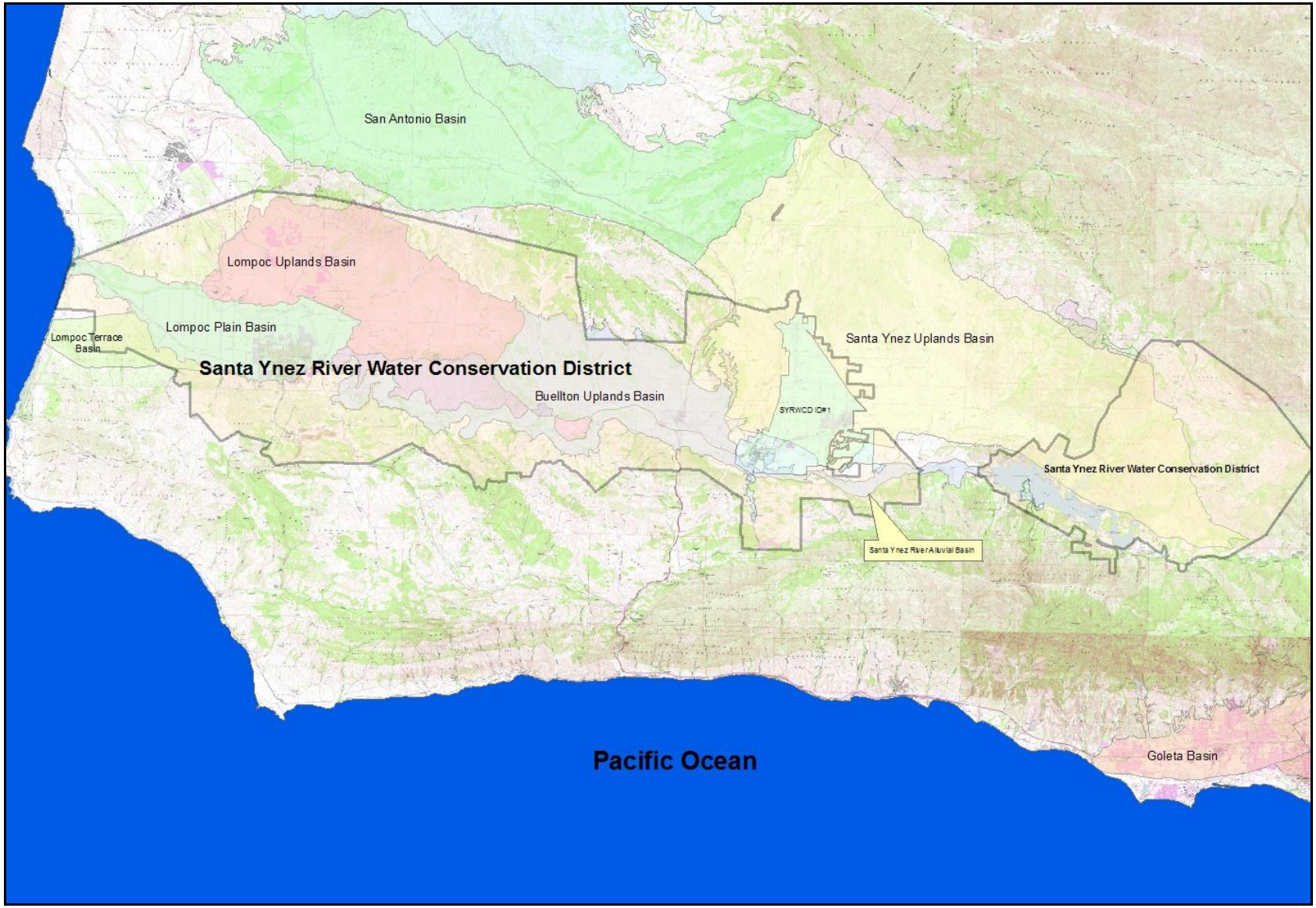


Figure 25: Santa Ynez River Water Conservation District Boundaries

Santa Ynez Uplands Groundwater Basin

Physical Description

The Santa Ynez Uplands Groundwater Basin underlies 130 square miles located about 25 miles east of Point Arguello and north of the Santa Ynez River. The basin is wedge shaped, narrowing to the east. It is bounded by a topographical groundwater divide (from the San Antonio Basin) to the northwest, faults and the impermeable rocks of the San Rafael Mountains to the north and east, and impermeable rock formations that separate it from the Santa Ynez River Alluvial Basin to the south. Average rainfall within the basin varies from a maximum of about 24 inches per year in the higher elevations to a minimum of about 15 inches per year in the southern and central areas. Rainfall and stream seepage are the primary sources of recharge to the basin.

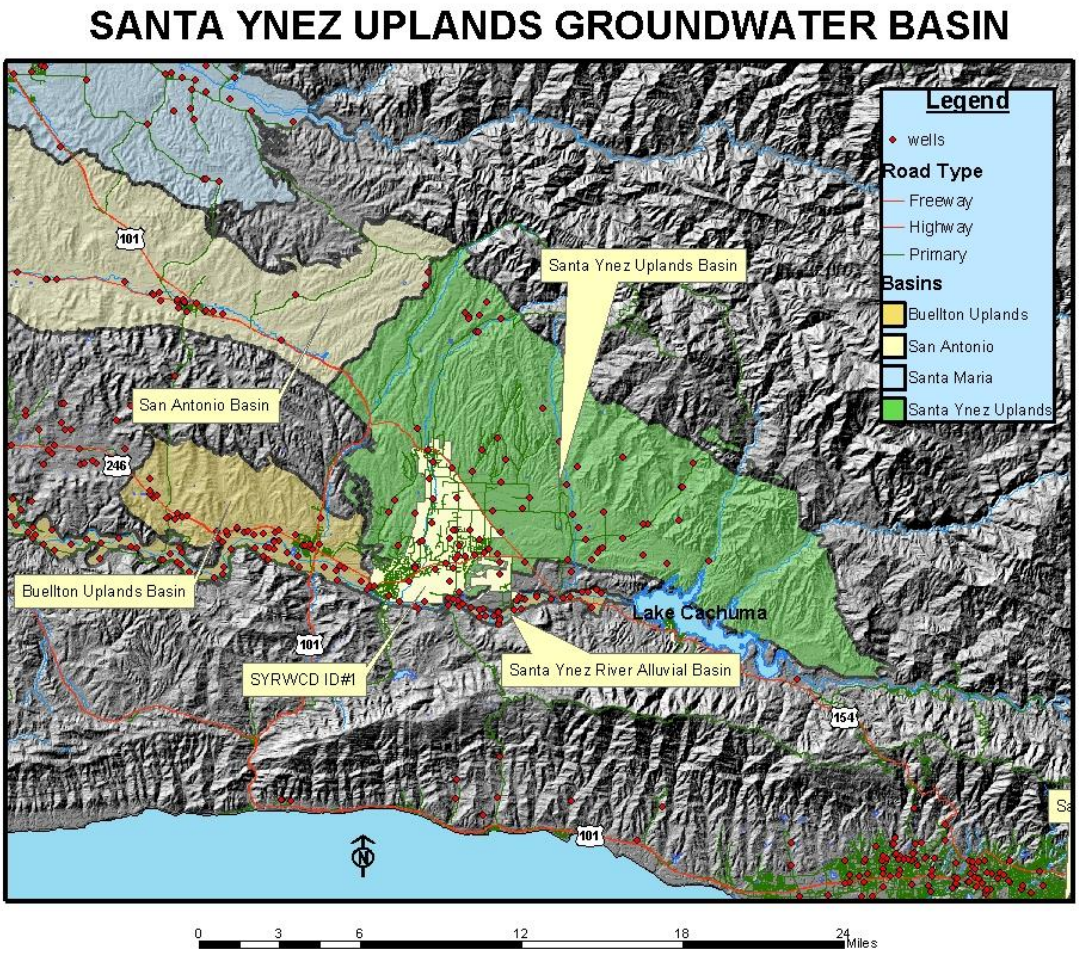


Figure 26: Santa Ynez Uplands Groundwater Basin

History and Analyses

The basin is best described by Upson and Thomasson (1951), Wilson (1957), LaFreniere and French (1968) and SBCWA (1977). These reports describe the basin in terms of the geologic setting and groundwater resources of the area. Work by Singer (1979) and Hamlin (1985) add to the information and focus on water resources for the Santa Ynez Indian Reservation as well as the water quality of the area. In addition, the SYRWCD produces an informative annual report to satisfy conditions of levying fees within its District boundaries.

The Paso Robles Formation is the major aquifer in the Santa Ynez Uplands Groundwater Basin. The formation consists of poorly consolidated gravel, sand, silt and clay (LaFreniere and French, 1968). In places it is difficult to distinguish the Paso Robles Formation from overlying terrace deposits. The Careaga Sand lies underneath the Paso Robles Formation but due to its great depth few wells tap it throughout all but the marginal areas of the basin.

Upson and Thomasson, in 1951, noted that the withdrawal of water from irrigation wells on the Santa Ynez Uplands and elsewhere in the sub-area had not yet altered the natural discharge of approximately 4,000 AFY to the Santa Ynez River alluvial corridor. In 1968, LaFreniere and French estimated a decline in storage of 44,000 AF based on declining water levels during the period 1945-1964 and a decline in surface water discharge to 2,600 AFY.

A 1992 analysis by the SBCWA indicated a gross overdraft of about 2,000 AFY. However, pumping pattern changes in the 1980s and importation of State Water in the 1990s significantly altered the amount of water extracted from the basin. The SYRWCD ID#1 shifted much of its pumping to the alluvial corridor and State Water Project deliveries began in 1997. In 2002, SBCWA commissioned Hopkins Groundwater Consultants, Inc. to provide an independent review of the SBCWA findings and conclusions in this study. Hopkins determined that the water budget deficit was most likely still on the order of approximately 2,000 AFY under historical groundwater demand conditions, but recent changes in basin demand and increases in imported water resulted in a basin that was balanced or in a state of slight surplus.

Available storage within the Santa Ynez Uplands Groundwater Basin is estimated to be about 900,000 AF (La Freniere and French, 1968). Safe yield of this basin is estimated to be 11,500 AFY (for gross pumpage). Estimated pumpage of the basin is 11,000 AFY (SBCWA 2001).

Groundwater supplies about 85% of the water demand within the basin. In addition, water is imported into the basin from the Cachuma Project, the State Water Project, and the Santa Ynez River Alluvial Basin. Agriculture accounts for about 75% of the water demand within the basin; the remaining demand is mostly from domestic consumers.

Figure 27: Agricultural Production Well 7N/30W-25Q2 in Marre Canyon

The basin is pumped by the SYRWCD ID#1, which serves the Santa Ynez and Los Olivos areas, and by private agricultural and domestic users. SYRWCD ID#1 and the City of Solvang also pump from the Santa Ynez River Alluvial Basin. This alluvial basin is described on page 58. The City of Solvang also pumps a small amount of water most years from a well located near the center of the City at City Hall. This "Central" area is not within the Santa Ynez Uplands Basin, nor is it in the Santa Ynez River Alluvial Basin. The water is believed to come from a small perched aquifer layer that is not hydraulically connected to the adjacent basins. Table 7 illustrates actual pumping from the two water agencies and estimated pumping from the private agricultural and domestic users within the groundwater basin during the period 2008 through 2010.

The SYRWCD ID#1 holds a State Water allocation of 2,000 AFY and a 200 AF drought buffer. 1,500 AFY are contractually committed for use by the City of Solvang. The drought buffer effectively increases the amount of water to be delivered in the event that overall deliveries are reduced by a given percentage. Contracting agencies typically do not request their full State Water allocation but use the State Water as a supplement to their other water sources. For a complete listing State Water deliveries for recent years see page 11. SYRWCD ID#1 is credited with importing water into the basin via the Cachuma Project, the State Water Project and the Santa Ynez River Alluvial Basin employing a conjunctive usage strategy. It is important to note that the SYRWCD ID#1 does not receive actual Cachuma Project water, but is delivered an equivalent volume of State Water through an Exchange Agreement with the South Coast members of the Cachuma Project. By the terms of this agreement, the SYRWCD ID#1's share of Cachuma Project water is delivered to other Cachuma Project members on the South Coast. This program reduces pumping and treatment costs.

Groundwater Pumping from the Santa Ynez Uplands, Buellton Uplands and Santa Ynez River Alluvial Basins				
Basin	**Area**	**2008**	**2009**	**2010**
City of Buellton	Buellton Uplands	121 AF	299 AF	210 AF
	SYR Alluvial	2,727 AF	755 AF	715 AF
City of Solvang	Solvang (Central)	191 AF	162 AF	144 AF
	SYR Alluvial	183 AF	207 AF	174 AF
Santa Ynez River Water Conservation District ID#1	SY Uplands	1,523 AF	1,897 AF	438 AF
	SYR Alluvial	1,868 AF	1,788 AF	1,226 AF
SYRWCD Reported Produced Water	SY Uplands	3,272 AF	3,094 AF	2,468 AF
	SYR Alluvial	11,598 AF	11,061 AF	10,890 AF

Table 7: Santa Ynez Uplands, Buellton Uplands and Santa Ynez River Alluvial Basin Pumping Amounts 2008-2010

The observation well used to generate the hydrograph shown in Figure 28 is located in the central part of the Santa Ynez Uplands Basin. From this hydrograph a general dewatering trend of the basin can be deduced beginning around 1960 and continuing until the end of the 1987-1991 drought. A significant water level rise occurs during the exceptionally wet 1990s followed by recent stabilization. Most of the wells within the Santa Ynez Uplands Basin extract from a source several hundred feet below ground surface. Therefore, a two to four year lag between the occurrence of stream seepage and rainfall percolation and corresponding water level changes in observation wells is not uncommon. It is also important to note that water suppliers within the area periodically shift their pumping patterns to draw more water from the Santa Ynez River Alluvial Basin and less from the Uplands Basin. This may result in more stable water levels in the Uplands area but may also reduce water levels in the Alluvial Basin. The primary reason for these periodic shifts in pumping patterns is to efficiently manage water supply and quality from the sources available.

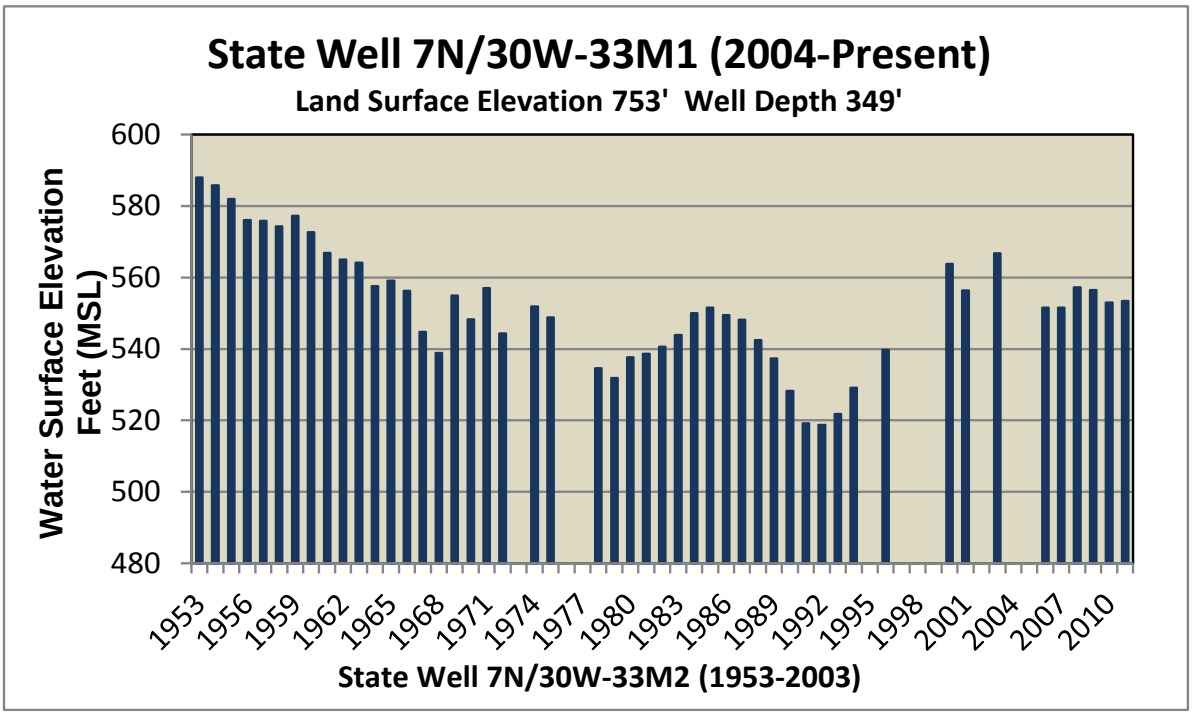


Figure 28: Hydrograph for State Well 7N/30W-33M1

Water Quality

Water quality within the basin is generally adequate for most agricultural and domestic purposes. The USGS report 84-4131 (Hamlin, 1985) focuses on water quality within the Uplands as well as adjacent basins and should be consulted for water quality information on this area.

Total Dissolved Solids

Studies completed in 1970 indicate TDS concentrations ranging from 400 to 700 mg/l. Although recent water quality data are limited, samples analyzed by the USGS in 2002 exhibited an average TDS concentration of around 490 mg/l. Figure 29 indicates that since the 1960s TDS concentrations in the basin have been relatively stable, with only a minor trend upward in the last 20 years. The state standard for TDS in drinking water is 1,000 mg/l (see Drinking Water Standards section on page 7). Note that no water quality data was collected at this site from 1979 through 1987. As is the case in many other areas of the County, quality from the water table aquifers or shallow water in some areas of the Santa Ynez Uplands Basin is dramatically worse than that from deeper or confined aquifers.

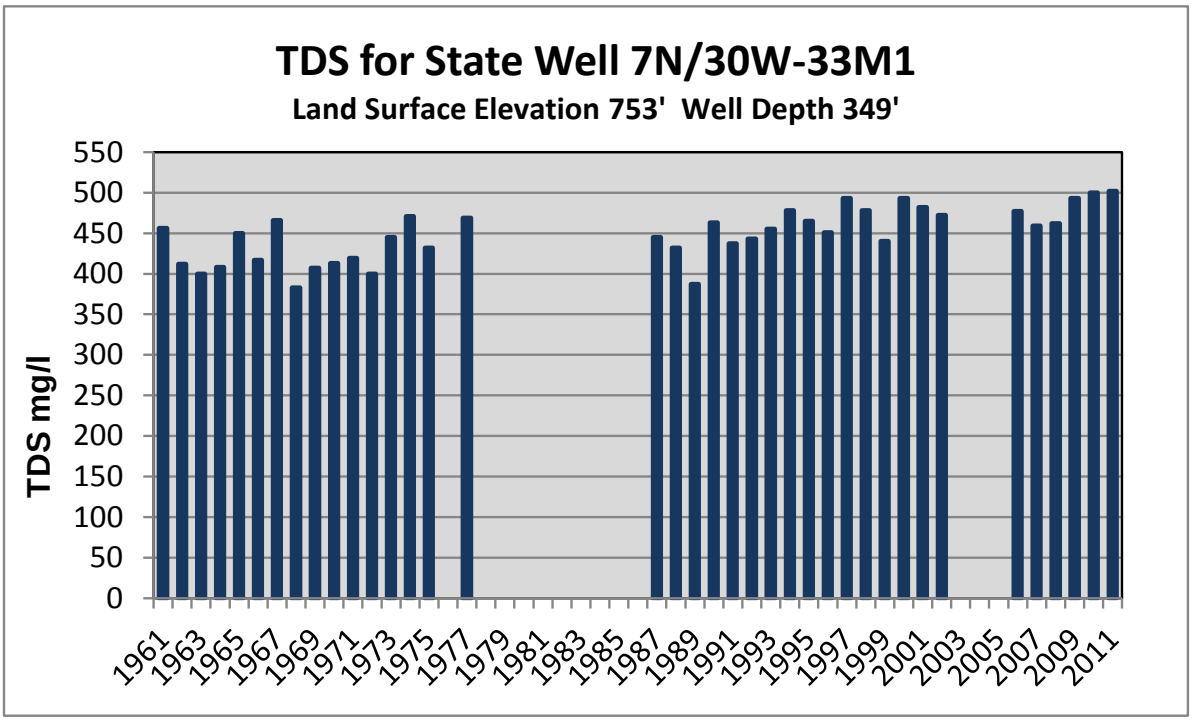


Figure 29: Total Dissolved Solids for State Well 7N/30W-33M1

Nitrates

According to data collected from State Well 7N/30W-30M1, nitrogen in the aquifer as nitrate has increased since the 1990s from 11 mg/l to near 26 mg/l (see Figure 30). State Well 7N/30W-30M1 is located approximately three miles east and up gradient of the Los Olivos/Ballard area. Historical water quality data from wells in the Los Olivos/Ballard area indicate elevated nitrate concentrations in some cases exceeding the MCL of 45 mg/l. Septic systems are suspected of being the source of the increasing nitrates in the area (Santa Barbara County Environmental Health Services, 2010).

Sulfates

Sulfates in the Santa Ynez Uplands Groundwater Basin have been relatively stable in the last 40 years at around 20-23 mg/l (Figure 30). The exception to this appears in late 1983 when 41 mg/l was measured. Rainfall was extremely high throughout the area in 1983 and considerable recharge to the aquifer was initiated. It is possible that this measurement was not representative of conditions of that year or long term conditions.

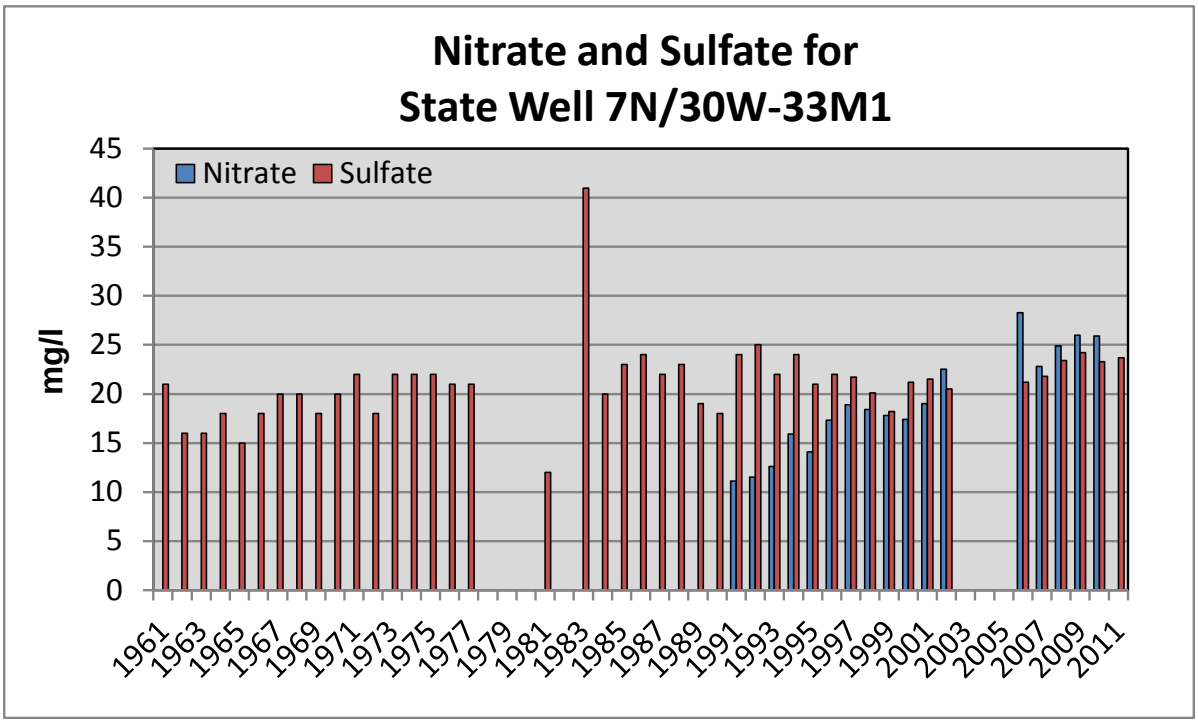


Figure 30: Nitrate and Sulfate for State Well 7N/30W-33M1

2009-2011 Trends

Rainfall during the period was above average with an average for the three year period of 20.23 inches compared to a long term average of 16.27 inches at the Santa Ynez Fire Station. This was mainly due to the wetter than average water year of 2009-2010 with 21.28 inches recorded and the wet 2010-2011 water year with 26.34 inches recorded. The 2008-2009 winter was dryer than normal with only 13.08 inches recorded, 5.59 inches of it in February 2009. No significant recharge to the groundwater basin occurred during the water year 2008-2009, but there was recharge from both percolation of direct rainfall and stream flow during both the 2009-2010 and 2010-2011 water years.

SBCWA and the SYRWCD ID#1 maintain a groundwater monitoring network in conjunction with the USGS to track water level and quality changes within the basin. During the period 2009 through 2011 groundwater quality was measured at one site in the basin and water level was monitored at 46 sites. There was little change in TDS, calcium, magnesium, nitrates and sulfates during the 2009-2011 timeframe. Chemical analyses indicate that the water quality in this area has not been degraded over the past few years and is within both agricultural and domestic usage standards.

Santa Ynez River Alluvial Groundwater Basin

The Santa Ynez River Alluvial Groundwater Basin consists of the unconsolidated sand and gravel alluvial deposits of the Santa Ynez River. These deposits are up to 150 feet thick and several hundred feet across, and extend 36 miles from Bradbury Dam to the Lompoc Plain. Storage within the upper 50 feet of the basin is about 90,000 AF. This figure is based upon work done by SBCWA staff following USGS WSP 1107 (study of Santa Ynez River TDS, salts and groundwater underflow) and WRCB Decisions 73-37 and 89-18 (modification of U.S. Bureau of Reclamation's water rights permits). Groundwater in the Alluvial Groundwater Basin is in direct hydraulic communication with surface flow of the river.

Inflow to the basin is from infiltration of river flow, direct percolation from rainfall, underflow from adjacent basins (Santa Ynez Uplands and Buellton Uplands), and percolation from wastewater ponds in Solvang and Buellton. In accordance with existing requirements included in State Water Resources Control Board Water Rights Decisions, water is released from Cachuma Reservoir to recharge the Alluvial Basin based on water levels in monitoring wells and "credits" of water held in reservoir storage. In addition, small amounts of recharge to the Santa Ynez River Alluvial Groundwater Basin can occur when water is released from Lake Cachuma to the riverbed for Endangered Species Act purposes under certain hydrological conditions detailed in the Biological Opinion for the U.S. Bureau of Reclamation Operation and Maintenance of the Cachuma Project. Thus, the Cachuma Project at certain times controls basin water levels. This basin is not subject to overdraft (i.e. a progressive long-term drop in water levels) because the average annual flow to the Santa Ynez River (the main recharge source) is greater than the volume of the basin. Water is extracted from this basin for municipal and agricultural uses by many entities both private and public.

Figure 31 on the following page illustrates the location of the Santa Ynez River Alluvial Groundwater Basin.

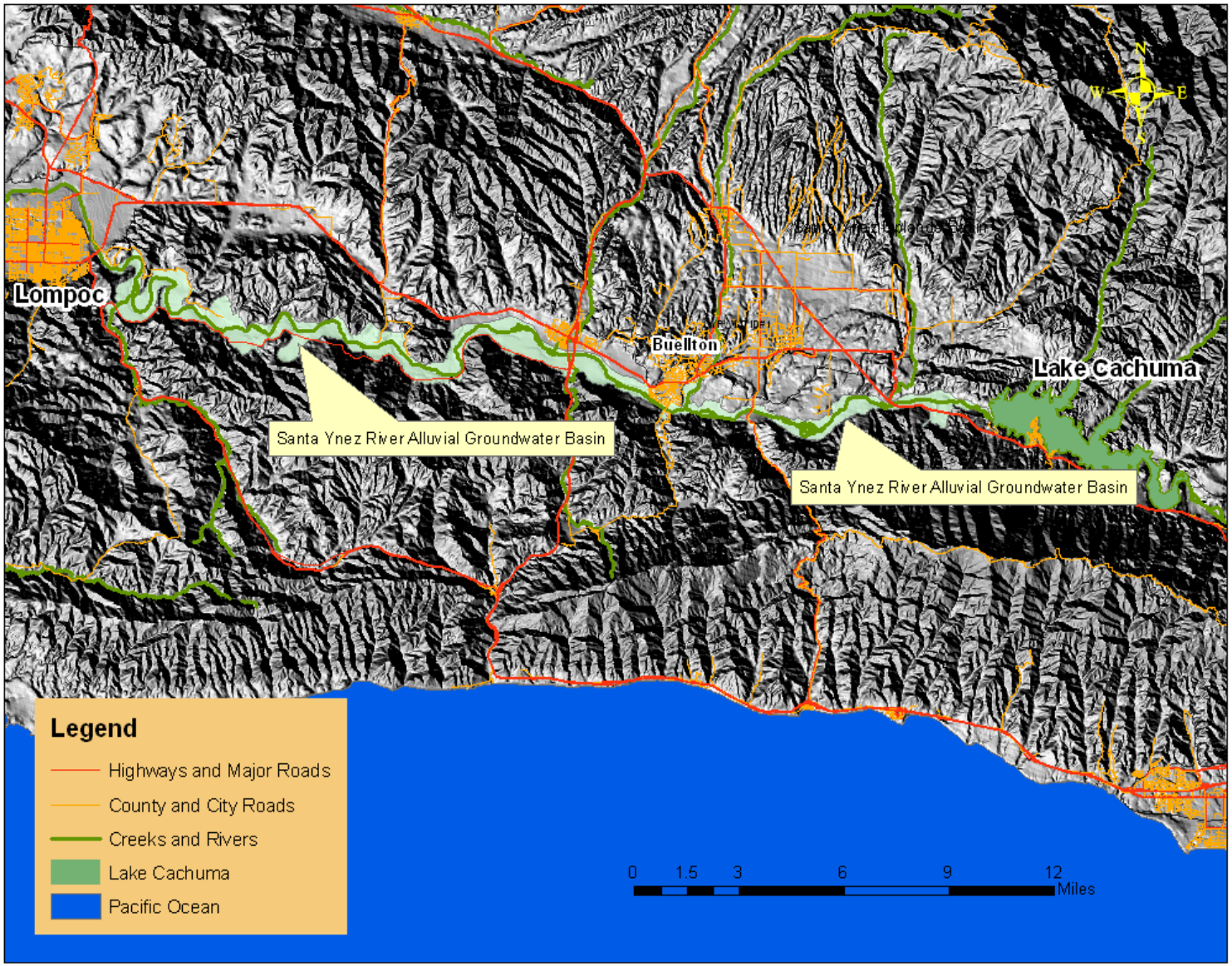


Figure 31: Santa Ynez River Alluvial Groundwater Basin

Buellton Uplands Groundwater Basin

Physical Description

The Buellton Uplands Groundwater Basin encompasses about 29 square miles located about 18 miles east of the Pacific Ocean and directly north of the Santa Ynez River. The basin boundaries include the impermeable bedrock of the Purisima Hills to the north, the Santa Ynez River Fault to the south, a limited connection to the Santa Ynez Upland Groundwater Basin to the east and a topographic divide with the Lompoc Basin to the west. The Santa Ynez River Riparian Basin sediments overlie portions of the Buellton Uplands in the south-east part of the basin. Due to the north to south hydrologic gradient the Buellton Uplands Basin likely discharges into the Santa Ynez River Riparian Basin (see Santa Ynez River Alluvial Basin section on page 58. SBCWA has estimated average annual rainfall in the basin to be about 17 inches per year. Recharge to the basin is from deep percolation of rainfall, stream seepage, return flow from agriculture, and underflow from adjacent basins.

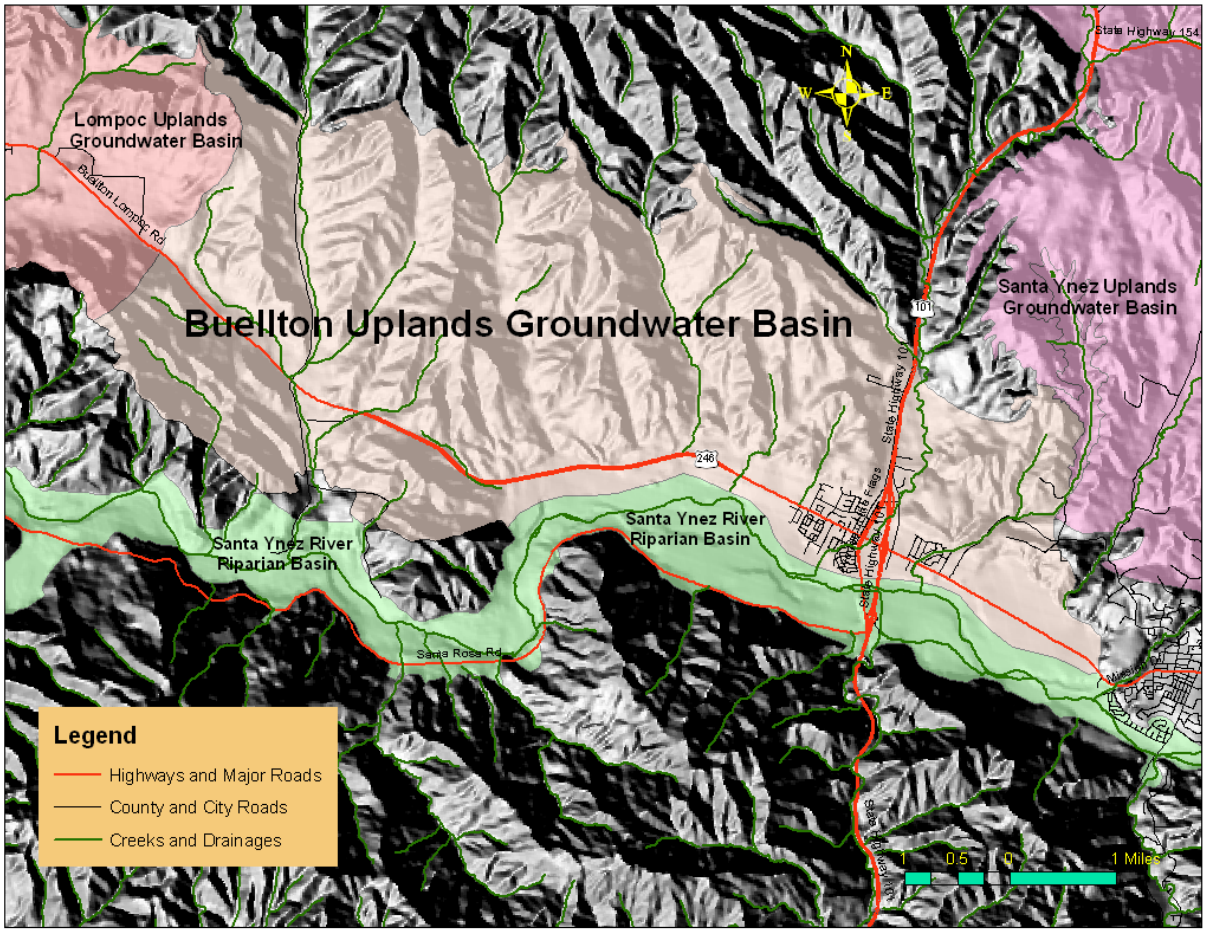


Figure 32: Buellton Uplands Groundwater Basin

History and Analyses

The Buellton Uplands Groundwater Basin has been a recognized hydrologic unit for decades and is designated on the 1980 groundwater basin maps adopted into the Santa Barbara County Comprehensive Plan. However, until 1995 this basin was not subject to detailed analysis by either the USGS or SBCWA. At that time SBCWA was commissioned to study the basin, and the results of that analysis are presented in the following discussion.

Available storage in the Buellton Uplands Basin is estimated to be 154,000 AF. The total volume of water in storage in this basin is estimated by SBCWA to be about 1.4 million AF (assuming a specific yield of 10%). Safe yield for consumptive use (net yield) is estimated to be 2,768 AFY (SBCWA, 1995). Based on an estimated average of 26% return flows, safe yield for gross pumpage (perennial yield) is estimated to be 3,740 AFY. Estimated pumpage from the basin is 2,599 AFY (gross) and 1,932 AFY (net). Thus, the basin is considered by SBCWA to be in a state of surplus with natural recharge exceeding pumpage by a net of 800 AFY. This surplus represents the amount of groundwater from the Buellton Uplands Basin that discharges annually into the Santa Ynez River Riparian Basin. Approximately 80% of the 2,599 AFY of pumpage in the basin is attributable to agricultural irrigation. The City of Buellton and scattered farmsteads around the rural area use the remaining 20%. The importation of State Water has further reduced the reliance on groundwater.

Water Quality

Water quality data for the basin is limited. However, data from late 1950s and early 1960s indicate TDS concentrations between 300 and 700 mg/l for several wells within the basin. There are currently no water quality monitoring sites operated through the County/USGS monitoring program.

2009-2011 Trends

Average rainfall during the three year period was 16.85 inches, slightly below the long term average of 17.39 inches. This was mainly due to the extremely dry 2008-2009 water year during which only 10.76 inches of rainfall was recorded. The median water year of 2009-2010 produced 18.52 inches and the wetter than average 2010-2011 water year yielded 21.26 inches.

During the period 2009 through 2011 ground water level was measured at four sites in the Buellton Uplands Basin. Water levels generally slightly rose during the period mostly attainable due to the average 2009-2010 and the wet 2010-2011 water years.

Lompoc Groundwater Basins

Physical Description

The Lompoc Groundwater Basins consist of three hydrologically connected areas: the Lompoc Plain, Lompoc Terrace, and the Lompoc Uplands. Within the Lompoc Uplands exists the Santa Rita Sub-area as a geologic syncline underlying the entire area. Together, these areas encompass about 76 square miles. These areas are best described by Upson and Thomasson, 1951, Wilson, 1955 and 1957, Evanson and Miller, 1963, Evanson and Worts 1966, Miller 1976 and SBCWA, 1977.

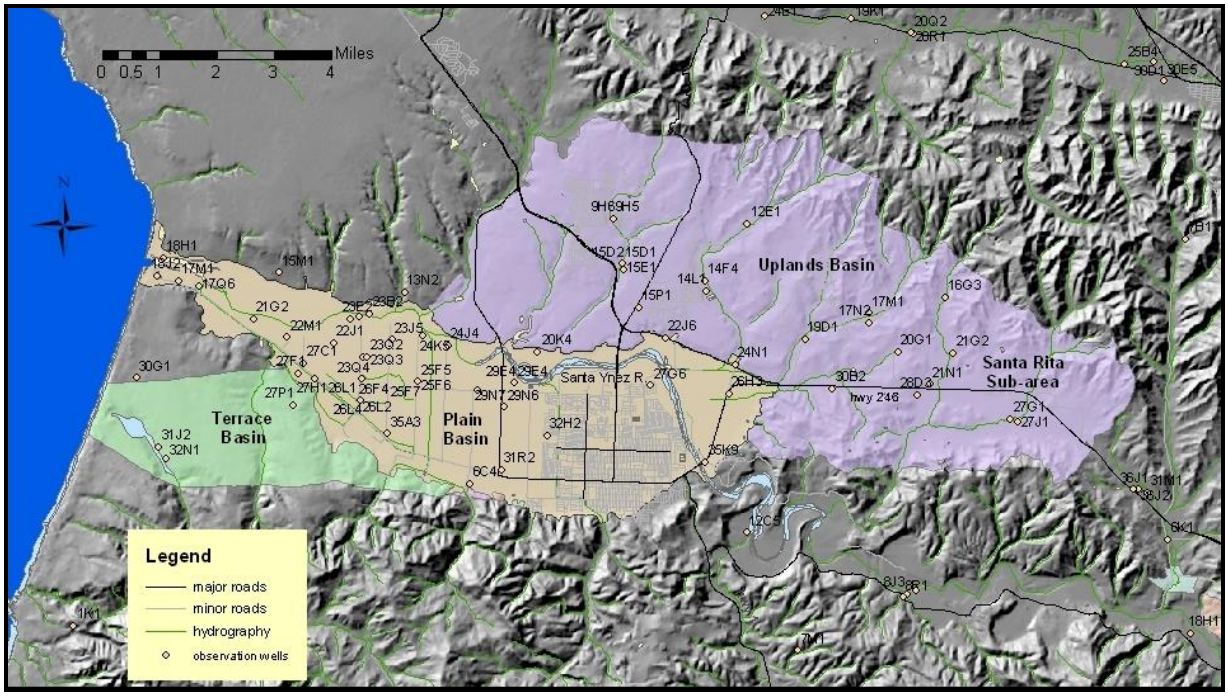


Figure 33: Lompoc Area Groundwater Basins

Lompoc Plain

The Lompoc Plain surrounds the lower reaches of Santa Ynez River and is bordered on the north by the Purisima Hills, on the east by the Santa Rita Hills, on the south by the Lompoc Hills and on the west by the Pacific Ocean. This alluvial area is divided into an upper and a lower aquifer. The upper aquifer is sub-divided into three different units: the shallow zone, the middle zone and the main zone. Based on previous hydrologic and water quality studies, these zones have only limited points of hydrologic continuity and exchange within the western and central Lompoc Plain, but they are well connected within the eastern Lompoc Plain. Orographic effects and wind influence precipitation measured within the area. The maximum average rainfall is about 18 inches and occurs near the southern edge of the area in the Lompoc Hills; the minimum precipitation is about 10 inches near the Pacific Ocean. Average rainfall near the City of Lompoc is 14 inches. Rainfall averages about 12 inches per year over the entire Lompoc Plain. This area is essentially in equilibrium as, during periods of dry climate, water is released from Lake Cachuma to recharge groundwater levels in the eastern portion of the Plain.

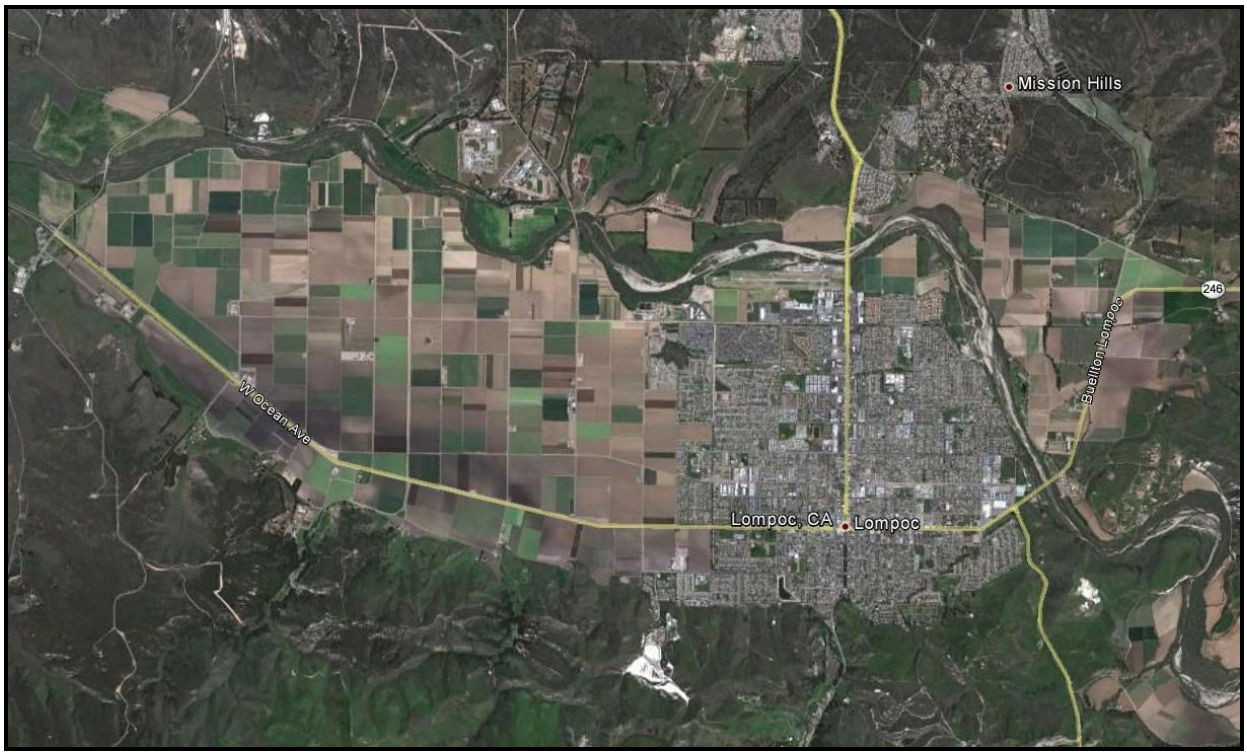


Figure 34: Aerial Image of the Lompoc Plain 2009

Lompoc Terrace

The Lompoc Terrace is formed by a down faulted block capped with permeable sediments (Evenson and Miller, 1963) on Vandenberg Air Force Base (VAFB) south of the Lompoc Plain. This area consists of Orcutt Sand deposits which overlay both the Graciosa and Cebada members of the Careaga Formation. The Careaga Formation is a marine formation which can yield small to moderate quantities of water (see Major Water Bearing Geologic Formations of Santa Barbara County, page 25). Rainfall averages 12 inches per year over the area which has a climate that is heavily influenced by the nearby Pacific Ocean's cool air masses. Thickness of the formation in the Terrace is 400-500 feet and usable groundwater in storage is estimated to be around 30,000 AF (SBCWA, 1977). Historically VAFB used this area for water supply but currently relies upon State Water as well as water imported from the San Antonio Groundwater Basin (see page 67).

Lompoc Uplands

The Lompoc Uplands is bordered on the west by the Burton Mesa, on the north by the Purisima Hills, on the east by a topographic divide which separates it from the Buellton Uplands Basin and on the south by the Lompoc Plain and the Santa Rita Hills. Historically, underflow from the Lompoc Uplands and Lompoc Terrace contributed to recharge of the Lompoc Plain. As a result of a long-term decline in water levels, underflow now sometimes moves to the Western and Central Lompoc Uplands from the Lompoc Plain. The Lompoc Uplands Area provides water to the communities of Vandenberg Village and Mission Hills. The Santa Rita Sub-area is the easternmost section of the basin and is hydrologically connected to the other areas by a geologic syncline, the axis of which runs east-west.

History and Analyses

Available storage within the Lompoc Groundwater Basins is estimated to be approximately 170,000 AF (Santa Barbara County Comprehensive Plan, 1994). Safe yield is estimated by the SBCWA to be 28,537 AFY (gross or perennial yield) and 21,468 AFY (net). Net pumpage or consumptive use from the Lompoc areas is estimated to be 22,459 AFY. Based on water level trends evaluated in a 2001 study, the area was near equilibrium with net extractions exceeding recharge by 913 AFY. All of this deficit was derived from the Lompoc Uplands, specifically the Santa Rita area and the Cebada and Purisima Canyons.

Agriculture uses about 70% of the total water consumed within the area. Municipal users account for the remaining demand and include the City of Lompoc, the Vandenberg Village CSD and Mission Hills CSD. The general direction of groundwater flow is from east to west, parallel to the Santa Ynez River. Localized depressions in the water table occur in areas of heavy pumping. One such area is in the northern part of the Lompoc Plain where the City operates municipal supply wells. Pumping depressions are also present in the Mission Hills and Vandenberg Village areas. Sources of recharge to the basin include percolation of rainfall and stream flow (including Cachuma Reservoir releases), agricultural water return flow, and underflow into the basin. Percolation also occurs from Mission Hills CSD's wastewater ponds on the Lompoc Upland and from Lompoc's regional wastewater facility on the Lompoc Plain.

The SYRWCD and the City of Lompoc have entered into an agreement with the Cachuma Member Units which addresses a number of concerns relating to the operation of Cachuma Reservoir, including protection of water quality in the Lompoc Plain. This agreement incorporates existing plans and water rights decisions and also provides flexibility to improve management procedures as warranted. The parties to the agreement have asked the State Water Resources Control Board to incorporate technical changes to existing water rights decisions but to leave the existing water management structure otherwise intact.

Water Quality

Water quality in the Lompoc Plain varies significantly both geographically and throughout the different zones of the upper and lower aquifer. For a detailed discussion on water quality throughout the Lompoc Groundwater Basins please consult USGS WRI 91-4172 “Ground-water Hydrology and Quality in the Lompoc Area, Santa Barbara County California, 1987-88” (Bright et al., 1992). The following discussion provides only a summary of water quality conditions in the Lompoc Groundwater areas.

Groundwater quality in the Lompoc Groundwater areas generally decreases from east to west as the basin nears the coastline of the Pacific Ocean. Areas of recharge in some portions of the eastern Lompoc Plain adjacent to the Santa Ynez River contain TDS concentrations greater than 1,000 mg/l. It is believed that leakage from the shallow zone is responsible for elevated TDS levels in the middle zone in the northeastern plain. Figure 35 illustrates TDS and sulfate trends over the past 45 years at State Well 7N/34W-27P5 which is located on the northern flank of the City of Lompoc in the northeastern section of the Plain. Sulfates have generally ranged between 400 and 600 mg/l and dissolved solids have generally ranged between 1,000 and 1,500 mg/l over the past 40 years. Point sources of sulfates and nitrates include sewage treatment plants, industrial discharges and agricultural return flows. Sulfates are not considered toxic to plants or animals at normal concentrations. In humans, concentrations of 500-750 mg/l

cause a temporary laxative effect. Problems caused by sulfates are most often related to their ability to form strong acids which can change the pH characteristics of the water body.

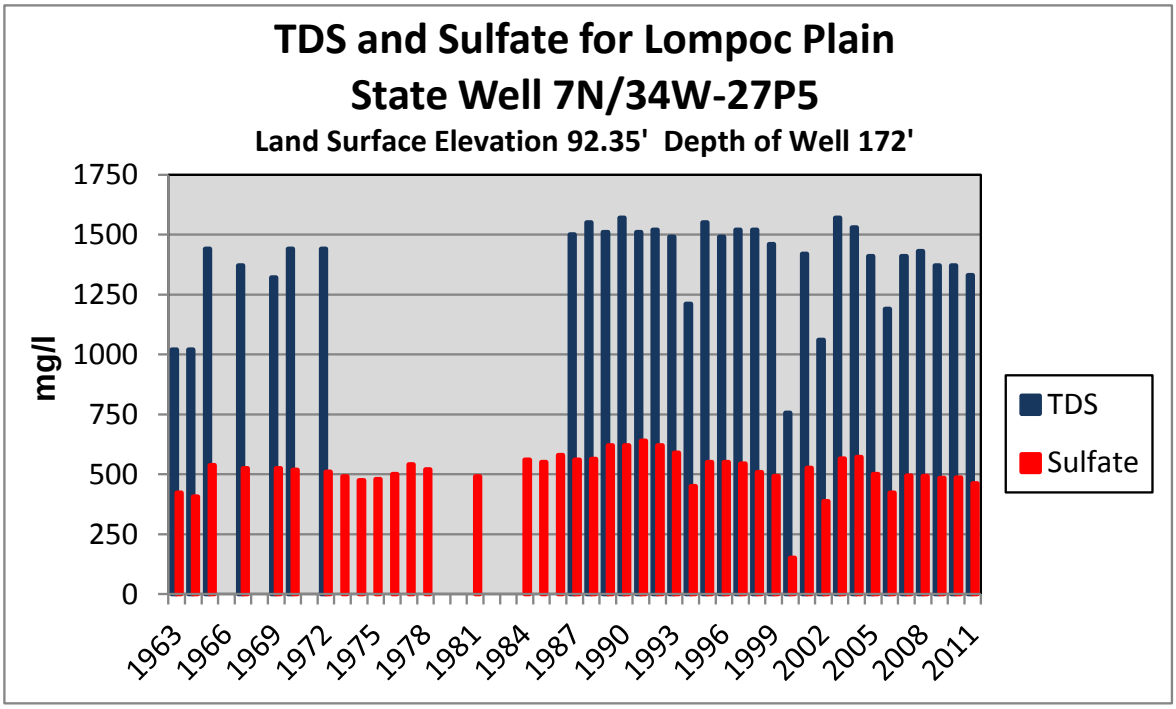


Figure 35: TDS and Sulfate for State Well 7N/34W-27P5 in the Lompoc Plain

In the middle zone, water samples taken from below agricultural areas of the north-eastern plain contained TDS concentrations averaging over 2,000 mg/l. However, some middle zone portion of the upper aquifer groundwater from the western plain exhibited TDS levels below 700 mg/l.

Upon crossing into Section 35 West in the far western section of the Lompoc Plain water quality changes dramatically. In this area, near the coast, groundwater from the main zone exhibited TDS concentrations as high as 4,500 mg/l. Water quality in the shallow zone of the Lompoc Plain tends to be poorest near the coast and in some heavily irrigated areas of the area. TDS concentrations of up to 8,000 mg/l near the coast were measured in the late 1980s. Contamination of the main zone near the coast is thought to be due to percolation of seawater through estuary lands and upward migration of poor quality connate waters from the underlying rock. The presence of elevated boron, a constituent common in seawater supports this conclusion.

Groundwater of the Lompoc Terrace and Lompoc Uplands Areas is generally of better quality than that of the Plain, with TDS averaging around 700 mg/l. Some of the natural seepage from these areas is of excellent quality. Figure 36 of TDS from well 7N/34W-15E3 is in the Lompoc Uplands and illustrates the significantly better quality of water in the Lompoc Uplands. This is a production well operated by Vandenberg Village CSD.

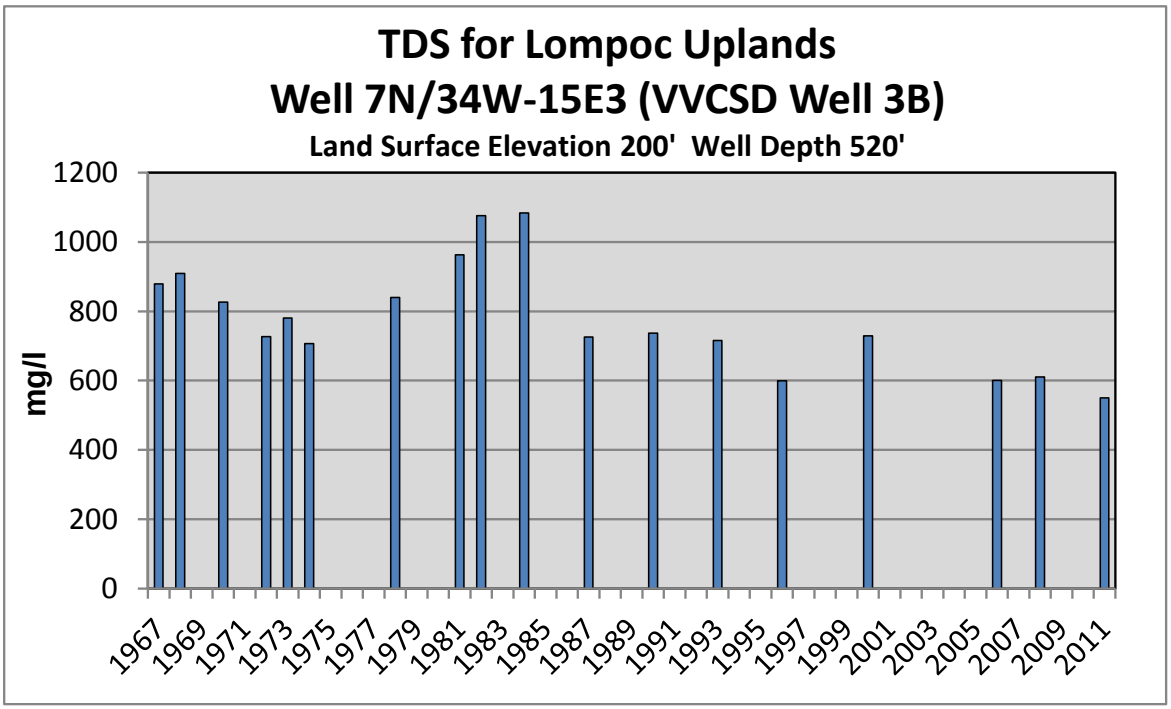


Figure 36: TDS for State Well 7N/34W-15E3 in the Lompoc Uplands

Groundwater users and public agencies within the area are working to clarify and resolve water quality concerns due to reduction in fresh water recharge from the Santa Ynez River after the construction of Cachuma Reservoir and the gradual increase in agricultural return flows. Public agencies are also exploring options for exercising SWRCB Permit 17447 to divert winter flows from the Santa Ynez River into spreading basins that would serve to recharge the Lompoc Plain and Lompoc Uplands Areas.

2009-2011 Trends

Rainfall during the period was above average with a three year average of 18.86 inches versus the long term average of 15.37 inches at Lompoc City Hall. This was mainly due to the extremely wet 2010-2011 water year in which 26.75 inches of rainfall was recorded.

During 2009-2011 period water quality was measured at four sites throughout the basin and water level was measured at 68 sites. In addition, the Santa Ynez River Water Conservation District coordinates both water level and water quality measurements at 16 sites in the Lompoc area funded by local water purveyors and the County as part of the ongoing monitoring in relation to operations of Lake Cachuma. There was no significant change in water level or water quality during the 2009-2011 time period in the Lompoc area. As previously mentioned, water levels are balanced by releases made from Lake Cachuma, thus in essence the basin is managed to maintain water level and water quality thresholds under current operation of the reservoir.

San Antonio Groundwater Basin

Physical Description

The San Antonio Valley is approximately 30 miles long by seven miles wide. It is cradled between the Solomon-Casmalia Hills to the north, the Purisima Hills to the south, the Burton Mesa to the west and the westernmost flank of the San Rafael Mountains to the east. The Watershed is approximately 130 square miles and the Groundwater Basin within the Valley is about 110 square miles. Average annual rainfall within the basin is about 15 inches.

The Valley is shaped by an eastward plunging syncline containing the deposits comprising the groundwater basin. The Paso Robles formation and alluvium are the most common material within the Groundwater Basin. Consolidated rocks lie below the basin deposits but surface about seven miles east of the Pacific Ocean, forcing groundwater to the surface, and creating a wetland area known as Barka Slough which denotes the western end of the Groundwater Basin. Land use within the Valley consists mainly of agriculture, ranching and a small amount of urban development in the town of Los Alamos.

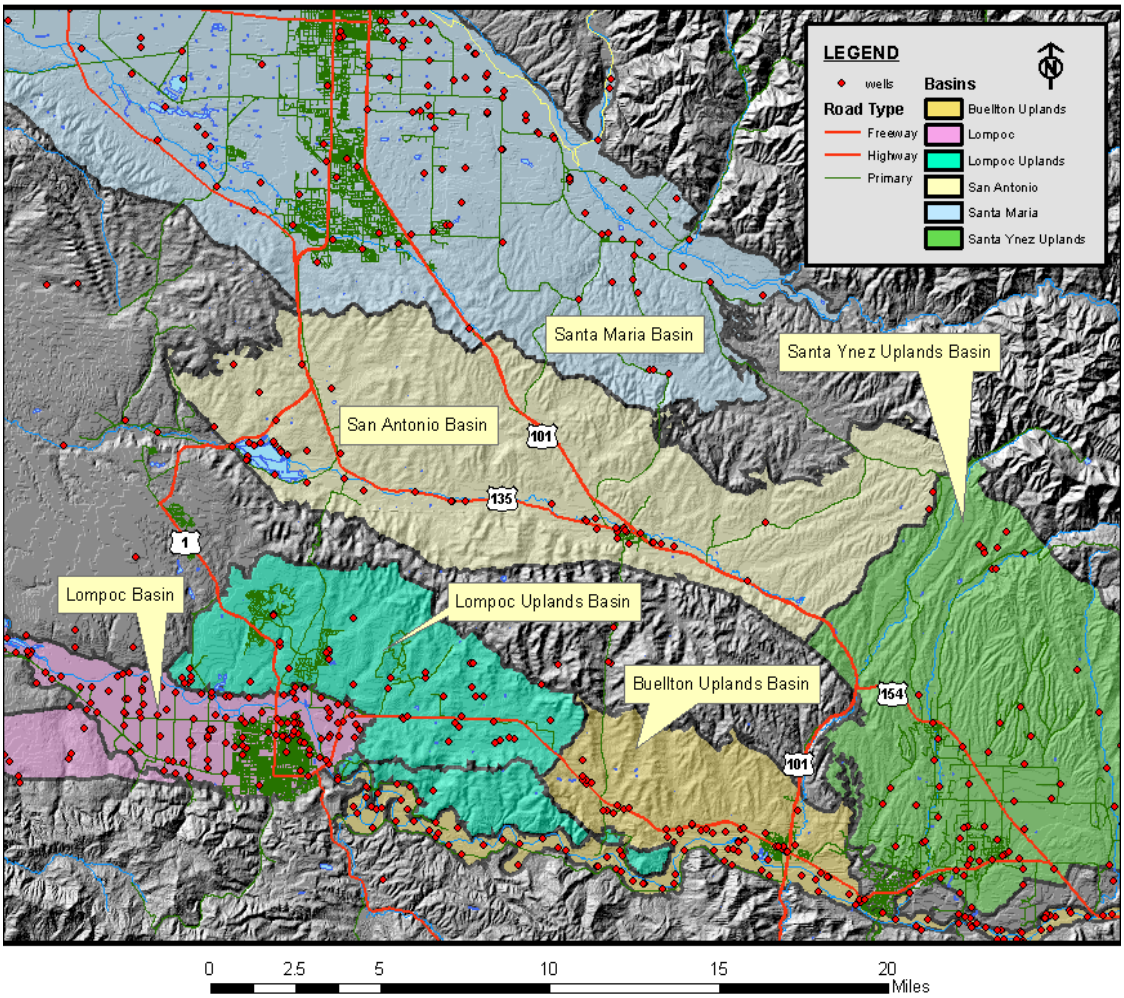


Figure 37: San Antonio Groundwater Basin

History and Analyses

The basin is best described by Muir (1964), SBCWA (1977), and Hutchinson (1980). Arnold and Anderson (1907) were the first to describe in detail the geography and geology of the San Antonio Valley for the purposes of petroleum exploration.

What is now the town of Los Alamos was surveyed in 1876 and one year later became a flourishing community having a hotel, three saloons, and several general merchandising stores. Rapid growth of the town brought about the demand for a dependable water supply, and, as a consequence, the first domestic water wells in the Valley were dug. Before this time the water had been obtained from springs that bordered the Valley. The pumping of water for irrigation started at the turn of the century with the beginning of the sugar-beet industry. By 1943 there were 21 active irrigation wells in the Valley, and by 1958 that number had increased to 39 (Muir, 1964). Similar to the Santa Maria Valley, irrigation developed slowly between 1900 and 1920, rapidly between 1920 and 1930, and then slowed between 1930 and 1943 (Worts, 1951).

Appraisals of the hydrologic resources of the area began in 1942 with work by G.F. Worts. Worts canvassed the wells and mapped the geology of the area but his work was suspended in 1943 and picked up again in 1957 by Muir. In addition, H.D. Wilson and R.E. Evanson were integral in developing baseline hydrologic conditions.

Safe yield of the basin was reported to be 8,667 AFY (gross) and 6,500 AFY (net) (USGS Open File Report, 1980). Available storage in the upper 200 feet of the basin is estimated to be about 800,000 AF. The supply/demand status of this basin was updated in a 1999 study (Baca et al) prepared by the County. The 1999 County study estimated net pumpage (net consumptive use) of groundwater in the basin to be 15,931 AFY (equivalent to gross pumpage of 21,128 AFY). Thus, the basin was considered to be in a state of overdraft at a level of 9,431 AFY (net).

In 2002 the Cachuma Resource Conservation District (CRCD) undertook the task of updating the land use survey for the watershed in preparation for the release of the San Antonio Creek Coordinated Resource Management Plan (May, 2003). The basin supply/demand status was re-evaluated in 2003 by SBCWA due to the presence of this updated land use survey, pumping pattern changes and to update recharge numbers based on long-term climate. It was found that pumping of the basin had increased but also that the recharge and thus safe yield numbers had been underestimated so that the average annual overdraft is still around 9,500 AFY (see Table 8, San Antonio Basin Hydrologic Budget on page 70).

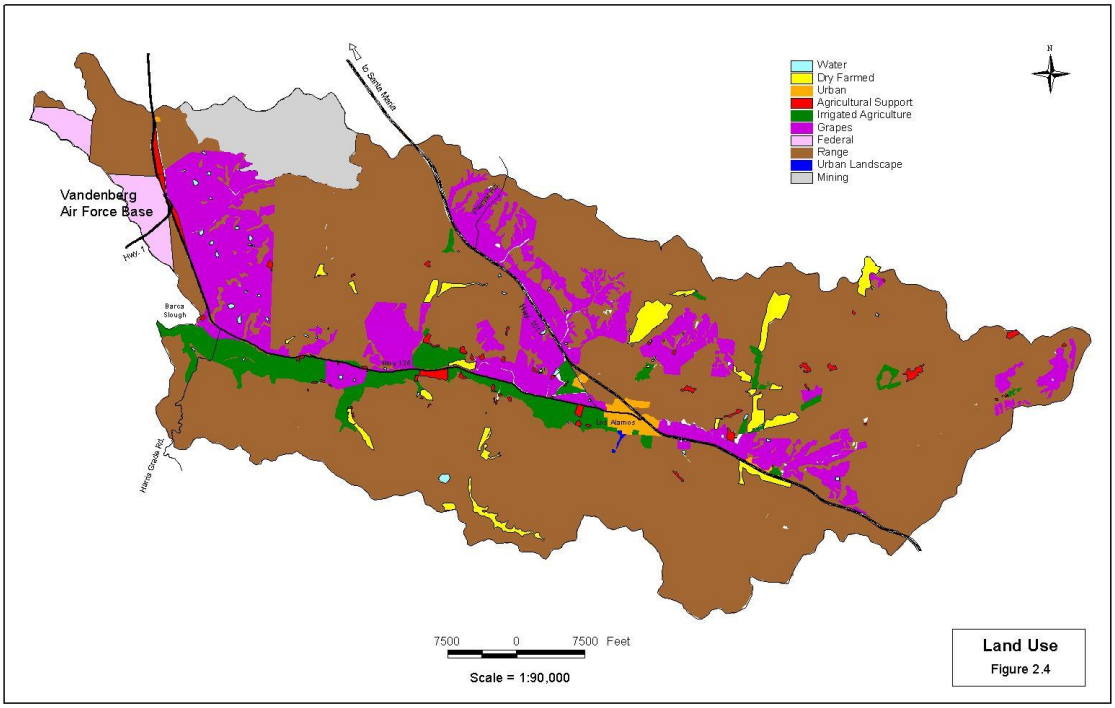


Figure 38: San Antonio Valley Land Use (Courtesy of CRCD)

San Antonio Valley Land Use

The CRCD used aerial imagery ground checked by staff to ascertain that 9,970 acres of vineyards and 2,800 acres of annual or vegetable crops were being grown in the basin. In addition it was determined that 1,381 acres of dry farming without supplemental irrigation existed in the basin. Figure 38 illustrates the distribution of land use throughout the Valley.

Based on these irrigated acreages and water duty factors supplied by the University of California Cooperative Extension the gross pumpage is estimated to be 25,540 AFY (net pumpage is estimated to be 20,432 after return flows of 20% are deducted).

Vandenberg Air Force Base (VAFB) historically pumped approximately 3,400 AFY from the San Antonio Basin. With the recent shift to State Water as its principal supply, VAFB pumpage has dropped to about 300 AFY. However, due to reductions in state water deliveries in 2009 1,424 AF was pumped over a nine month period (Kalata, M., 2010).

Recent analysis shows that the basin was previously evaluated during a dry period (1958-1977) and thus both deep percolations from rainfall and stream seepage are believed to have been previously underestimated. The trends during this period are depicted by the Los Alamos station on the Cumulative Departure from Mean chart as Figure 7 on page 19 in the Climate and General Hydrologic Trends section. Note how in the previous evaluation period used to calculate safe yield (1958-1977) the trend is downward and dry, and in the last 25 years the cumulative departure for Los Alamos has climbed back up to almost mean. This means that the area was drier than normal from around 1950 to around 1975 and has been wetter than normal

between around 1975 to around 2000. This trend also correlates well with the Pacific Decadal Oscillation (depicted on Figure 10, page 23).

Using the climatically balanced base period of 1943-2001 for evaluating the basin, SBCWA arrived at about 10,000 AFY for deep percolation of rainfall using methodology after Blaney, 1963 and Ahlroth, 2002 that calculates deep percolation from rainfall. Stream seepage estimates have varied between 2,000-5,000 AFY. 5,000 AFY is more reasonable taking into account the wetter base period and lowered groundwater levels. This means the safe yield of the basin is actually about 15,000 AFY. Table 8 lists the calculated inputs and outputs of the San Antonio Groundwater Basin.

Groundwater is the sole source of water supply within the basin boundaries, there are no surface diversions and there are no deliveries of State Water to the basin. The VAFB boundary stretches into the westernmost portion of the basin and occasionally uses groundwater for Base operations as a backup to State Water supplies and for blending purposes. VAFB's water is actually exported out of the Los Alamos basin to the Lompoc Terrace and Uplands areas.

Water discharges from the basin through well extractions and surface outflow to the Pacific Ocean. The surface outflow at the western end of the basin supports the Barka Slough wetland. As previously stated, the basin is in overdraft at an estimated level of around 9,500 AFY. This may lead to adverse effects over the long term in either supply or water quality. Overdraft will also result in a gradual progressive reduction in the amount of water discharged on an average annual basis from the basin. Thus, the Barka Slough wetland may progressively diminish.

San Antonio Basin Hydrologic Budget		
Outputs from San Antonio Groundwater Basin	**2003 Analysis**	**1999 Analysis**
1. Los Alamos Community Service District	-270	-188
2. Other domestic usage throughout the basin	-170	
3. Agricultural extractions	-20,000[1]	-11,843
4. Vandenberg Air Force Base	-300	-3400
5. Baseflow out of Basin	-800	
6. Evapotranspiration of Phreatophytes in Barka Slough and along San Antonio Creek	-3000	
Sub total	**-24,540**	**-15,431**
Inputs from San Antonio Groundwater Basin		
1. Underflow into Basin	0	0
2. Deep Percolation from Rainfall	10,000	
3. Stream Seepage	5,000	
Sub total	**+15,000**	**+6,500[2]**
Totals	**-9,540**	**-9,431**

All amounts expressed as AFY
[1]Using 20% return flow value; 1999 analysis used 25%
[2]From USGS open file report, 1980

Table 8: San Antonio Basin Hydrologic Budget

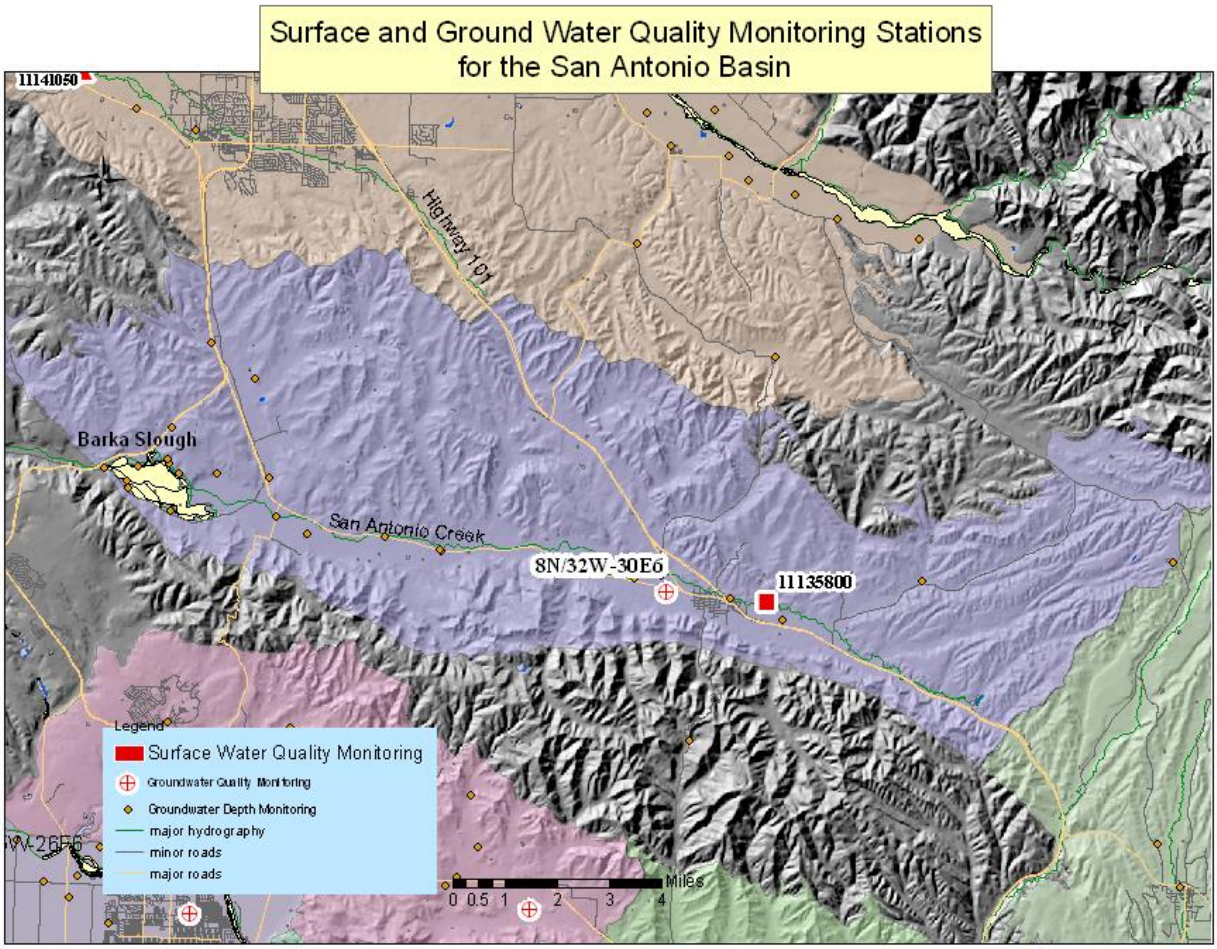


Figure 39: Locations of Water Quality and Streamflow Monitoring in the San Antonio Basin

Depth and Screen / Perforation Information For Groundwater Quality Monitoring Sites			
State Well ID	**USGS Number**	**Depth**	**Screen Intervals**
8N/32W-30E6	344442120173201	600’	300’-600’
Description of Surface Water Quality Monitoring Sites			
Station Number		**Description**	**Watershed Size**
11135800		San Antonio Creek at Los Alamos	34.9 sq. mi.

Table 9: Well Information for San Antonio Basin Water Quality Monitoring Sites

Water Quality

Water quality studies conducted by the USGS in the late 1970s indicated an average TDS concentration within the basin of 710 mg/l, with concentrations generally increasing westward toward the ocean along the Valley floor. Tributary canyons such as Howard, Canada de las Flores and Harris generally have much better quality water with TDS on the order of 300-600 mg/l. The cause of the westward water quality degradation has been thought to be the accumulation of lower quality water from agricultural return flow and the dissolution of soluble minerals (Hutchinson, 1980). The highest TDS concentration (3,780 mg/l) was found in the extreme western end of the Valley and westward of the Barka Slough; the lowest concentration (263 mg/l) was found at the extreme eastern end. Analyses compiled for samples taken between 1958 and 1978 indicate that groundwater quality remained fairly stable during that period. Analyses of water sampled in 1993 for several wells show only slight increases since the previous study. There is evidence that poor quality connate waters exist within fracture zones of the bedrock and that this water might be induced into overlying strata, especially west of Barka Slough. There is no evidence of seawater intrusion in the basin, nor is the basin considered susceptible to seawater intrusion due to the consolidated rock that separates the basin from the ocean. Figure 39 indicates the current surface and groundwater quality monitoring locations in the San Antonio Groundwater Basin.

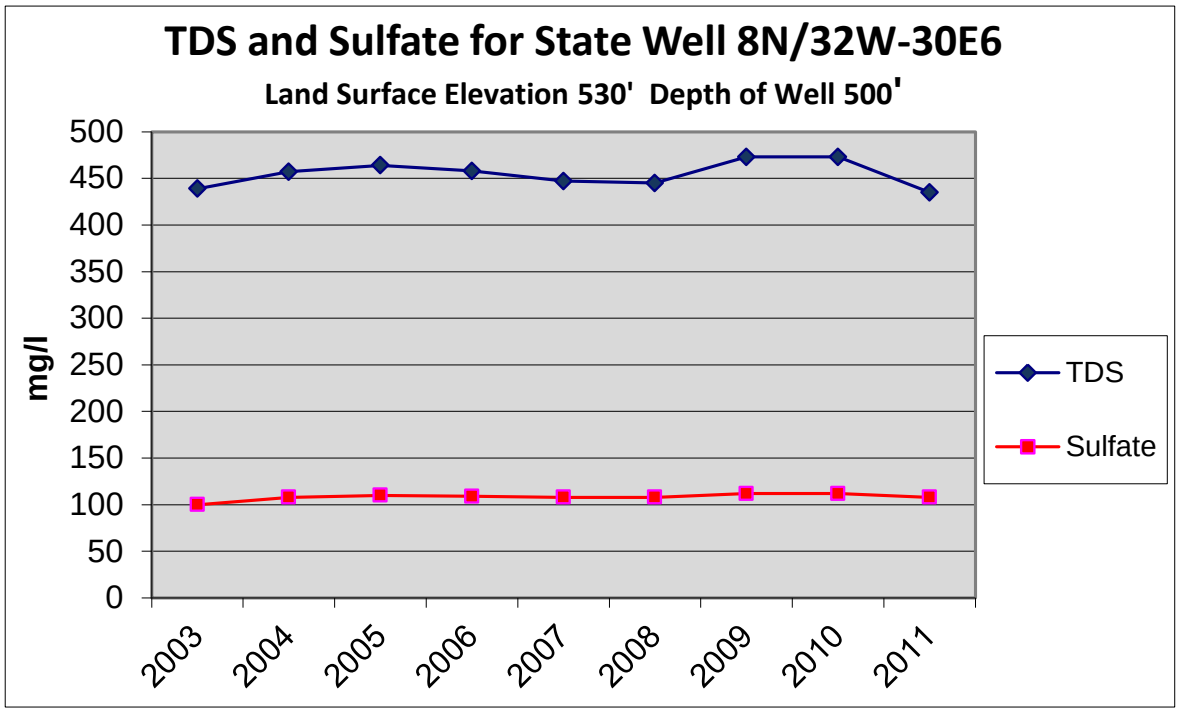


Figure 40: TDS and Sulfate for State Well 8N/32W-30E6

2009-2011 Trends

Rainfall during the period was slightly above average with an average for the three year period of 16.60 inches versus a long term average of 15.41 inches. As was the case for many areas of Santa Barbara County during the 2009-2011 period the 2008-2009 water year was quite dry with only 10.51 inches recorded at the Los Alamos Fire Station, near average 17.61 inches

recorded during the 2009-2010 water year and 21.68 inches recorded during the wetter than normal 2010-2011 water year. The Los Alamos Fire Station maintains one of the best rainfall records in the County with continuous records since 1909.

During the period 2009 through 2011 groundwater quality was measured at one site in the basin and water level was monitored at 20 sites. The one water quality site was just initiated in 2003. There was little change in TDS, calcium, magnesium, nitrates and sulfates during the 2009-2011 timeframe. Figure 40 on the previous page depicts this and all indicators are that the water quality in this area has not been degraded over the past few years and is far within both agricultural and domestic usage standards.

As previously mentioned water level data was collected at 20 sites throughout the San Antonio Basin during the 2009-2011 period. General trends are as follows: in the far eastern part of the basin in the uplands area there appears to be no substantial change as well in the far western part of the basin near the Barka Slough. However, in the north central part of the basin where vineyard development has been increasing there were significant declines in the 2008-2009 water year with below average rainfall but good recovery in the 2009-2010 and 2010-2011 water years with average and above average rainfall, respectively. Unfortunately there is no long term trend that can be deciphered at this time as these wells were just added to the monitoring program around 2003 when concern about water usage in the San Antonio Basin due to increased irrigated acreage began.

Santa Maria Groundwater Basin

Physical Description

The Santa Maria Groundwater Basin Main Unit is a 170 square mile alluvial basin drained by the 1,741 square mile Santa Maria watershed and bordered by the Nipomo Mesa and Sierra Madre Foothills to the north, the San Rafael Mountains to the east, the Solomon-Casmalia Hills to the south and the Pacific Ocean to the west (see basin maps, pages 74 and 76). The basin is situated in the northwest portion of Santa Barbara County and extends into the southwest portion of San Luis Obispo County. The Santa Maria Valley is approximately 28 miles long and 12 miles wide. Average rainfall varies from about 12 to 16 inches per year within the basin. Surface drainage is primarily from the Sisquoc and Santa Maria Rivers that traverse the north side of the basin from east to west. Orcutt Creek, Bradley Canyon, Cat Canyon and Foxen Canyon are the primary drainages on the south side of the basin. Near the coast west of Bonita School Road, the aquifer is confined under silt and clay, comprising the upper part of the alluvium; the remaining part of the basin east of Bonita School Road is considered to be unconfined. Depression of the water table occurs in areas of heavy pumping.

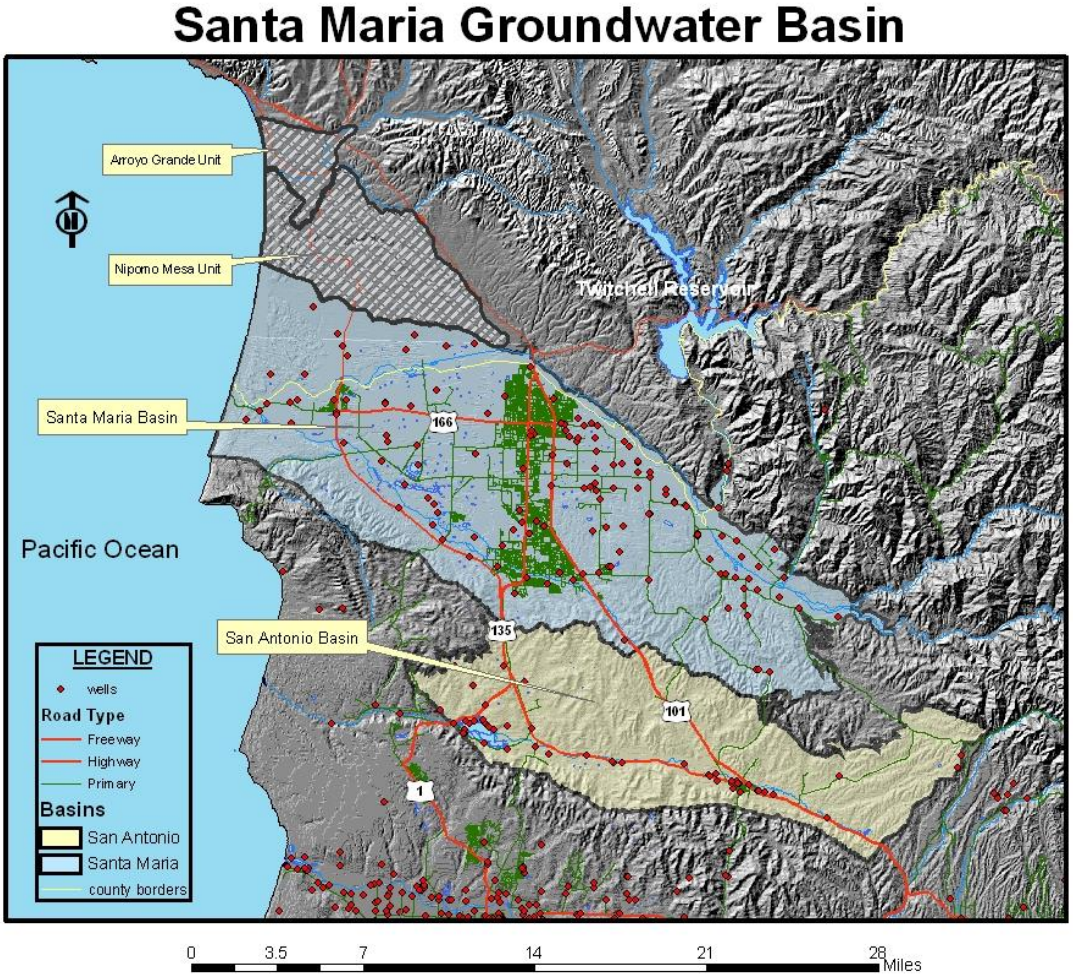


Figure 41: Santa Maria Groundwater Basin

The Santa Maria Groundwater Basin has three distinguishable units that appear to have only limited interaction: the Main Basin Unit, the Nipomo Mesa Unit, and the Arroyo Grande Unit. In previous reports and analyses by SBCWA only the Main Basin Unit has been addressed. The Nipomo Mesa and Arroyo Grande Units are completely within San Luis Obispo County. The Nipomo Mesa consists of older dune sands and alluvial deposits resting atop the Paso Robles Formation that thins north of the Santa Maria River and the Santa Maria Main Basin Unit. The Arroyo Grande Unit consists of well-sorted alluvial deposits resting atop a thin veneer of the Paso Robles formation, terminating in the five cities area in San Luis Obispo County. The California Department of Water Resources (DWR) released Water Resources of the Arroyo Grande – Nipomo Mesa Area in 2003 which focuses on the Arroyo Grande, Nipomo Mesa and Valley, and Oso Flaco areas. The report concludes that no overdraft currently exists in the areas of the study using a climatic base period of 1984-1995.

History and Analyses

The Santa Maria Groundwater Basin is best described by Worts (1951), Miller and Evanson (1966) and SBCWA (1977, 1994). As one of the largest agricultural and historically important oil producing coastal valleys of California, this basin has been studied extensively. Modern exploration began in 1888 when the area's geological features were mapped by the State mineralogist in conjunction with the University of California Geology Program and the USGS. Beginning in 1903 the area grew rapidly in response to oil development, and in 1907 the first comprehensive report on the area was published. USGS Bulletin 322 focused mainly on the basin geology and included some mention of water resources. Water resources examined in that report were limited to water diversions from surface runoff of winter and springtime river flows and perennial springs, and from artesian wells in the western part of the basin as groundwater pumping had yet to be developed. Examination of the basin continued to be focused mainly on oil until 1931 when Lippincott established baseline hydrologic conditions for consideration of federal and state funding toward flood control and water conservation projects.

Other historical reports of significance were completed by the USGS (1946); Toups Corporation (1976), USGS (1976, 1985), SBCWA (1977, 1991, 1994, 2001), Luhdorff and Scalmanini (1997, 2000), and Hopkins (2002). For details see References section at the end of this report.

The SBCWA has maintained an extensive network of water level monitoring wells throughout the basin the data from which may be indicative of the conditions of the area of the basin in which they are located. For example, the conditions of the main part of the basin may be reflected by the hydrograph in Figure 43 on page 77 from State Well 10N/34W-14E4.

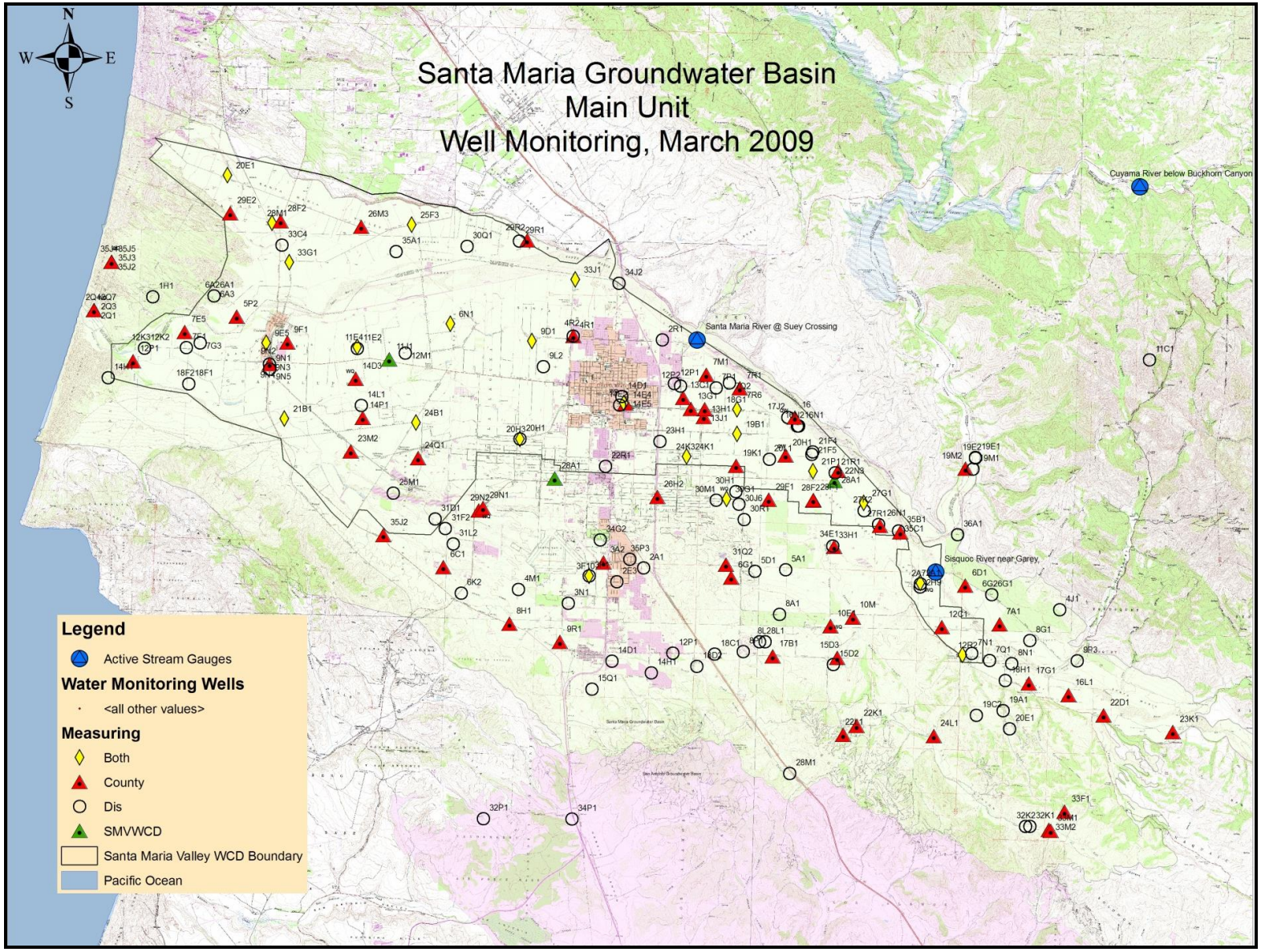


Figure 42: Distribution of Groundwater Monitoring Sites in the Santa Maria Valley

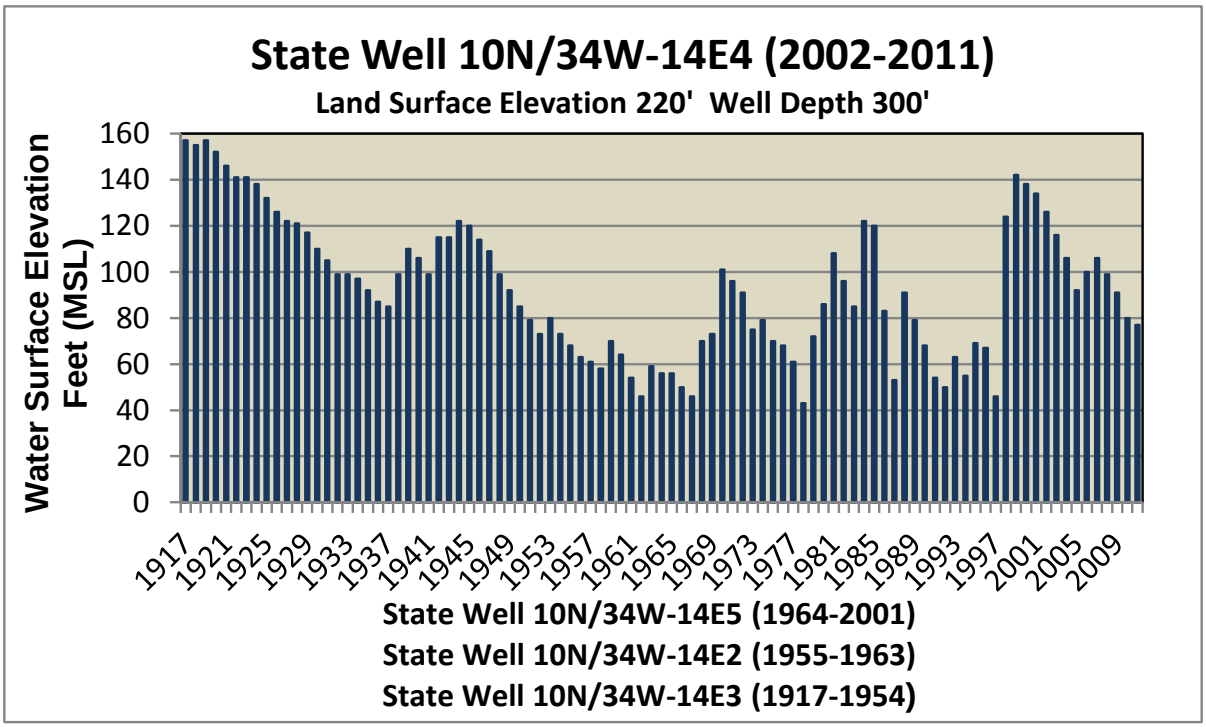


Figure 43: Hydrograph for State Well 10N/34W-14E4

Note that during the early part of the record, the slopes of both increasing and decreasing water levels are more gradual than those of the later part of the century. The higher rate of *filling* in the later part of the century is a function of the presence of the Twitchell Reservoir Project, which adds, on average, an additional 18,000 AF per year of recharge to the basin. The higher rate of dewatering is due to increased pumpage of the basin. This information indicates the increased susceptibility of the basin to periods of drought under current usage conditions.

The gross perennial yield of the basin is estimated to be approximately 125,000 AFY. Water storage above sea level within the basin was estimated to be about 2.5 million AF (MAF) in 1984, 1.97 MAF in 1991, and 2.5 MAF in 2002 (Ahlroth, 2002). The maximum recorded storage level occurred in 1918 and was estimated to be over 3 MAF. The portion of the groundwater basin located in San Luis Obispo County is estimated to contain storage of 45,600 AF, a part of which is included in the SBCWA estimate (California Department of Water Resources, 1979).

Recent Litigation

Litigation regarding the status and use of groundwater in the Santa Maria Basin was initiated in 1997. Records of these proceedings are available at the website:
http://www.sccomplex.org/home/index.htm

The litigation encompasses all of the Santa Maria Groundwater Basin, not just that part within Santa Barbara County. As previously mentioned, the Santa Maria Groundwater Basin has three distinguishable units that appear to have only limited interaction: the Main Basin Unit, the Nipomo Mesa Unit, and the Arroyo Grande Unit.

These units were evaluated in the litigation as one complete basin; however as part of the stipulation they are considered to be separate management areas. The judge ruled in proceedings on June 30, 2005 that the basin is not currently in overdraft but that overdraft is likely in the future unless additional conservation measures are undertaken. Overdraft is defined as more water being taken out of the basin than is being recharged, over a long period of time. Overdraft can be defined as exceeding the safe yield of the basin (see Groundwater Terms section, page 4).

The issue of overdraft within the basin has been often studied because of its implications for water supply and water quality degradation including the buildup of nitrates, sulfates, total dissolved solids, and the threat of salt-water intrusion from the Pacific Ocean. There have been numerous historic reports on the basin including those by SBCWA, USGS, DWR and private consultants. These reports, using different climatic base periods and other assumptions have concluded different levels overdraft within the basin. A partial listing of these reports and the resulting overdraft calculation is included in Table 10 below. To meet requirements of the 2005 stipulation, Luhdorff and Scalmanini Consulting Engineers prepares an annual report of conditions within the basin which includes climate, groundwater, Twitchell Reservoir operations and agricultural usage. For the most recent conditions of the basin, these reports can be viewed at http://www.ci.santa-maria.ca.us/Twichell-03.html

Year	Agency	Calculated Overdraft (AFY)	Base Period Used
1946	USGS	12,000	1931-1946
1966	USGS	20,000	1931-1966
1976	City of Santa Maria	6,000	1935-1974
1976	USGS	10,000	1946-1976
1977	SBCWA	20,000	1918-1975
1991	SBCWA	15,700	1918-1990
2000	SMVWCD	0	1968-1989
2002	SBCWA	2,400	1943-1999

Table 10: Historical Water Budget Analyses for the Santa Maria Basin

Water Supply and Usage

The basin supplies groundwater to the City of Santa Maria, Golden State Water Company, the City of Guadalupe, Casmalia Community Services District, oil operations and private agriculture throughout the Valley. Groundwater was the only source of water used within the Valley until 1997 when State Water was imported as an additional source. Table 11 on page 80 lists groundwater extractions from the water purveyors within the Santa Maria Basin. Note that the town of Casmalia lies outside of the Santa Maria Basin but the water supplied to the town is drawn from just within the basin boundary. In addition, agricultural, oil industry and farmstead usage is estimated to be around 120,000 AFY (gross amount).

The cities of Santa Maria and Guadalupe, and Golden State Water Company (formally California Cities Water Company) have contracted to receive a combined total of 17,250 AFY from the State Water Project (SWP) consisting of 16,200 AFY, 550 AFY and 500 AFY of allocation respectively (see State Water Project, page 7). Actual deliveries in 2011 were 11,785 AF to the City of Santa Maria, 176 AF to the City of Guadalupe and 445 AF to Golden State Water Company. According to the City of Santa Maria Water Master Plan, approximately two-thirds of its SWP supply is designated for blending purposes to meet established City water quality objectives and will not be used to support new development. Thus, this use of SWP water represents a corresponding reduction in long-term pumpage (and overdraft) of the basin. Another benefit of SWP water importation is the relatively high quality of return flows from water use in the City. This serves to improve overall water quality in the basin.

It should be noted that the maximum amount of SWP water allocation actually delivered to the basin depends on a number of factors including state wide climate, water trade and supplemental programs, and environmental constraints. For example, the SWP has limited 2011 deliveries to 80 percent of maximum allocation due to environmental constraints and lack of storage in surface reservoirs due to several years of below normal snow pack in the Sierra Nevada Mountains of California.

Water Quality

Reports by Worts (1951), Toups Corporation (1976), Brown and Caldwell (1976) and Hughes (1977) best describe the conditions of water quality within the basin. Also, the Cachuma Resource Conservation District produced the *Santa Maria Watershed Non-point Source Pollution Management Plan* in September 2000, which serves as a mitigation plan for water quality impairments in the basin and summarizes water quality conditions. Water quality within the basin has been positively affected by the operations of Twitchell Reservoir in which the high sulfate and salts of water from the Cuyama Valley are diluted with the better quality runoff from the Huasna and Alamo Watersheds prior to release. The recharge from Twitchell Reservoir has been reduced from 20,000 AFY per year to 18,000 AFY per year due to the loss of storage from siltation. This estimate does not include the additional recharge from the cloudseeding program and surcharging of the reservoir as they are not yet long-term approved programs.

As with most groundwater basins, the Santa Maria Basin exhibits better water quality in the deeper and confined aquifer than in that of the shallow or “water table” aquifer. The shallow zones *usually* contain the most water quality impairments due to the infiltration of pollutants and poor quality surface water. The importation of State Water, which is generally of better quality than the local sources, provides for higher quality “return flows” and thus improves the basin water quality. In addition to improvements provided by the operations of Twitchell Reservoir and State Water importation, the Laguna Sanitation District helps to improve water quality in the basin by utilizing a reverse osmosis process to remove, and a deep injection well to dispose of, approximately 8,000 pounds of salts per day, which would otherwise accumulate in the basin system. With the deep injection system these salts stay far below the aquifer and are not a threat to return to the aquifer. Water quality data is currently collected as part of the County Water Resources-USGS monitoring program as well as from area specific programs, such as the City of Santa Maria and Laguna Sanitation District sewage treatment plants and Golden State Water Company which serves water to the Orcutt, Tanglewood, Lake Marie and Sisquoc areas. Table 12 on page 82 lists current water quality monitoring sites as part of the County Water Resources-USGS monitoring program.

Santa Maria Basin Groundwater Production by Purveyor (Acre-Feet)				
Year	**City of Santa Maria**	**Golden State Water Co.**	**City of Guadalupe**	**Casmalia CSD**
1990	12,057	8,691	724	No data
1991	11,478	8,211	685	No data
1992	11,636	8,383	718	No data
1993	11,835	8,177	653	No data
1994	12,133	8,566	668	No data
1995	12,265	8,443	662	No data
1996	12,323	8,966	585	No data
1997	8,011	9,441	622	No data
1998	410	7,922	303	No data
1999	454	9,039	265	No data
2000	547	9,129	300	No data
2001	2,698	8,772	434	No data
2002	468	9,211	384	No data
2003	1,179	8,866	No data	22
2004	1,223	9,159	No data	No data
2005	897	8,626	415	29
2006	543	8,511	411	17
2007	2,550	9,383	No data	17
2008	6,626	9,083	684	19
2009	6,615	8,463	878	19
2010	3,087	7,489	881	10
2011	1,186	7,374	713	9
Long Term Average	**5,465**	**8,632**	**578**	**18**

Table 11: Santa Maria Basin Groundwater Production by Water Purveyor 1990-2011

Total Dissolved Solids

Data collected from observation wells for a 1976-1977 USGS study indicated that TDS concentrations generally increase from east to west, with the highest levels occurring in the western part of the basin and TDS concentrations near Guadalupe at over 3,000 mg/l. It must be noted that these measurements most likely were made from wells drawing from the shallow water table and may not be indicative of the complete aquifer. Currently, TDS concentrations near Guadalupe are measured at around 1,500 mg/l and in the center of the basin under the town of Santa Maria also appear to be relatively high (see Figure 44 below). Again this is most likely due to recycling of shallow water from irrigation and may not be representative of the aquifer as a whole.

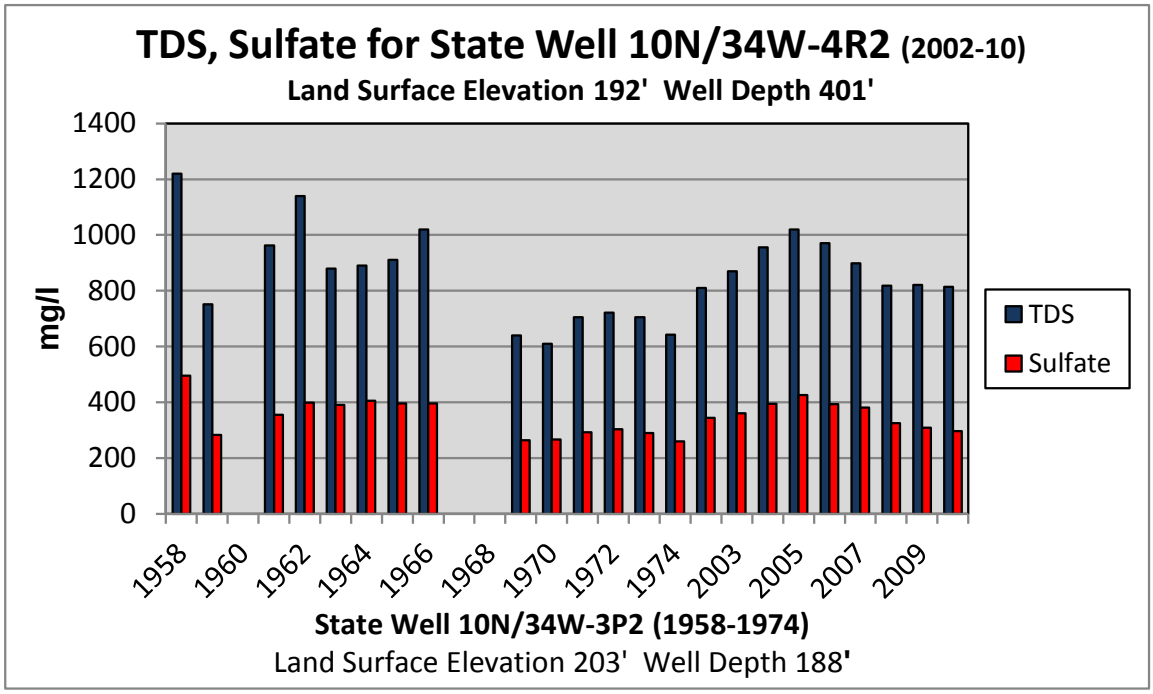


Figure 44: TDS and Sulfate in the Santa Maria Basin 1958-2010

TDS levels increased significantly in the Orcutt area wells after the 1930s but have remained relatively stable or even decreased since 1987. The importation and domestic use of State Water Project water now results in better quality discharge from the City of Santa Maria treatment plant on Black Road and also from Laguna Sanitation District to the south. This may greatly improve future water quality within the basin.

Nitrates-Sulfates

A study conducted by the State of California Regional Water Quality Control Board (1995) indicates that the basin is subject to nitrate contamination, particularly in the vicinity of the City of Santa Maria and in Guadalupe. The study shows that nitrate concentrations have increased from less than 30 mg/l in the 1950s to over 100 mg/l in the 1990s in some parts of the basin. It is again important to note that there is a significant difference in water quality between shallow and deep water. Movement between these different aquifer zones is complex and not well documented. Certainly, the flushing of the basin from wetter climate and lower usage would help protect against water quality impairments.

Construction Information for Groundwater Quality Monitoring Sites (Listed East to West)			
State Well ID	**USGS Number**	**Depth**	**Screen Intervals**
9N/33W-2A1	345324120184201	48’	
9N/33W-2A7	345325120184201	512’	125’-507’
10N/33W-22N3[1]	345535120204401		
10N/33W-20H1	345552120220001	175’	100’-175’
10N/33W-30G1	345459120232301	662’	325’-662’
10N/34W-26H2	345459120250301	445’	Unknown
9N/34W-3A2	345340120261801	331’	247’-331’
10N/34W-4R2	345808120271401	401’	160’-400’
10N/34W-29N1	345441120291301	112’	107’-
10N/35W-14D3	345712120321701	350’	102’-
10N/36W-2Q1*	345823120383901	671’	568’-671’
10N/36W-2Q3*	345823120383903	444’	397’-444’
10N/36W-2Q4*	345823120383904	378’	291’-378’
10N/36W-2Q7*	345823120383907	44.2’	18.5’-46.5’
11N/36W-35J2*	345921120381601	615’	527’-615’
11N/36W-35J3*	345921120381602	495’	247’-495’
11N/36W-35J4*	345921120381603	228’	175’-228’
11N/36W-35J5*	345921120381604	138’	74’-138’

Description of Surface Water Quality Monitoring Sites		
Station Number	**Description**	**Watershed Size**
11136800	Cuyama River below Buckhorn Canyon	886 sq. mi.
11138500	Sisquoc River near Sisquoc	281 sq. mi.
11141050	Orcutt Creek near Orcutt	18.5 sq. mi.
345727120375401[2]	Green Canyon Creek @ Main St. near Guadalupe	5.28 sq. mi.

[1]No construction information for this site
[2]A “site ID” as no “station ID” is listed for this site

Table 12: Water Quality Monitoring Sites in the Santa Maria Valley

Salt Water Intrusion

Coastal monitoring wells are measured biannually for any indication of seawater intrusion; to date there has been no evidence of such. The concern of seawater intrusion is based on evidence that the Careaga Sand outcrops on the ocean floor several miles west and there are no known barriers to seawater intrusion. Although it is possible that the seawater-fresh water interface has migrated shoreward during drought periods, the slope of groundwater has remained to the west in the westernmost part of the basin. Figure 45 below illustrates the consistency of chloride concentrations though time.

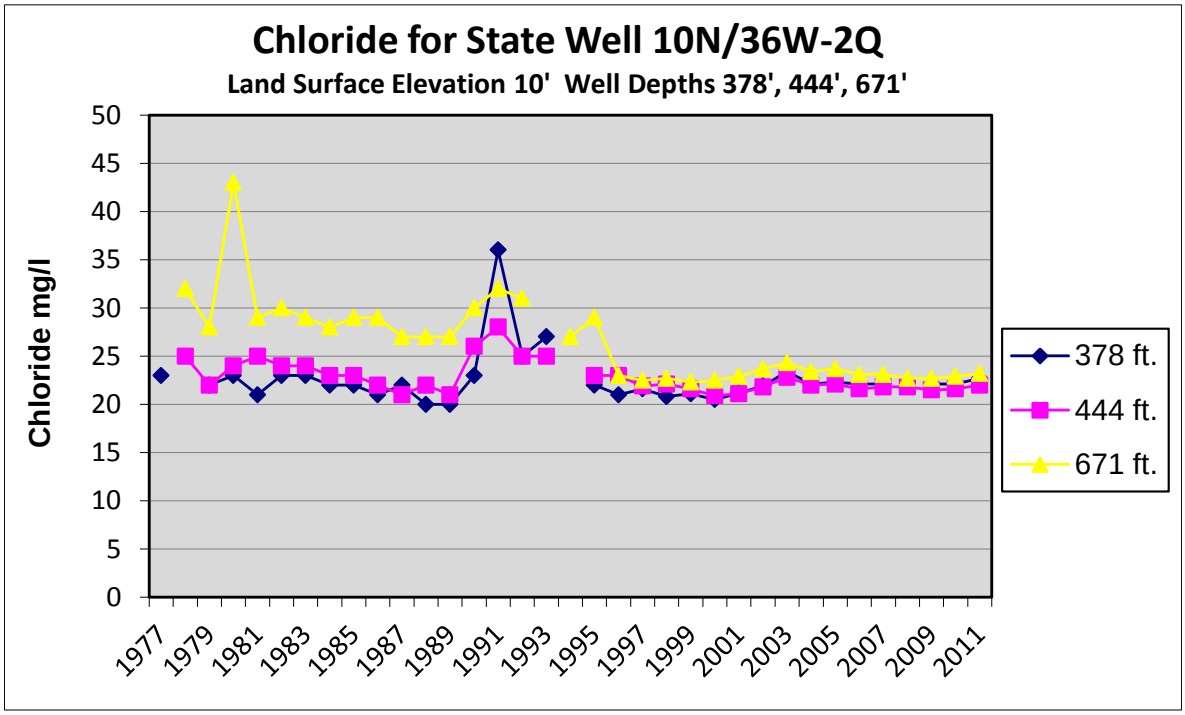


Figure 45: Chloride Concentration for State Wells 10N/36-2Q

Basin Wide "Salts Balance"

Sources of salt inflow to the Santa Maria Groundwater Basin include surface runoff, Municipal and Industrial accretions and agricultural return flows. There may also be salt contributions from the erosion of up-gradient geologic units. Salt removal from the basin occurs through the processes of surface and subsurface outflow. The SBCWA estimated in 1977 that net salt addition to the basin was about 48,000 tons per year (Ahlroth et al) under 1975 conditions and that by 2000 it would be about 53,000 tons per year. A revised analysis of salt loading is a significant task and the RWQCB in conjunction with Proposition 84 funding is working on a Groundwater Assessment Report which will address salt and nutrient issues necessary for the eventual development of a salt nutrient plan. As previously mentioned Laguna Sanitation's deep injection of salts greatly helps the basin salt balance by preventing those salts from entering the useable aquifer.

2009-2011 Trends

During the period 2009-2011, the period since the last SBCWA Groundwater Report, the Santa Maria Groundwater Basin received only minor recharge during the 2009-2010 water year and significant recharge during the 2010-2011 water year. The table below illustrates the rainfall amounts. Note that average precipitation years generally do not produce runoff.

Station	WY 2008-2009	WY 2009-2010	WY 2010-2011	Three Year Average	Long Term Average
Santa Maria	9.21	15.82	24.48	16.50	13.87
Sisquoc	11.21	18.95	27.30	19.15	15.29
Twitchell Dam	11.61	21.13	28.82	20.52	18.54

Table 13: Precipitation for the Santa Maria Watershed 2009-2011

As in most areas of Santa Barbara County the 2008-2009 water year was below average, the 2009-2010 water year was near average and the 2010-2011 water year was above average.

During the period ground water levels were measured at 80 sites in the Santa Maria Groundwater Basin. Water quality was monitored at 11 sites throughout the basin during the period. Except for the slow creeping up of nitrates in the western part of the basin there was little to no change in water quality in the basin between 2009-2011. There was some recharge from the storms during the 2009-2010 season and significant recharge during the storms of 2010-2011 which brought water levels up in 2011. In the eastern part of the basin there are places where water level slightly declined (9N/33W-12R2) and places where the water level slightly rose (10N/33W-26N1). In the Central portion of the basin most wells dropped slightly during the period, for example well 10N/34W-13J1 dropped 13 feet. This is most likely due to localized pumping patterns. In the far western part of the basin, water level remained steady during the period 2009-2011.

Cuyama Groundwater Basin

Physical Description

The Cuyama Valley is a rural agricultural area about 35 miles north of the City of Santa Barbara and is bound by Sierra Madre Mountains on the south and by the Caliente Range on the north. Although located within the coastal ranges of Southern California the climate is similar to high desert due to the surrounding high mountain ranges. The Cuyama River drains the Valley with a surface water drainage area of 690 square miles of Santa Barbara, San Luis Obispo, Ventura and Kern Counties. Land surface elevations in the *watershed* vary from 800 feet above mean sea level near Twitchell Reservoir to over 8,000 feet at Mt. Pinos and land surface elevations within the *Groundwater Basin proper* vary from around 1,950 feet to 3,600 feet above mean sea level. Average rainfall ranges from about 8 inches per year on the valley floor to 24 inches per year at the crest of the Sierra Madre Mountains. The Cuyama Valley is a down faulted block, or graben, that is bordered on the north by the Morales and Whiterock Faults and on the south by the South Cuyama and Ozena Faults. The eastern part of the central valley is underlain by a syncline whose strike is parallel to the elongation of the valley and plunges towards the northwest. The north limb of this fold is truncated against the Morales Fault (Singer and Swarzenski, 1970).

Figure 46: The Cuyama Valley

The Cuyama Groundwater Basin supports a variety of crops; however the two largest agricultural operators in the area, Grimmway and Bolthouse, focus on carrots. Since early 2009, remaining vineyards and nectarine orchards on the valley floor have been removed to make way for expansion of carrots. In addition to carrots onions, alfalfa, barley, potatoes, vineyards and pistachios make up the bulk of the agricultural variety, but most of those are grown in the upper part of the basin near Ventucopa. The total irrigated acreage in the basin is estimated to be 20,000-25,000 in any given year (Andersen et al., 2009).

History and Analyses

The basin is best described by Upson and Worts (1951) and Singer and Swarzenski (1970). Agricultural water use began in 1938 and has since progressively increased. Groundwater within the basin makes up 100% of water supply for Cuyama Valley agriculture, petroleum operations, businesses, homes and farmsteads. Agriculture accounts for over 95% of the water use within the Valley.

In 1970 Singer and Swarzenski estimated a 21,000 AFY overdraft and a dewatered storage of over 400,000 AF based on the period 1947-1966. A water budget completed by the County in 1992 estimated a 28,000 AFY overdraft (Baca et al., 1992). An evaluation by the California Department of Water Resources indicated that there was an average groundwater overdraft of 14,600 AFY based on the period 1982-1993 (Pierotti and Lewy, 1998). Historical water level declines of 200-250 feet are not uncommon in the main part of the basin where a pumping depression exists. An analysis by the SBCWA in 2008 indicated a current dewatered storage of over 1,500,000 AF.

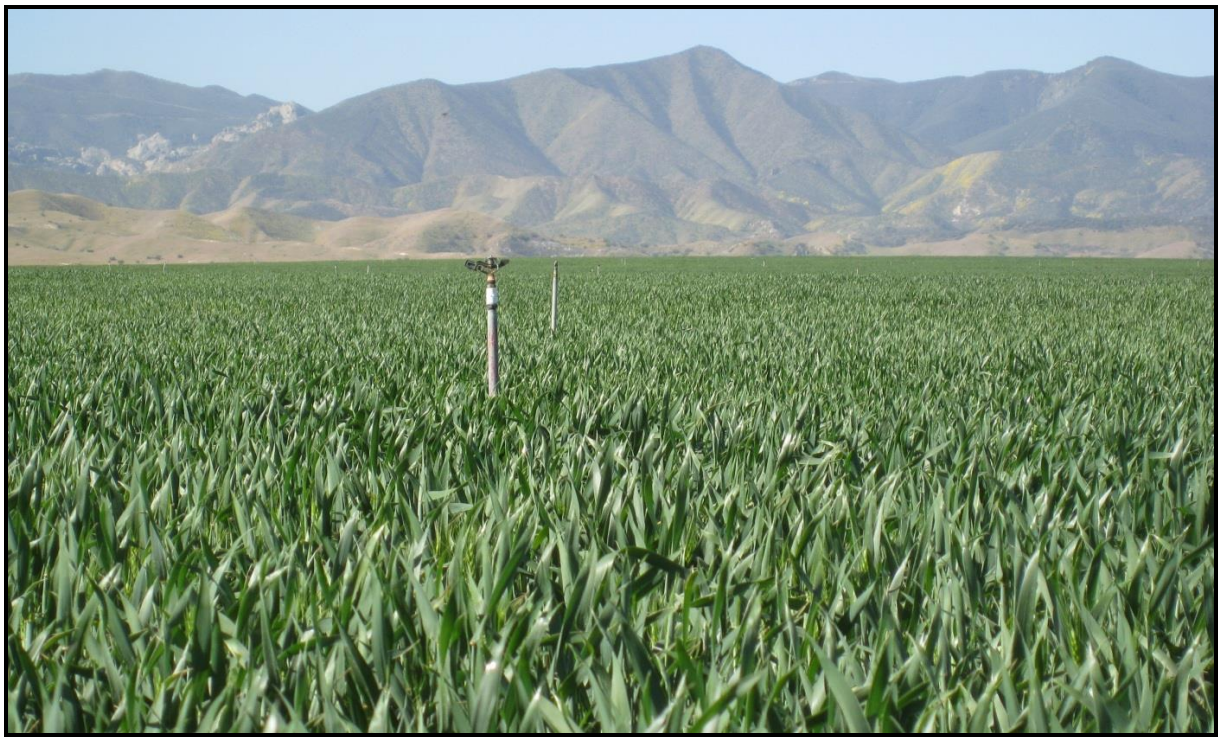


Figure 47: Barley with Lion Canyon in the Background

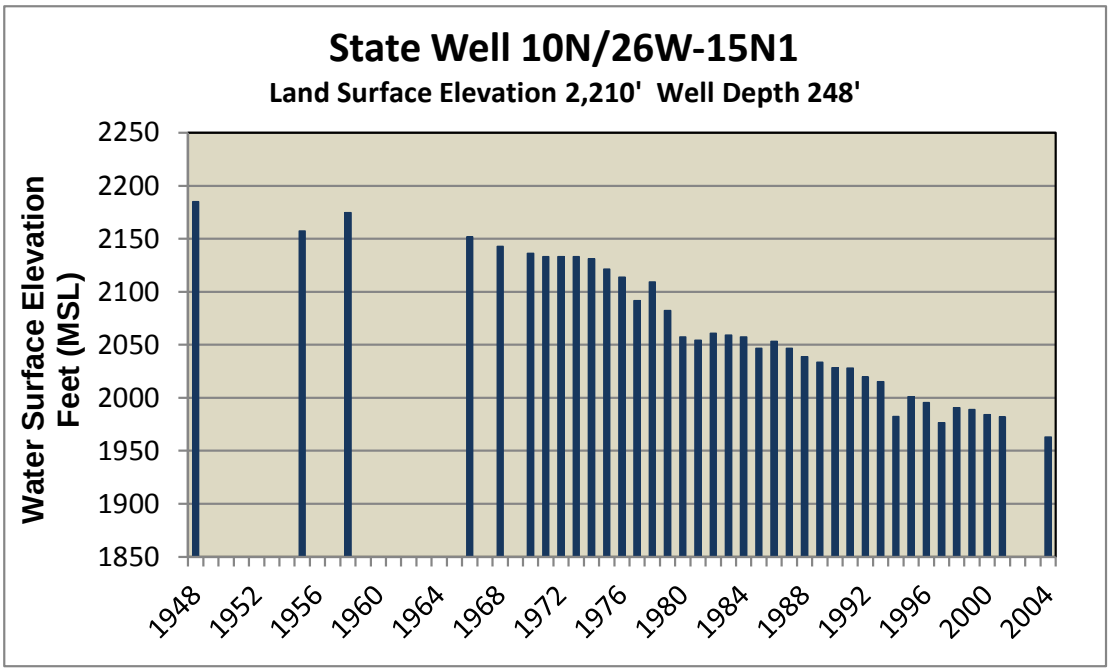


Figure 48: Hydrograph for State Well 10N/26W-15NE1

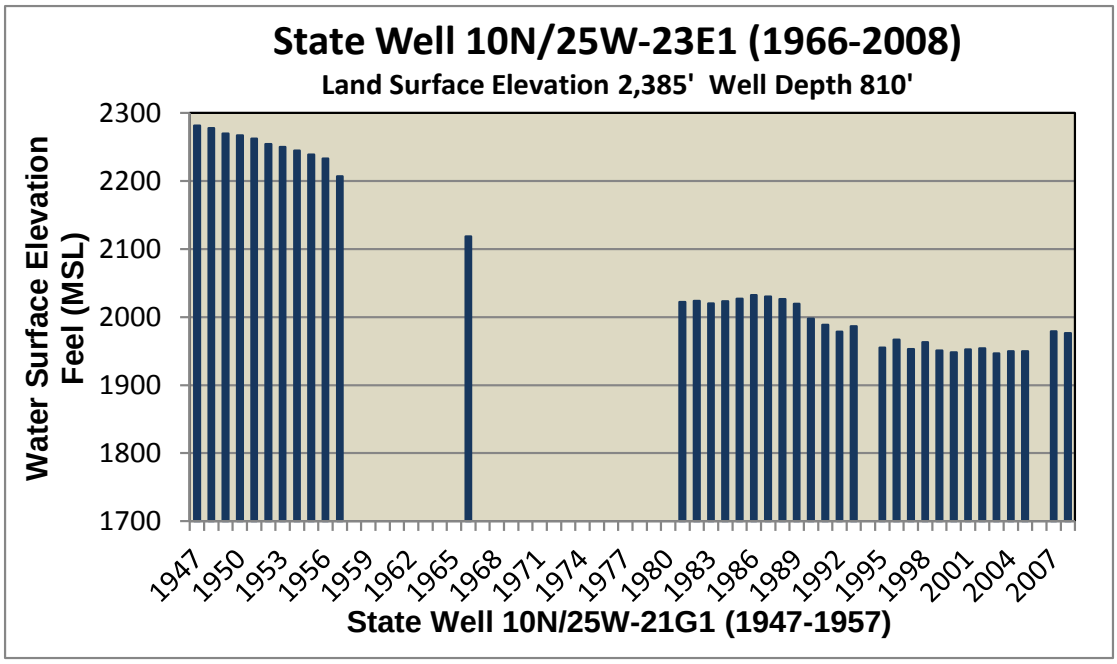


Figure 49: Hydrograph for State Well 10N/25W-23E1

From Figure 48 above in the western part of the basin it is evident that water levels have dropped over 200 feet since development of agriculture in the area and from Figure 49 it is evident that water levels have dropped near 300 feet since development of agriculture in the area. The very wet period of 1992 to 2006 appears to have slowed the progressive drop in the center part of the basin but as this was the second wettest period of climate on record dating back to the late 1800's for the area the downward trend would be expected to continue. Well 10N/26W-15N1 was discontinued in 2007 due to lack of access to the site.

Water Quality

Groundwater quality in the Cuyama Basin ranges from hard (high in dissolved solids) to very hard and is predominantly of the calcium and magnesium-sulfate type, in great part due to the abundance of gypsum as a source material in the middle and upper parts of the watershed (Upson and Worts, 1948). TDS typically range from 1,500 mg/l to 1,800 mg/l in the main part of the basin. In the Cuyama Badlands on the eastern part of the basin sub-watersheds Ballinger, Quatal, and Apache Canyons have better water quality of a sodium or calcium bicarbonate type with TDS typically ranging from 400 mg/l to 700 mg/l. Figure 50 demonstrates this difference. The Main Zone Well (20H1) averages around 2,000 mg/l whereas the Badlands Well (33M1) averages 700-750 mg/l. Note the spikes on Badlands Well 33M1 which follow wet rainfall years of 1969 and 1994. Presumably these are attributable to overland flow from rainfall which is flushing the upper part of the basin after dry periods.

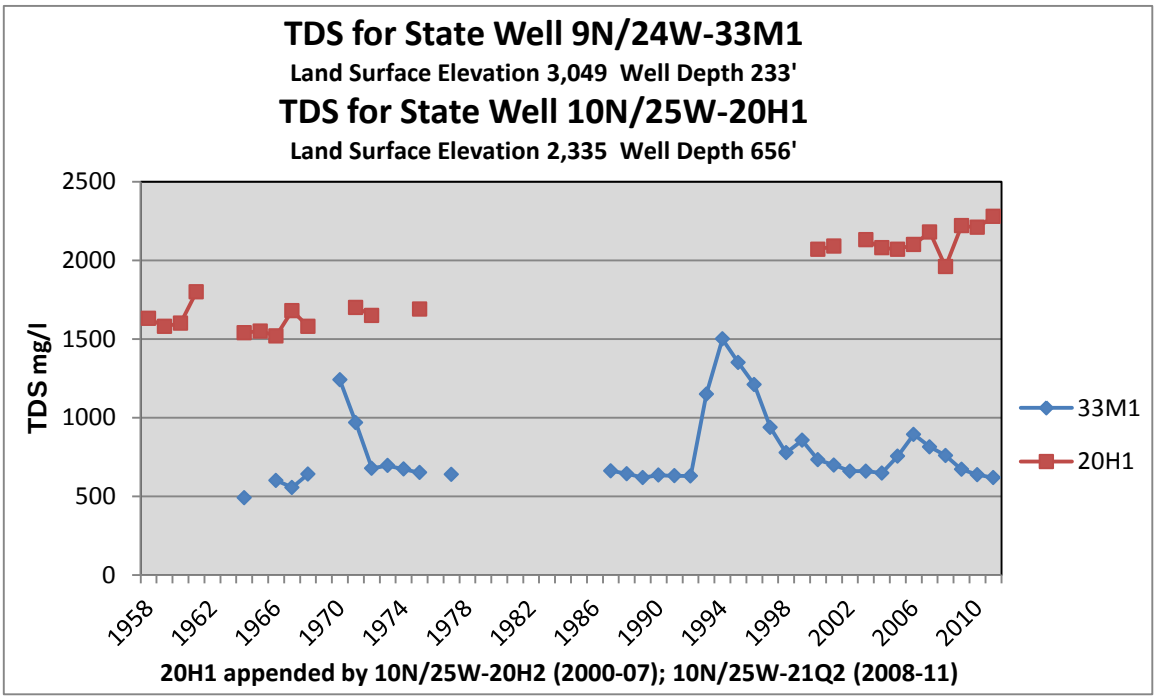


Figure 50: TDS for State Wells 9N/24W-33M1 and 10N/25W-20H1

Figure 51 reflects boron concentrations in the basin. Boron is generally higher in the upper part of the basin (33M1) and shows up in higher concentration in the uplands shallow well (233 feet deep) than in the deeper wells (depths of 1,000 feet) in the main part of the basin. Boron is not regulated by the State but is generally accepted to be detrimental at about 300 micrograms per liter (ug/l).

Water quantity and quality deteriorate toward the west end of the basin, where the basin sediments thin. Toward the northeast end of the basin at extreme depth there exists poor quality water, perhaps connate (trapped in rocks during deposition) from rocks of marine origin. Although groundwater in the Cuyama Valley is only of fair to poor chemical quality, it has been used successfully to irrigate most crops. Presumably this has been possible because the sodium content of most of the water is relatively low and the soils are quite permeable. However, the leaching of soils carries dissolved salts from the root zone to the water table and may impact water quality over time (Singer and Swarzenski, 1970).

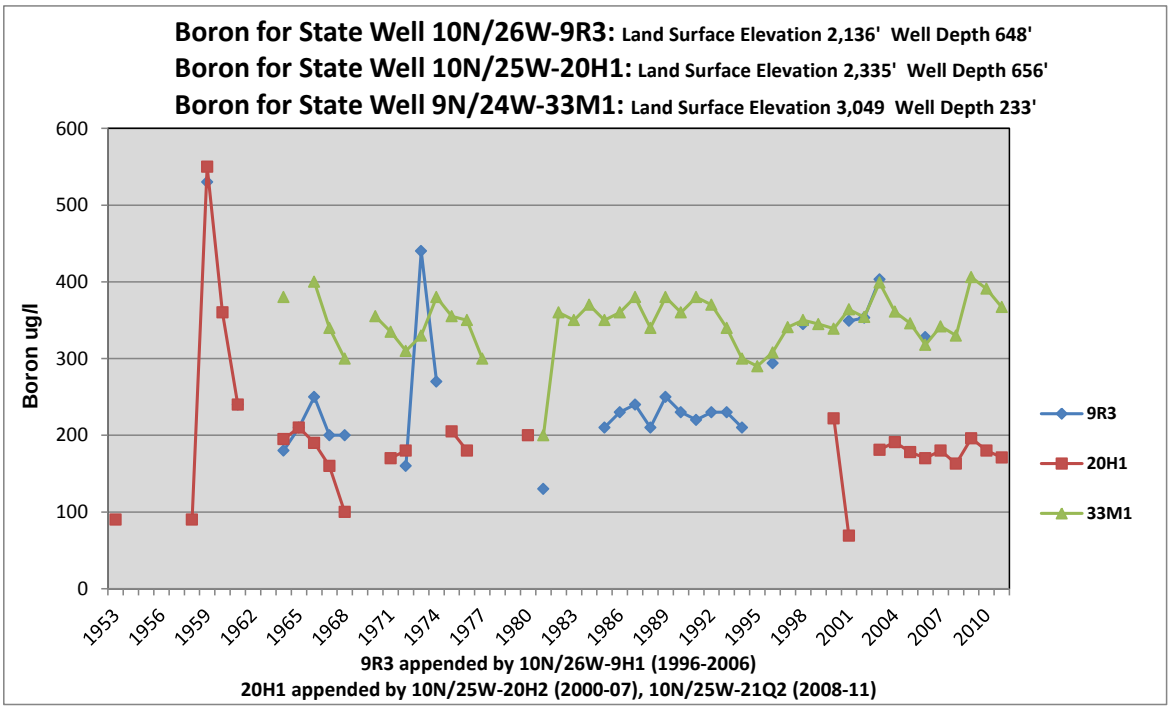


Figure 51: Boron for State Wells 10N/26W-9R3, 10N/25W-20H1 and 9N/24W-33M1

2009-2011 Trends

Rainfall during the period was slightly above average during the period as the table below illustrates. During the period 2009 through 2011 water quality was measured at numerous sites in the basin and water level was monitored at 52 sites. This increase in monitoring is attributed to both the ongoing Cuyama Water Availability Study (see page 90 following this section) and the GAMA program: http://www.swrcb.ca.gov/gama/

Station	Elevation	2009 Total	2010 Total	2011 Total	Three Year Average	Historical One-Year Average
Cuyama	2275'	5.40	7.88	10.73	8.00	7.94
SB Canyon	3000'	9.45	12.66	18.55	13.55	13.03
Don Victor	4600'	14.04	24.94	32.58	23.85	23.72

Table 14: Cuyama Valley Rainfall 2009-2011

There was little change in TDS, calcium, magnesium, nitrates and sulfates during the 2009-2011 period. In some cases, concentrations of these nutrients actually fell during the period, most likely due to a lack of rainfall, recharge and flushing of the watershed. As the Cuyama watershed is mostly dry, water quality data must be examined with caution as sometimes overland flow from rainfall events "flushes" the watershed and inorganic mineral concentrations actually peak during storm flows. Typically in other areas of Santa Barbara County mineral concentrations are diluted during widespread storm runoff out of natural watersheds.

Water level sites were monitored quarterly throughout the basin during the period. The trends are as follows: In the Ventucopa Uplands the trend was down after the 2008-2009 water year

but was up after the wet 2010-2011 water year. The Ventucopa Uplands is a relatively shallow unconfined aquifer that quickly responds to climate changes year to year. In the main zone of the Cuyama Basin where there is more water available but at much greater depths and is geohydrologically confined (under pressure) the trends were downward, with declines of 5-15' not uncommon. In the Sierra Madre foothills area which contains the pumping field for the New Cuyama Community Services District most wells are slightly down, for example wells 10N/26W-20M1 and 9N/26W-1F3.

2008-2012 Cuyama Groundwater Basin Study

Due to concerns raised by constituents in the Cuyama Valley the SBCWA has been commissioned to produce a comprehensive report on current and future water availability on the Cuyama Groundwater Basin. The SBCWA has elected in turn to conduct this study in cooperation with the USGS as they hold the most expertise and highest level of credibility in a water resources science investigation. This project will be conducted over a four year period, ending in January 2013. Projects of these types take a long time due to the nature of data collection and analysis. Along with periodical updates a final report will be published. The USGS will cost share for some of the elements of the project.

The proposed study includes five main tasks: (1) data compilation, (2) new data acquisition, (3) model development, (4) analysis of water availability, and (5) report preparation. Climate, land-use, geologic, hydrologic, water-quality, and geodetic data will be compiled and assembled into a Geographic Information System and integrated into new monitoring networks. New data collection includes depth-dependent or aquifer dependent geohydrologic and geochemical data from existing wells, and from the installation of up to four new multi-well monitoring sites in the Valley. The existing pre-monitoring network maintained by Santa Barbara County and the USGS has been enhanced during the study period and is being used to collect temporal and spatial water-level and water-quality data. Stream flow data is being collected at selected streams to help determine the recharge characteristics of the Valley. Geodetic data has been collected to determine if subsidence is occurring in the Valley. Geohydrologic and hydrologic models are close to being developed as part of this study to more accurately assess and simulate the storage and flow of water in Cuyama Valley. The hydrologic model will be used to perform selected water-use and climate scenario analyses to address the possible alternatives to current water use and development. Data collected on the three-dimensional character of the aquifer flow and chemistry could provide guidance as to the future use of water in the valley. The model will provide an analysis tool of the historical groundwater use and an analysis of future water availability under different water-use scenarios.

The image on the following page shows the current monitoring network as of December 2011. The monitoring sites have been increased from 17 to 52. It is anticipated that once the study is completed that the monitoring network will be scaled back to pre-study level.

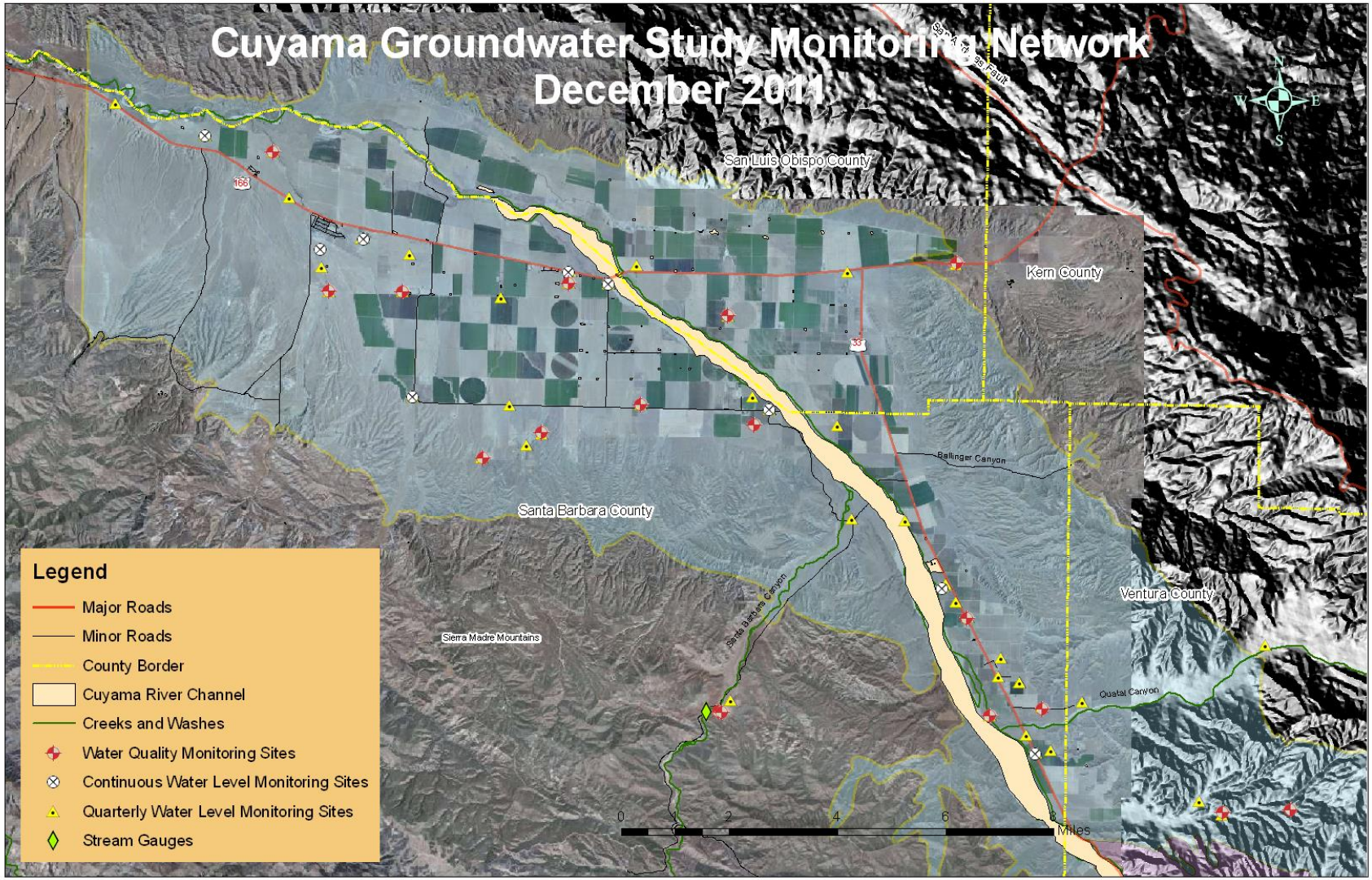


Figure 52: Cuyama Groundwater Basin Study Monitoring Network

Other Groundwater Extraction Areas

The following extraction areas are relatively small, undeveloped or lacking groundwater data:

More Ranch Groundwater Basin

The supply/demand status of this basin was updated in a 1993 study (Baca, 1993) prepared by the County. The discussion presented below reflects this report. The More Ranch Basin occupies about 502 acres in the southern Goleta area between the More Ranch Fault and the Pacific Ocean. The unconsolidated sand and silt of Santa Barbara Formation that comprise the basin overlie consolidated bedrock of the Sisquoc and Monterey Formations. Most of the area encompassed by this basin is in open space. Developed land uses include residential dwellings with some open field and greenhouse agriculture. Water quality within the basin averages from 800 to 2,300 mg/l, TDS. The safe yield of the basin is estimated to be 84 AFY (gross), 76 AFY (net). The gross demand is estimated to be about 24 AFY, resulting in a surplus of 60 AFY.

Ellwood to Gaviota Groundwater Area

The Ellwood to Gaviota Groundwater Area covers about 105 square miles in the southern part of Santa Barbara County between the crest of the Santa Ynez Mountains and the Pacific Ocean. Geologically, the area consists of the south limb of a large anticline (concave upward fold) which forms the Santa Ynez Mountains. The terrace and alluvial deposits located near the coast formed as the mountains uplifted, folded and eroded. Rainfall in the area ranges from about 18 inches per year near the ocean to over 30 inches at the crest of the Santa Ynez Mountains. Surface drainage is south, down the steep slope of the mountains to the Pacific Ocean. The direction of groundwater flow is also south.

Samples analyzed from many groundwater wells in the late 1960s indicated that most of the groundwater of the Ellwood-Gaviota area was too hard for domestic use without treatment. In addition, salinity was found at hazardous concentrations in many wells. Seawater intrusion might be occurring in alluvial areas near the coast. However, the presence of impermeable strata might prevent seawater from reaching deeper aquifers.

The USGS (Miller and Rapp, 1968) estimated the total ground water in storage above sea level within the area to be over 2 million AF. This study also estimated that average annual recharge (safe yield for net consumptive use) to this area is 6,000 AFY on the basis of groundwater discharge measurements. Groundwater comprises the majority of the water supply used within the area, although some Cachuma Reservoir water was imported into the eastern half of the region in the early 1960s (less than 1,000 AFY) and is still used in support of agriculture to the present time.

Groundwater in the Ellwood-Gaviota area is produced from wells which tap bedrock aquifers or alluvial sediments which have accumulated along canyon floors. Land uses supported by this pumpage include the Exxon Los Flores Canyon oil processing facility, the Chevron Gaviota oil processing facility, residential development and agriculture at the El Capitan Ranch, the El Capitan and Refugio State Parks, the Tajiguas Municipal Landfill and several large avocado orchards. A detailed land use and water demand survey of this area has not been conducted. Water resources are evaluated by the County on a project-by-project basis during the review of

applications for discretionary and ministerial County land use permits. The Environmental Thresholds and Guidelines Manual (Baca, 1995) describes the adopted County methodology for estimating the safe yield of bedrock aquifers.

Gaviota to Point Conception Groundwater Area

This area encompasses about 36 square miles between the crest of the Santa Ynez Mountains and the Pacific Ocean. It is located west of the Ellwood to Gaviota Area described in the previous section. The geologic structure and hydrology of the Gaviota to Point Conception and the Ellwood to Gaviota Groundwater Areas are nearly identical. The primary difference between the two is that the Santa Ynez Mountains are lower within the Gaviota to Point Conception area. As a result, there is less annual precipitation, less runoff and less recharge to the aquifer.

Groundwater is the only water supply source within the area. The primary land use within the area is ranching and some limited agriculture. A number of remote ranch homes are also present in this area. A detailed land use and water demand survey of this area has not been conducted. Water resources are evaluated by the County on a project-by-project basis during the review of applications for discretionary and ministerial County land use permits. Environmental Thresholds and Guidelines Manual describes the adopted County methodology for estimating the safe yield of bedrock aquifers.

Conclusions

The groundwater basins of Santa Barbara County are relied upon heavily as a source of water for both municipal and agricultural uses and as such need to be protected and conserved. The South Coast Basins are managed through conjunctive use and the Goleta Basin is adjudicated. The Lompoc Groundwater Basin is also managed through California Water Rights Order 89-18 and the City of Lompoc has a groundwater management plan in progress. However, other Groundwater Basins in Northern Santa Barbara County are not managed and are in a state of overdraft. The Santa Ynez Uplands and Santa Maria Groundwater Basins are in a state of slight overdraft, and the San Antonio and Cuyama Groundwater Basins are in a state of significant overdraft.

The SBCWA is currently working with the USGS on a water availability study for the Cuyama Groundwater Basin that will assess both current conditions as well as future conditions to be expected under differing climatic and cultural scenarios. The study will be completed in early 2013. A similar study of the San Antonio Groundwater Basin will be under consideration once the Cuyama study is completed. The Cuyama and San Antonio Groundwater Basins are the only groundwater basins in Santa Barbara County where groundwater serves as the sole source of water. The 2005 stipulation agreement and settlement for the Santa Maria Groundwater Basin has resulted in a management authority called the Twitchell Management Authority which is currently working on an expanded monitoring plan and conservation measures for the Santa Maria Groundwater Basin. Through this process, it is intended that issues of overdrafting will be addressed and eliminated. Even a slight overdraft can be harmful to groundwater basins as it can lead to water quality impairments.

The 2009 through 2011 period was typical for the region with one very dry year, one average year and one extremely wet year. Minor amounts of recharge to groundwater basins and inflow to reservoirs occurred during the winter of 2009-2010 and significant amounts of recharge occurred during the extremely wet 2010-2011 winter. It is important to note that in some areas with deeper aquifers there is a three to four year lag time between substantial rainfall and recharge and when the water actually shows up in the aquifer. Analysis of cumulative departure from mean precipitation and climatic indicators such as the Pacific Decadal Oscillation and Dendrochronology indicate that the area should be prepared for dry periods in excess of those seen in the past 30 years. In addition, climate change may alter the precipitation and recharge patterns of the past.

The County Public Works Department and the USGS will continue the cooperative water resources monitoring program providing groundwater depth and quality (as well as surface water flow and quality) and water resources investigations to evaluate trends in water resources throughout the County.

References

Ahlroth, J., Santa Maria Ground Water Budget Status, Santa Barbara County Water Agency memorandum, August 26, 1992.

Ahlroth, J., Lompoc Groundwater Basin: Update of Long-Term Storage Changes and Overdraft Status, Santa Barbara County Water Agency memorandum, October 21, 1998.

Ahlroth, J., *Personal Communication*, February, 2002.

Almy, R., Ahlroth, J. and Holland, P., Revisions to the Buellton Uplands Groundwater Basin Report, Santa Barbara County Water Agency memorandum, 1995.

Andersen, C., Dobrowski, B., Harris, M., Moreno, E., and Roehrdanz, P., Conservation Assessment for the Cuyama Valley: Current Conditions and Planning Scenarios, a Group Project Final Report for the Donald Bren School of Environmental Science and Management, University of California, Santa Barbara, 2009.

American Society of Civil Engineers, Guidelines for Cloud Seeding to Augment Precipitation, 1995.

Arnold and Anderson, Geology and Oil Resources of the Santa Maria Oil District, Santa Barbara County, California, U.S. Geological Survey Bulletin 322, 1907.

Baca, Brian R., Carpinteria Groundwater Basin Supply/Demand; Alternatives to be presented to the Santa Barbara County Planning Commission, Santa Barbara County Resource Management Department, April 4, 1991.

Baca, Brian R., and Ahlroth, J., San Antonio Basin: Update of Supply/Demand Status, Santa Barbara County memorandum, July 9, 1999.

Baca, Brian R., More Ranch Groundwater Basin, Santa Barbara County Resource Management Department memorandum, November 3, 1993.

Baca, Brian R., Planning Implications of the Water Conveyance Agreement between the City of Santa Barbara and the La Cumbre Mutual Water Company, Santa Barbara County Resource Management Department memorandum, February 9, 1993.

Baca, Brian R., and Ahlroth, J., Groundwater Basin Status for the City of Santa Barbara and Goleta Areas, Santa Barbara County Resource Management Department memorandum, July 28, 1992.

Baca, Brian R., Geology and Safe Yield of the Buellton Uplands Groundwater Basin, Santa Barbara Planning and Development Department memorandum, compiled July 1994.

Bachman, Steven, Groundwater Management Plan, Goleta Groundwater Basin for Goleta Water District and La Cumbre Mutual Water Company, 2010.

Bachman, Steven, Montecito Water District Future Water Demand and Supply Options, 2007.

Bright, D.J., Stamos, C.L, Martin, P., Nash D.B., Ground-Water Hydrology and Quality in the Lompoc Area. Santa Barbara County. California. 1987-88, U.S. Geological Survey Water Resources Report 91-4172, Sacramento, California, 1992.

Brown and Caldwell, Development of a Nonpoint Source Pollution Control Program for the Santa Maria Valley, 1976.

Brown and Caldwell, Montecito County Water District Water Supply Management, 1978.

Cachuma Resource Conservation District, San Antonio Creek Coordinated Resource Management Plan, 2003.

California Department of Water Resources, 2009 Water Plan, Volume 2 Chapter 10, 2010.

California Department of Water Resources, Ground Water in the Arroyo Grande Area, 1975.

California Department of Water Resources, Southern District, Water Resources of the Arroyo Grande – Nipomo Mesa Area, 2002.

California Department of Water Resources, Compilation of Federal and State Drinking Water Standards and Criteria, Quality Assurance Technical Document 3, 1995.

California Regional Water Quality Control Board, Assessment of Nitrate Contamination in Ground Water Basins of the Central Coast Region Preliminary Working Draft, Central Coast Region, 1995.

California State Water Resources Control Board, 2nd Revised Draft Environmental Impact Report: Consideration of Modifications to the U.S. Bureau of Reclamation's Water Right Permits 11308 and 11310 to Protect Public Trust Values and Downstream Water Rights on the Santa Ynez River below Bradbury Dam, 2011.

CH2MHILL, Basin Status Report for the Goleta Groundwater Basin, 2005

City of Santa Barbara Public Works Department, City of Santa Barbara Long Term Water Supply Program, 1994.

City of Santa Barbara Water Resources Division, City of Santa Barbara Long-Term Water Supply Plan, 2011.

Cosby, P .G., Santa Barbara County Growth Inducement Potential of State Water Importation, Santa Barbara County Water Agency, 1991.

Dames & Moore, Santa Barbara County Comprehensive Plan, Final Program EIR. Groundwater Section Conservation Element, 1993.

Evanson et al., Yield of the Carpinteria and Goleta Ground-Water Basins, Santa Barbara County, California, U.S. Geological Survey Open File Report, 1962.

Evanson and Miller, Suitability of Irrigation Water and Changes in Ground-Water Quality in the Lompoc Subarea of the Santa Ynez River Basin, Santa Barbara County, California, U.S. Geological Survey Open File Report, 1963.

Evanson and Worts, Hydrologic Inventory of the Lompoc Subarea, Santa Ynez River Basin, Santa Barbara County, California, U.S. Geological Survey Open File Report, 1966.

Freckleton, John R., Geohydrologv of the Foothill Ground-Water Basin near Santa Barbara. California, U.S. Geological Survey Water Resources Investigation Report 89- 4017, Sacramento California, 1989.

Fugro Consultants, Inc., Carpinteria Groundwater Basin, Annual Report for 2008, 2009, 2010.

Geotechnical Associates Inc., Hydrogeologic Investigation Montecito Ground Water Basins, 1974.

Geotechnical Associates Inc., Hydrogeologic Update Carpinteria Groundwater Basin, 1986.

Goleta Water District, *Personal Communication,* 1992.

Hoover, Michael F., Hydrologic Summary of the Carpinteria, Montecito, and Santa Barbara Water District Service Areas for Santa Barbara Regional Water Reclamation, Santa Barbara, California, 1980.

Hoover, Michael F., Safe Yield Evaluation of the Montecito Basin and Toro Canyon Area, Santa Barbara, California, 1980.

Hopkins, Curtis, Hydrogeological Review of the Santa Maria Valley Groundwater Basin Water Budget Models, Dated 2000, Santa Barbara County, California, 2002.

Hughes, Jerry L., Evaluation of Ground Water Quality in the Santa Maria Valley, California, U.S. Geological Survey, Water-Resources Investigation 76-128, 1977.

Hutchinson, C.B., Appraisal of Ground-Water Resources in the San Antonio Creek Valley, Santa Barbara County, California, U.S. Geological survey Water-Resources Investigations Open-File Report 80- 750, 1980.

Hydrologic Consultants, Inc., Development of a System of Models for the Lompoc Groundwater Basin and Santa Ynez River, 1997.

Kalata, Michael D., VAFB 30 CES, *Personal Communication*, 2010.

LaFreniere, G.F. and French, J.J., Ground-Water Resources of the Santa Ynez Upland Ground Water Basin, Santa Barbara County California, U.S. Geologic Survey, 1968.

Lippincott, J.B., Report on Water Conservation and Flood Control of the Santa Maria River in Santa Barbara and San Luis Obispo Counties, 1931.

Luhdorff and Scalmanini Engineers, Development of a Numerical Ground-Water Flow Model and Assessment of Ground–Water Basin Yield, Santa Maria Valley Ground-Water Basin, March 2000.

Luhdorff and Scalmanini Engineers, 2010 Annual Report of Hydrogeologic Conditions, Water Requirements, Supplies and Disposition, Santa Maria Valley Management Area, 2011.

Mann, John F., Safe Yield of the Goleta Ground Water Basin, 1976.

Martin, Peter, Ground-Water Monitoring at Santa Barbara, California: Phase 2 – Effects of Pumping on Water Levels and on Water Quality in the Santa Barbara Ground-Water Basin, U.S. Geological Survey Water Supply Paper 2197, 1984.

Mathany, T.M., Kulongski, J.T., Ray, M.C., and Belitz, Kenneth, Groundwater Quality Data in the South Coast Interior Basins Study Unit, 2008: Results from the California GAMA Program: U.S. Geological Survey Data Series 463, 2009.

Michaelsen and Haston, Reconstruction of the flows of the Santa Ynez River at Bradbury Dam, Santa Barbara County California 1537-1964, 1998.

Miller, G .A. and Rapp J .R., Reconnaissance of the Ground- Water Resources of the Ellwood-Gaviota Area, Santa Barbara County, California, U.S. Geological File Report, 1968.

Miller, Groundwater Resources in the Lompoc Area, Santa Barbara County, California, U.S. Geological Survey Open File Report 76-183, 1976.

Miller and Evanson, Utilization of Groundwater in the Santa Maria Valley Area, California, USGS Water Supply Paper 1819-A, 1966.

Morro Group, The, Review of Groundwater Conditions in the Northern Santa Maria Basin and Scenarios for the Evaluation of Impacts of Development on the Water Resources of Nipomo Mesa, Appendix A, , 1990.

Muir, K.S., Geology and Ground Water of San Antonio Creek Valley Santa Barbara County California, U.S. Geological Survey Water Supply Paper 1664, 1964.

Muir, K.S., Ground-Water Reconnaissance of the Santa Barbara-Montecito Area, Santa Barbara County, California, U.S. Geological Survey Water Supply Paper 1859-A, 1968.

Pierotti, B. and Lewy, R., Evaluation of Groundwater Overdraft in the Southern Central Coast Region, 1998.

Santa Barbara County Environmental Health Services, Los Olivos Wastewater Management Plan, 2010.

Santa Barbara County Flood Control, 1996 Precipitation Report, 1996.

Santa Barbara County Planning & Development Department, Santa Barbara County Comprehensive Plan, Conservation Element, Groundwater Resources Section, 1994.

Santa Barbara County Planning and Development Department, Environmental Thresholds and Guidelines Manual, 1995.

Santa Barbara County Resource Management Department, Orcutt Community Plan Update Proposed Final Environmental Impact Report (95 EIR-01), 1995.

Santa Barbara County Water Agency, Adequacy of the Groundwater Basins of Santa Barbara County, 1977.

Santa Barbara County Water Agency, Santa Maria Valley Water Resources Report, 1994.

Santa Maria Groundwater Litigation, Superior Court of the State of California, County of Santa Clara Consolidated Case No. CV770214, 2000.

Santa Maria Valley Water Conservation District, Resolution of the Board of Directors (to adopt and implement a groundwater management plan), 1995.

Singer, J.A. and Swarzenski, W.V., Pumpage and Ground-Water Storage Depletion in Cuyama Valley, California, 1947-66, U.S. Geological Survey Open File Report, 1970.

Slade, Richard C., Original Report and Addendum Hydrologic Assessment Determination of Groundwater in Storage within the Montecito Water District, 1991.

Solak, Mark, et al., Precipitation Augmentation Potential from Convection Band Seeding in Santa Barbara County, 1996.

Stetson Engineers Inc., Seventeenth Annual Engineering and Survey Report on Water Supply Conditions of the Santa Ynez River Water Conservation District, 1994-95, 1995.

Stetson Engineers Inc., Eighteenth Annual Engineering and Survey Report on Water Supply Conditions of the Santa Ynez River Conservation District 1995-1996, 1996.

Stetson Engineers Inc., Thirty Third Annual Engineering and Survey Report on Water Supply Conditions of the Santa Ynez River Water Conservation District 2009-2010, 2010.

Tetra Tech, Inc., Historical Water Balance of the San Antonio Groundwater Basin, 2011.

Toups Corporation, Santa Maria Valley Water Resources Study, 1976.

Turner, K.M., Reliability of Storage Schemes, Tree Rings, and Hurst Phenomena, California Department of Water Resources, 1992.

Upson, JE, Geology and Groundwater Resources of the South Coast Basins of Santa Barbara County, California, U.S. Geological Survey Water-Supply Paper 1108, 1951.

Upson and Thomasson, Geology and Water Resources of the Santa Ynez River Basin, Santa Barbara County, California, Upson and Thomasson, U.S. Geological Survey Water Supply Paper 1107, 1951.

URS Corporation, Urban Water Management Plan Goleta Water District, 2005.United States Bureau of Reclamation, Environmental Assessment for the Walker River Basin Cloud Seeding Project, 2010.

U.S. Geological Survey, Bulletin 322, 1907.

U.S. Geological Survey, Bulletin 222, 1946.

Weather Modification Association, Position Statement on the Environmental Impact of Using Silver Iodide as a Cloud Seeding Agent, 2009.

Wilson, H.D., Ground-Water Appraisal of the Santa Ynez River Basin, Santa Barbara County, California, 1957.

Woodring and Bramlette, Geologic Map of the Santa Maria District, Santa Barbara County, California, 1950.

Worts, G.F., Geology and Groundwater Resources of the Santa Maria Valley Area, California, U.S. Geological Survey Water Supply Paper 1000, 1951.

Appendix A – Groundwater Monitoring Sites Listing

The following is a listing of water level monitoring sites for depth to groundwater which the Santa Barbara County Water Agency funds. Most of the sites are in the unincorporated areas of the County. Individual cities and water districts fund many more sites. For data in those areas contact the individual agency.

To get record for a specific site listed below go to http://nwis.waterdata.usgs.gov/usa/nwis/gwlevels and query on the "Site ID" field.

State Well Number	Locality	USGS Site ID
4N/28W-2P3	Tuckers Grove Park; E	342709119471401
4N/28W-16J5	S Patterson; Luv Plants	342539119483504
4N/30W-1G1	1st Grove: Las Varas R	342732119583101
5N/29W-31C1	Las Varas Cyn: Sespe	342838119573501
5N/30W-28R1	El Capitan Cyn: St Park	342845120010701
5N/30W-28R2	El Capitan Cyn: St Park	342847120010801
5N/30W-30N2	El Refugio Ranch	342850120040002
5N/30W-19E1	Grove W of Refugio Rd	343008120035801
6N/31W-13D1	Santa Ynez: nr Hwy 246	343623120061201
6N/31W-1P2	West of Refugio Road	343727120055801
6N/31W-1P3	West of Refugio Road	343728120055101
6N/30W-7G5	S Ynez off Meadowvale	343651120043401
6N/30W-7G6	S Ynez off Meadowvale	343651120043402
7N/30W-30M1	SY Upl: Long Cyn Loop	343921120051601
7N/30W-19H1	SY Upl: Long Cyn Loop	344028120041801
7N/30W-29N2	SY Upl N of Roblar Ave	343903120040701
7N/30W-16B1	Sedgewick Ranch	344127120023301
7N/30W-22E1	Bar-Go Ranch	344023120015101
7N/30W-27H1	Bar-Go Ranch	343935120010801
7N/30W-33M1	300 ft W of Mora Ave	343833120030901
7N/30W-32R1	NW Baseline-Mora Jct	343812120031701
6N/30W-9N1	SW jct Hwy 154 & 246	343627120030801
7N/30W-24Q1	Starlane Ranch	343956119592401
7N/30W-35R1	Nr Starlane entrance rd	343809120000601
6N/30W-11G1	Happy Cyn: Westerly	343649120001801
6N/29W-7L1	N of Rd to Phillips Rnch	343646119583001
6N/29W-8P1	Phillips Ranch @ House	343632119573301
6N/29W-8P2	Phillips Ranch @ House	343632119573302
6N/29W-5A1	Phillips Ranch - North	343755119570901
6N/30W-1R3	Happy Canyon	343718119592001
6N/29W-6F1	Happy Cyn: Kastner	343746119583101
6N/29W-6G1	Happy Cyn: Kastner	343746119582201
7N/29W-29R1	Happy Canyon	343900119570201
7N/29W-29R2	Happy Canyon	343900119570301
5N/29W-1C1	San Marcos Ranch	343251119522201

State Well Number	Locality	USGS Site ID
6N/32W-2Q1	SYR Alluvial; Buellton	343719120124901
6N/31W-7F1	Buellton Upland Well	343655120111201
6N/31W-17F1	SYR Alluvial; Buellton	343609120101201
6N/31W-17F3	SYR Alluvial; Buellton	343608120101001
6N/31W-10F1	Fredenborg Cyn: Solvng	343656120080601
6N/31W-4A1	Ballard Cyn nr Solvang	343800120083001
7N/31W-34M1	Ballard Cyn nr Solvang	343824120081801
6N/31W-11D4	Alamo Pintado Road	343705120071001
6N/31W-2K1	Alamo Pintado Road	343741120064801
6N/31W-3A1	Hilltop West of Ballard	343759120072901
7N/31W-35K4	North of Ballard School	343826120065002
7N/31W-36L2	Refugio Rd N of Baseln	343831120055001
7N/31W-22A3	Foxen Cyn nr Los Olivos	344044120072801
7N/31W-23P1	Los Olivos: Matties Tav	344002120070001
8N/31W-25Q1	Neverland: Domestic#1	344418120053101
8N/31W-25Q2	Neverland: Well ZL3	344424120053301
8N/30W-30N1	Neverland: Well ZL2	344426120050701
8N/31W-36H1	Midland School	344354120051501
8N/30W-30R1	Midland School	344420120041701
7N/33W-28D3	W Santa Rita Valley	343946120215301
7N/33W-21N1	W Santa Rita Valley	343956120214001
7N/33W-21G2	Mid Santa Rita Valley	344025120211501
7N/33W-27G1	E Santa Rita Valley	343926120201001
7N/33W-27J1	E Santa Rita Valley	343923120200101
7N/33W-36J1	Drum Cyn - Santa Rosa	343824120175201
7N/33W-36J2	Drum Cyn - Santa Rosa	343825120174601
7N/32W-31M1	Drum Cyn - Santa Rosa	343821120173601
6N/32W-6K1	Drum Cyn - Santa Rosa	343739120171301
7N/32W-7B1	Drum Cyn - Santa Rosa	344215120170001
6N/34W-12C5	SYR Alluvial; Santa Rita	343735120245902
6N/32W-18H1	SYR Alluvial; Santa Rita	343613120164501
6N/32W-16P3	SYR Alluvial; Santa Rita	343544120151801
7N/34W-15P2	Uplands E of Hwy 1	344100120270401
7N/34W-12E1	N of Mission Hills	344219120250601
7N/34W-15E1	Vandnbrg Village CSD	344134120272201
7N/34W-15D1	Vandnbrg Village CSD	344140120272301
7N/34W-15D2	Vandnbrg Village CSD	344140120272302
7N/34W-9H5	Vandnbrg Village CSD	344221120273501
7N/34W-9H6	Vandnbrg Village CSD	344221120273502
7N/34W-14F4	Mission Hills CSD	344126120255201
7N/34W-14L1	Mission Hills CSD	344117120255001
7N/33W-19D1	Lower Cebada Canyon	344035120235901
7N/33W-17N2	Upper Cebada Canyon	344051120224901
7N/33W-17M1	Upper Cebada Canyon	344100120224901
7N/33W-30B2	E Lompoc V: Valla Bros	343949120232901
7N/33W-20G1	W of Tularosa Road	344025120221601
7N/35W-24J4	At N end of Douglas Ave	344021120303504
7N/34W-30L10	SW cor Central & Leege	343941120300106

State Well Number	Locality	USGS Site ID
6N/34W-6C4	E of San Pasqual Rd	343815120300602
7N/34W-31R2	NW of Floradale-Ocean	343828120293201
7N/34W-29N6	E of Floradale: Bob Witt	343926120293001
7N/34W-29N7	E of Floradale: Bob Witt	343926120293002
7N/34W-29E4	E of Floradale: J Fischer	343948120292002
7N/34W-20K4	USPrison E of Floradale	344017120285502
7N/34W-32H2	E of Bailey: Wineman	343901120284201
7N/34W-27G6	E of North A Street	343949120264901
7N/34W-26H3	Eastern Lompoc Valley	343943120252201
7N/34W-22J6	E LV; W of Rucker Rd	344033120263404
7N/34W-24N1	Purisima Mission nr 246	344010120251601
7N/35W-18H1	Surf (N. side of Lagoon)	344135120355201
7N/35W-18J2	Surf (S. side of Lagoon)	344118120355902
7N/35W-17M1	Surf (near RR xing)	344114120353501
7N/35W-17Q6	Surf (old Barrier Bridge)	344110120351201
7N/35W-27C1	Ocean Ave & Renwick	344001120331401
7N/35W-22J1	W Valley: Jordan Farm	344021120324101
7N/35W-23E2	W Valley: Jordan Farm	344043120322402
7N/35W-23Q4	W Valley: Jordan Farm	344008120320901
7N/35W-23Q2	W Valley: Jordan Farm	344009120320402
7N/35W-23Q3	W Valley: Jordan Farm	344009120320403
7N/35W-26F4	W Valley: Jordan Farm	343948120320901
7N/35W-26L1	W of Union Sugar Ave	343929120321001
7N/35W-26L2	W of Union Sugar Ave	343929120321002
7N/35W-26L4	W of Union Sugar Ave	343929120321004
7N/35W-35A3	S Artesia Ave	343859120314003
7N/35W-24N3	N Artesia Ave: Beattie	344046120321401
7N/35W-23J5	N Artesia Ave	344025120313701
7N/35W-25F5	NW of DeWolf & Central	343947120310701
7N/35W-25F6	NW of DeWolf & Central	343947120310703
7N/35W-25F7	NW of DeWolf & Central	343947120310702
7N/35W-24K5	DeWolf Ave: Henning	344029120310305
6N/36W-26G1	South VAFB near SLC6	343426120380901
6N/36W-26C1	South VAFB near SLC6	343445120382601
6N/36W-01K1	South VAFB near SLC4	343755120372101
7N/35W-31J2	South VAFB: Bear Cyn.	343841120355202
7N/35W-32N1	South VAFB: Bear Cyn.	343831120354301
7N/35W-30G1	South VAFB - Wade Rd.	343944120361901
7N/35W-27P1	S. VAFB (Lom Terrace)	343923120332501
7N/35W-27F1	E. of So. VAFB entrance	343952120332001
7N/35W-27H1	E. of So. VAFB entrance	343948120330101
7N/35N-22M1	W of VAFB entrance N	344025120333401
7N/35W-21G2	AFB: 3300' NW of 22M1	344041120341101
7N/35W-23B2	N of SY River on VAFB	344048120320201
7N/35W-15M1	W. of 13th; N. of SYRivr	344124120334401
10N/32W-19M2	Cuy. R. below Twitchell	345541120173001
9N/32W-6D1	Santa Maria Mesa Road	345323120173801
9N/32W-7A1	Santa Maria Mesa Road	345238120164701

State Well Number	Locality	USGS Site ID
9N/32W-17G1	Foxen Canyon Road	345129120160301
9N/32W-16L1	Foxen Canyon Road	345116120150601
9N/32W-22D1	Sisquoc Ranch Road	345053120163201
9N/32W-23K1	Hdqtrs: Sisquoc Ranch	345035120123501
8N/35W-12M1	Field N of S Antonio Rd	344650120312001
8N/34W-9K1	E of S20; N of Barka S	344712120273901
8N/34W-2M1	Hampton Farms Well	344802120255901
8N/34W-14L1	NE jct Hwy 1-SA road	344624120253901
8N/34W-23B1	W of Hwy 1 @ SA crk	344546120252901
8N/34W-24E1	SE of jct Hwys 1 & 135	344530120245201
8N/33W-19K1	30' S of Hwy 135	344530120231601
8N/33W-20Q2	SW Hyw135-Batchelder	344518120221002
8N/33W-22K3	Mid San Antonio Basin	344521120200801
8N/32W-30E5	Carrari .3 W of Los Ala	344441120172801
8N/32W-30D1	Field W of Los Alamos	344457120174001
8N/33W-13C1	Berringer N of office	344645120182401
8N/33W-13Q1	Berringer S of office	344609120180701
8N/32W-29L2	S of SkyView Motel	344437120161401
8N/32W-28P1	SE of Los Alamos	344417120151001
8N/32W-28P4	100' NW of 28P1	344417120151002
8N/32W-25D1	Alisos Cyn Rd NE of 101	344757120122101
8N/34W-17H1	N side Barka Slough	344633120281901
8N/34W-16C1	N side Barka Slough	344640120274401
8N/34W-16C2	N side Barka Slough	344640120274402
8N/34W-16C3	N side Barka Slough	344640120274403
8N/34W-16C4	N side Barka Slough	344640120274404
8N/34W-16F1	N side Barka Slough	344636120274201
8N/34W-16G3	N side Barka Slough	344626120272901
8N/34W-17E1	SW side Barka Slough	344630120290101
8N/34W-17K2	S side Barka Slough	344618120283201
8N/34W-17Q1	S side Barka Slough	344611120283001
8N/34W-21A1	S side Barka Slough	344550120273901
8N/34W-15F2	E of Barka Slough	344628120264201
8N/34W-15F4	E of Barka Slough	344628120264203
10N/33W-20H1	E of Philbric Road	345552120220001
10N/33W-21P1	W of Bradley Channel	345534120212001
10N/33W-28F2	W of Bradley Channel	345459120211901
10N/33W-28A1	Betteravia Rd @ big 90°	345523120204902
10N/33W-27G1	1 mile SE of 28A1	345458120200601
10N/33W-26N1	3000' WNW of Fugler Pt	345431120194201
10N/33W-35B1	1000' WNW of Fugler Pt	345424120191501
9N/33W-2A7	Andrew Ave; Garey, CA	345325120184201
9N/33W-12C1	.6 mi. SE of Garey, CA	345233120181001
9N/33W-12R2	W side Sisquoc, CA	345201120173901
9N/33W-6G1	Reservoir nr Zimmerman	345326120231401
9N/33W-5A1	East of Telephone Rd	345337120215601
10N/33W-34E1	E of Dominion Road	345405120204701
9N/33W-24L1	Cat Cyn & Palmer Rds	345024120181801

State Well Number	Locality	USGS Site ID
9N/32W-33M1	Cat Canyon Road	344835120152701
9N/34W-3A2	SW Lakeview-Broadway	345340120261801
9N/34W-3F10	SM City: N of Foster Rd	345314120264101
10N/34W-14E4	SM City: downtown yard	345650120255901
10N/34W-14E5	SM City: downtown yard	345649120255201
10N/34W-26H2	E of McCoy Ln, nr 101	345459120250301
10N/33W-7M1	N of E Main St	345725120235701
10N/33W-7R1	E Main St: DeBernardi	345710120230801
10N/33W-7R6	E Main St: DeBernardi	345710120230802
10N/34W-13C1	Suey Rd; Rosemary Fm	345657120242901
10N/34W-13G1	Jones Rd; Rosemary Fm	345644120241801
10N/34W-13H1	N of Jones @ Rosemary	345644120235801
10N/34W-13J1	Rosemary Rd @ Farm	345635120235901
10N/33W-18G1	E side Rosemary Farms	345645120231101
10N/33W-19B1	S side Stowell Road	345616120231001
10N/34W-24K1	SW Rosemary - Battles	345548120242202
10N/34W-24K3	SW Rosemary - Battles	345548120242201
10N/33W-19K1	N of Betteravia Road	345538120231101
10N/33W-30M2	S of Prell Rd in Ind. yard	345454120234501
10N/33W-30G1	Telephone and Prell	345459120232301
10N/33W-29F1	W of Prell jct Telephone	345459120222301
10N/35W-21B1	Mahoney Bros Farm	345621120340101
10N/35W-23M2	S of Brown Road	345544120322501
10N/35W-14P1	N of Brown Road	345624120320901
10N/35W-24B1	SW jct Ray & Brown Rd	345620120305201
10N/35W-24Q1	Ex B&W feedlot well	345538120304801
10N/35W-35J2	Field E of Hwy 1	345406120313501
10N/34W-29N2	Taylor Residence	345441120291301
9N/34W-6C1	Laguna Sanitation Yard	345330120300801
9N/34W-8H1	Hwy 1 nr Graymare Frm	345225120283101
9N/34W-9R1	Off end of Palomino Dr	345205120271801
10N/35W-7E5	North of 18F2 across rd	345801120362801
10N/35W-18F2	SW from Guadalupe	345659120362002
10N/35W-9N2	SW Main St - Hyw166	345725120342503
10N/35W-9E5	Guadalupe City Well	345750120343001
10N/35W-9F1	Guadalupe: Waller Seed	345751120340001
10N/35W-11E4	Silva Farm N of Hwy 166	345748120321901
10N/34W-6N1	E of Bonita School Rd	345818120300601
10N/34W-20H3	S of Stowell nr RR line	345604120282202
10N/34W-9D1	Adam Bros Farm	345800120280801
11N/35W-33G1	Division St @ RR Xing	345926120340001
11N/35W-28M1	E of Guadalupe dunes	350012120342601
11N/35W-28F2	Off of Division St.	350015120341001
11N/35W-20E1	Oso Flaco Lake Road	350107120353201
11N/35W-26M3	Off of Oso Flaco Rd. E	350011120302101
11N/35W-25F3	Division @ Bonita Road	350014120310501
11N/34W-30Q2	SE of Nipomo Mesa Rd	345950120294501
11N/34W-29R2	Southeast of 30Q1	345959120281901

State Well Number	Locality	USGS Site ID
10N/27W-11A1	N jct Aliso Rd - Hwy 166	345808119433501
10N/26W-18F1	.5 mi W of New Cuyama	345709119415501
10N/26W-20M1	New Cuyama CSD Well	345603119411901
10N/26W-20P1	New Cuyama CSD Well	345540119410901
10N/26W-16Q1	Russel Rnch nr Hyw166	345637119394701
10N/26W-21A1	S of H 166, E of 16Q1	345618119393701
10N/26W-9H1	Russel Ranch N of River	345800119393101
10N/26W-4R1	Russel Ranch N of River	345822119391801
9N/26W-1F3	Kiger Homestead Well	345325119365603
10N/25W-30F1	W of Kirchenmann Rd	345512119354101
9N25W-27C1	Reyes Ranch: SB Cyn	345023119322601
9N/25W-13B1	Farry: well nr gravel ops	345206119294701
9N/24W-32C1	Clark well: Ventucopa	344944119275701
9N/24W-33M1	Lambert well: Quatal Rd	344910119270501

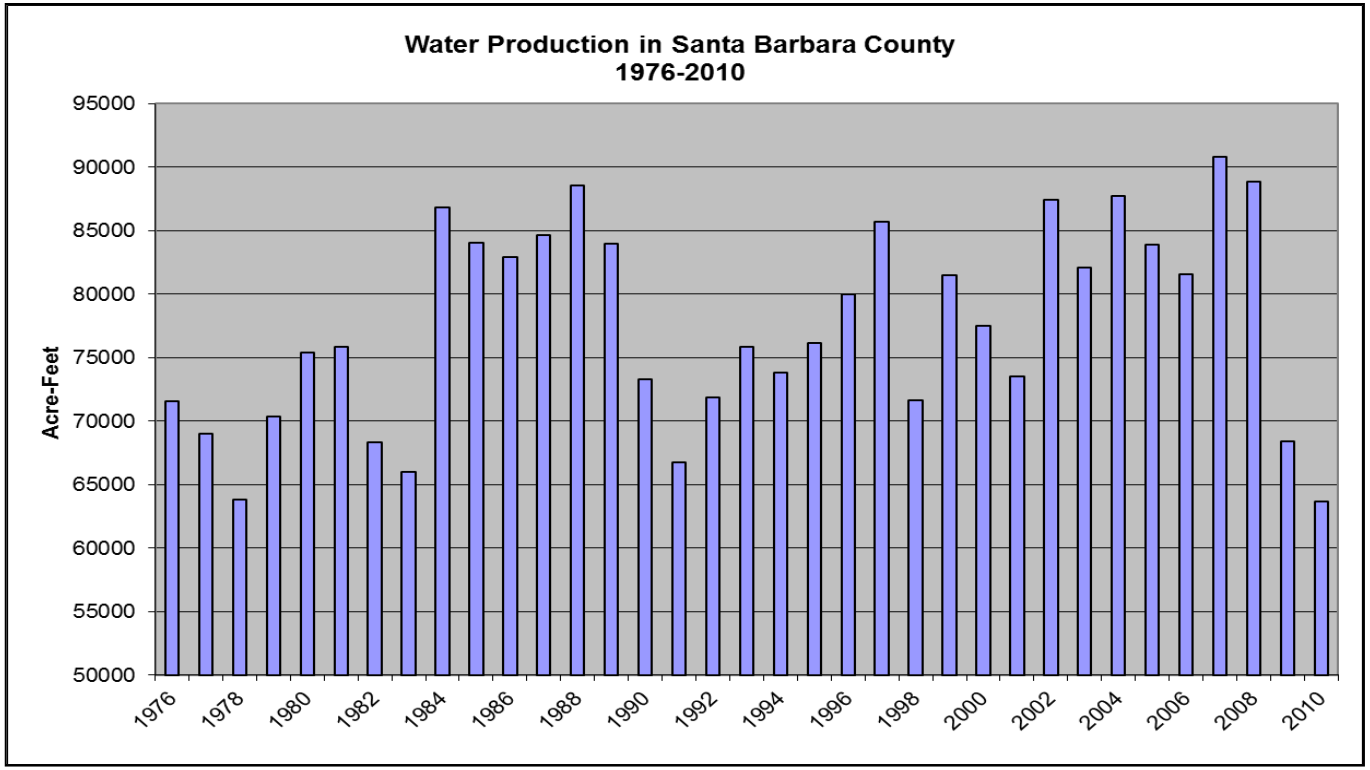
Appendix B - Santa Barbara County Water Production

By Purveyor and Calendar Year

Year	City of Buellton	Golden State Wtr (Orcutt)	Carp. Wtr District	Cuyama CSD	Goleta Wtr District	City of Guada-lupe	La Cumbre Mut Wtr	City of Lompoc	Los Alamos CSD	Mission Hills CSD	Monte-cito Wtr District	City of Santa Barbara	City of Santa Maria	Santa Ynez Riv WCD	City of Solvang	Vanden-berg AFB	Vanden-berg Vill CSD	Totals
1976	535	4330	5368	300	15844	845	1672	3416	158	500	3995	14463	8080	5409	1264	3795	1543	**71517**
1977	528	4849	5025	321	14867	781	1565	3327	158	500	3713	12718	7509	6643	1198	3796	1464	**68962**
1978	641	4621	4305	300	13785	722	1339	3282	161	500	3463	12404	7445	5063	1098	3353	1309	**63791**
1979	716	5099	4934	295	15405	666	1326	3596	205	500	3858	13719	8069	6006	1122	3278	1525	**70319**
1980	752	5608	5129	292	16034	762	1533	3753	230	583	4099	14543	8739	6527	1231	4026	1527	**75368**
1981	770	6109	5338	333	15610	738	1508	3607	211	492	4295	14095	8691	6517	1622	4330	1589	**75855**
1982	725	5508	4449	262	13331	675	1387	3596	211	417	3612	13475	8311	5343	1569	4169	1291	**68331**
1983	743	5714	3898	235	11896	733	1284	3618	179	416	3576	14439	8904	4447	1362	3375	1181	**66000**
1984	971	7079	6130	254	15796	961	2067	4447	240	570	5483	16826	10537	7885	1876	4211	1482	**86815**
1985	939	7276	5488	258	15344	908	1900	4525	230	522	4905	16335	10635	7159	2028	4063	1486	**84001**
1986	1057	7625	5068	275	14874	800	1827	5029	269	542	4789	16277	11039	6174	2028	3768	1485	**82926**
1987	1153	7916	5845	274	15290	757	2008	4884	262	569	4889	16140	11192	6327	1999	3717	1441	**84663**
1988	1204	8678	5986	218	15358	823	2209	5354	253	700	5314	16517	11848	6529	2153	3850	1577	**88571**
1989	1221	8860	6280	195	11451	828	1617	5612	256	694	5234	15067	12470	6742	2080	3793	1582	**83982**
1990	1083	8691	5362	189	10013	724	1298	4930	251	633	5034	9849	12057	6337	1963	3401	1438	**73253**
1991	955	8210	4055	182	9393	685	1166	4413	238	578	3779	9559	11478	5814	1852	3065	1342	**66764**
1992	964	8381	4315	173	11066	718	1320	4653	225	600	4025	10507	12074	5402	1868	4124	1401	**71816**
1993	958	8174	4312	168	11837	653	1321	4670	240	618	4420	11371	11835	7599	1871	4394	1380	**75821**
1994	918	8572	4489	169	10634	668	1555	4770	236	628	4368	12079	12133	5332	1807	4186	1287	**73831**
1995	896	8447	4314	181	13317	662	1542	4772	260	604	4155	12716	12265	5202	1611	3916	1293	**76153**
1996	923	9906	4298	191	12184	585	1648	5086	276	658	4702	13216	12323	6500	1641	4463	1356	**79956**
1997	991	9376	4635	213	14667	622	1632	5804	256	733	5369	14546	12796	6343	1686	4486	1523	**85678**
1998	806	8154	3985	165	11758	574	1337	5231	238	540	4200	12970	10665	4290	1425	3958	1291	**71587**
1999	897	9259	4442	189	12741	749	1849	5408	320	762	5538	13784	11851	6163	1533	4538	1467	**81491**
2000	975	8262	4379	190	13317	618	1546	4566	263	609	5112	13395	11231	5303	1532	4980	1233	**77511**
2001	991	8053	3901	183	12225	658	1399	4465	251	591	4473	12531	11155	5355	1559	4476	1201	**73467**
2002	1135	9464	4436	212	14851	782	2138	5625	344	632	5978	14353	13339	6479	1517	4521	1598	**87404**
2003	1146	9071	4215	178	12923	764	1880	5567	328	*602	5716	13649	13495	5734	1455	4471	1504	**82096**
2004	1258	9331	4899	192	14830	*748	2142	5932	368	772	6592	14234	13650	6026	1596	4267	1619	**87708**

Year	City of Buellton	Golden State Wtr (Orcutt)	Carp. Wtr District	Cuyama CSD	Goleta Wtr District	City of Guada-lupe	La Cumbre Mut Wtr	City of Lompoc	Los Alamos CSD	Mission Hills CSD	Monte-cito Wtr District	City of Santa Barbara	City of Santa Maria	Santa Ynez Riv WCD	City of Solvang	Vanden-berg AFB	Vanden-berg Vill CSD	Totals
2005	1188	10129	4633	176	14326	788	1723	5032	362	697	5734	13178	13857	5216	1454	3892	1479	**83864**
2006	1260	8770	4289	168	13220	882	1856	5079	362	671	5887	13320	13671	5350	1490	3716	1521	**81512**
2007	1305	9727	4024	186	15759	*748	2316	5653	362	718	7158	15007	14902	6357	1677	3925	1729	**90805**
2008	1371	9329	3916	172	15057	1045	2275	5476	357	718	7085	14357	14278	6272	1573	3925	1627	**88833**
2009	1337	7528	2123	166	10496	965	1611	4796	323	664	5125	12877	13420	2640	1399	1549	1381	**68400**
2010	1195	7037	1952	146	9695	934	1451	4389	275	601	4453	11791	13072	2382	1308	1761	1203	**63645**
Avg	986	7804	4578	217	13406	760	1664	4696	262	604	4861	13609	11400	5796	1613	3873	1439	**77506**
Max	1371	10129	6280	333	16034	1045	2316	5932	368	772	7158	16826	14902	7885	2153	4980	1729	**90805**
Min	528	4330	1952	146	9393	574	1166	3282	158	416	3463	9559	7445	2382	1098	1549	1181	**63645**

*No report thus average used



Appendix C - Santa Barbara County Groundwater Basins Summary

Basin	Size	Estimated basin SAFE YIELD		Estimated Net Demand on Groundwater (AFY)	Surplus (Overdraft) (AFY)	Available Water in Storage (AF)	Land Use Summary
		For Gross Pumpage (Perennial Yield) (AFY)	For Net Pumpage (Net Yield) (AFY)				
Carpinteria	6,700 acres	5,000	3,865	3,750 (Pumpage level assumes all available surface supplies are utilized)	126	16,000*	One city; orchards, irrigated crops and greenhouses.
Montecito	4,300 acres	1,650	1,215	Pumpage not required due to surplus surface supplies	0	16,110*	Primarily low-density residential use; unincorporated.
Santa Barbara	4,500 acres	1,400	1,120	Pumpage not required due to surplus surface supplies. Managed by City of SB	2,838 (Basin on overall City supply)	10,000*	Primarily residential, industrial and commercial.
Foothill	3,000 acres	953	905	898 (Max. long-term pumpage. Managed by City of SB)	Not subject to overdraft per SB / LCMWC agreement	5,000	Primarily residential.
Goleta North / Central	5,700 acres	3,700	3,420	3,420	Not subject to overdraft per court decision	60,000*	Primarily residential, industrial and commercial. Basin has been adjudicated and is not subject to overdraft.
Goleta West	3,500 acres	500	475	220	255	7,000*	Primarily residential, industrial and commercial.
Buellton Uplands	16,400 acres	3,740	2,768	1,932	800	154,000	Extensive agriculture; one city.
Santa Ynez Uplands	83,200 acres	11,500	8,970	10,998	(2,028)	900,000	Three towns, one city and other low density residential; varied high-value agriculture.
Lompoc	48,600 acres	28,537	21,468	22,459	(913)	170,000	One city, unincorporated urban development, Vandenberg AFB; varied agriculture; petroleum.

**Useable Storage*

Basin	Size	Estimated basin SAFE YIELD		Estimated Net Demand on Groundwater (AFY)	Surplus (Overdraft) (AFY)	Available Water in Storage (AF)	Land Use Summary
		For Gross Pumpage (Perennial Yield) (AFY)	For Net Pumpage (Net Yield) (AFY)				
San Antonio	70,400 acres	20,000	15,000	24,540	(9,540)	800,000	One town; extensive agriculture; some petroleum; VAFB
Santa Maria	110,000 acres (80,000 within SBC)	125,000	80,000	100,000 (87,500 with City of Santa Maria reduction in pumpage due to SWP supply)	(2,368)	1,100,000	Two cities; extensive unincorporated urban area (SBC); extensive irrigated agriculture; petroleum
Cuyama	441,600 acres (81,280 within SBC)	10,667	8,000	36,525	(28,525)	1,500,000	Extensive agriculture; some petroleum; very low population density
Special Basins / Limited Data							
More Ranch	502 acres	84	76	24	60	N/A	Primarily open space; limited residential / agriculture
Ellwood to Gaviota Coastal Basins	67,200 acres		N/A	N/A	N/A	N/A	Agriculture, primarily orchards and grazing; limited municipal / industrial
Gaviota to Pt. Conception Coastal Basins	23,040 acres		N/A	N/A	N/A	N/A	Agriculture, primarily grazing
Santa Ynez River Riparian Basins	12,000 acres (3 sub-units)		N/A	N/A	N/A	Annual average flow exceeds storage capacity	Two cities; 7,300 acres of irrigated cropland

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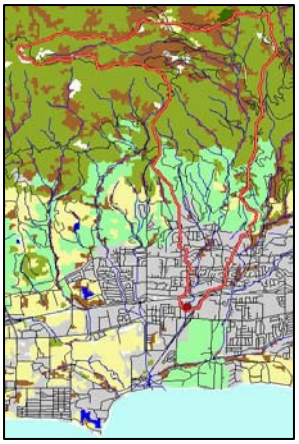
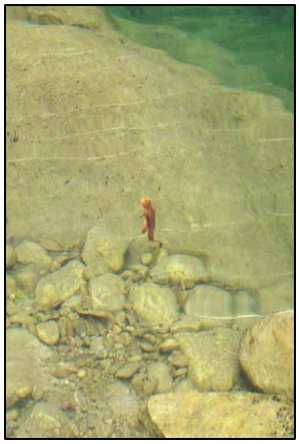
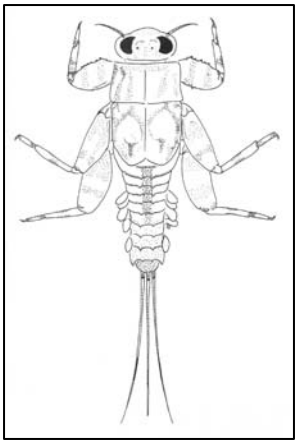
Appendix 3-C: South Coastal Santa Barbara County Creeks Bioassessment Report, 2008

SANTA BARBARA COUNTY CREEKS BIOASSESSMENT PROGRAM

2008 ANNUAL REPORT







Prepared by:

Santa Barbara County, Project Clean Water

Executive Summary

This report summarizes the results of the 2008 Santa Barbara County Creeks Bioassessment Program. The Program was initiated in 2000 to assess and monitor the "biological integrity" of local creeks as they respond through time to natural environmental conditions and human impacts. The Program involves annual collection and analysis of benthic macroinvertebrate (BMI) samples and other pertinent physiochemical and biological data in study creek reaches using USEPA endorsed rapid bioassessment techniques. BMI samples are analyzed in the laboratory, and six "core metrics" specified in the *Index of Biotic Integrity (IBI) for Southern Santa Barbara County Streams* (Ecology Consultants, Inc., 2004) are calculated for each study reach. The IBI provides a measurement of biological integrity for study streams based on the evaluation of the core metrics, which reflect different aspects of the BMI community including diversity, composition, and trophic structure.

This year's study included 11 study reaches in nine different creeks along approximately 35 miles of the southern Santa Barbara County coast. From east to west, study creeks are Rincon Creek, Carpinteria Creek, Montecito Creek, San Antonio Creek, Atascadero Creek, San Jose Creek, Tecolote Creek, Arroyo Hondo Creek, and Gaviota Creek.

Physiochemical and biological data for the study reaches was gathered through field surveys and laboratory analyses. The six IBI core metrics were calculated for each study reach, and IBI scores and classifications of biological integrity were determined.

This year (2008), there were notable differences in BMI community structure compared to previous years, namely higher percent EPT, higher biotic index scores, higher percentage of non-insects and Dipterans, and higher percentage of sensitive BMIs. These changes were presumably due lower flows from unusually light storm flows in local creeks this winter. The changes in BMI community composition had an affect on IBI scores, which tended to be lower at minimally disturbed study reaches (i.e., C3, AH1) and highly disturbed study reaches (i.e., C1, AT1, and AT2) compared to the previous year. Lower stream flows can drastically affect aquatic life (e.g., algae, BMIs, fish, etc.) residing there, as well as Habitat Assesment Scores. Classifications of biological integrity were again consistent with the ranges established for the individual study reaches in previous years, despite the environmental fluctuations that have occurred through time.

Continued study is needed to monitor the biological integrity of local creeks and help determine the effectiveness of creek restoration efforts. The combined bioassessment efforts of the County of Santa Barbara and City of Santa Barbara provide a good data set including creeks with a full range of stressors and impact intensity, so additional study reaches are not necessary at this time. After another year of study, the IBI scoring system should be revisited and refined in light of the additional data collected.

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I. Introduction

This report summarizes the results of the 2008 Santa Barbara County Project Clean Water Bioassessment Program. The Program was initiated in 2000 to assess and monitor the "biological integrity" of local creeks as they respond through time to natural environmental fluctuations and human impacts. Karr and Dudley (1981) defined biological integrity as "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region." (Miller et al., 1988). "Bioassessment" is the science of assessing the biological integrity of water bodies based on comparisons of how closely or not so closely they resemble those of "reference" habitats in the region, or those that are in a relatively pristine, natural condition. Bioassessment studies have focused on one or more biological assemblages including benthic macroinvertebrates (BMIs), fish, amphibians, diatoms, and riparian vegetation. This Bioassessment Program focuses on BMIs.

The Program involves annual collection and analyses of BMIs and other pertinent physiochemical and biological data in selected study creek reaches using U.S. Environmental Protection Agency (USEPA) endorsed rapid bioassessment techniques. BMI samples are analyzed in the laboratory, and six "core metrics" specified in the *Index of Biotic Integrity (IBI) for Southern Santa Barbara County Streams* (Ecology Consultants, Inc., 2004) are calculated for each study reach. The IBI provides a measurement of biological integrity for study streams based on the evaluation of the six core metrics, all of which reflect different aspects of the BMI community including diversity, composition, and trophic structure.

The IBI was developed by analyzing data from more than 40 creek study reaches in coastal southern Santa Barbara County that were studied over a four year period from 2000 to 2003. Collectively, the data set encompasses creeks with a wide range of physiochemical conditions, from steep mountain tributaries to wide lowland streams, and degree of impairment, from nearly pristine creeks to those that are highly impacted by human uses. Development of the IBI was funded in a joint effort by the County of Santa Barbara and the City of Santa Barbara. See *Santa Barbara County Creeks Bioassessment Program, 2003 Annual Report and Index of Biological Integrity* for a detailed discussion of the IBI (Ecology Consultants, Inc. 2004).

II. Study Area

This year's study included 11 study reaches in nine different creeks along approximately 35 miles of the southern Santa Barbara County coast. From east to west, study creeks are Rincon Creek, Carpinteria Creek, Montecito Creek, San Antonio Creek, Atascadero Creek, San Jose Creek, Tecolote Creek, Arroyo Hondo Creek, and Gaviota Creek. Study reach locations are shown in Figures 1-4, and listed in Table 1.

Table 1: Study Reaches	
RIN1:	Rincon Creek, just upstream of Highway 150 crossing at Gobernador Cyn. Rd.
C1:	Carpinteria Creek, approx. ¼ mi. downstream of Carpinteria Ave.
C3:	Gobernador Creek, approx. ¼ mi. upstream of debris basin
MONT2:	Montecito Creek just upstream of Olive Mill Rd.
SA2:	San Antonio Creek, approx. ¼ mi. upstream of Highway 154
AT1:	Atascadero Creek just downstream of Patterson Rd.
AT2:	Atascadero Creek just downstream of Cieneguitas Creek confluence
SJ2:	San Jose Creek, approx. ½ mi. upstream of Patterson Rd.
T1:	Tecolote Creek just upstream of Vereda Nueva
AH1:	Arroyo Hondo, approx. 1 mi. upstream of U.S. 101.
GAV1:	Gaviota Creek at State Beach, just below entrance road/US 101 junction.

III. Methods

Physiochemical and biological data for the study reaches was gathered through a combination of field surveys and laboratory analyses. Table 2 lists physiochemical and biological parameters determined for each study reach, parameter abbreviations used throughout the remainder of the report, and the method of calculation (e.g., lab or field).

Table 2
List of Parameters Calculated for Each Study Reach

Parameters	**Units of Measurement**	**Method of Calculation**
Wet stream width	Ft.	Field
Channel bottom width	Ft.	Field
Bank full width	Ft.	Field
Discharge	Cubic feet per second (cfs)	Field
Habitat assessment score	None	Field
Stream temperature	Degrees Celsius (°C)	Field
pH	None	Field
Dissolved oxygen concentration	Milligrams per liter (mg/l)	Field
Conductivity	Microsiemens (µS)	Field
Specific conductance (corrected to 25° Celsius)	µS	Field
BMI density	# per sq. meter (#/m^2)	Field/lab
Insect family diversity	NA	Field/lab
Percent Ephemeroptera/Plecoptera/Tricoptera (EPT)	NA	Field/lab
Biotic index score	NA	Field/lab
Percent sensitive BMIs	NA	Field/lab
Percent non-insects + Diptera	NA	Field/lab
Percent predators + shredders	NA	Field/lab
Percent riparian canopy cover	NA	Field

FIGURE 1: STUDY AREA

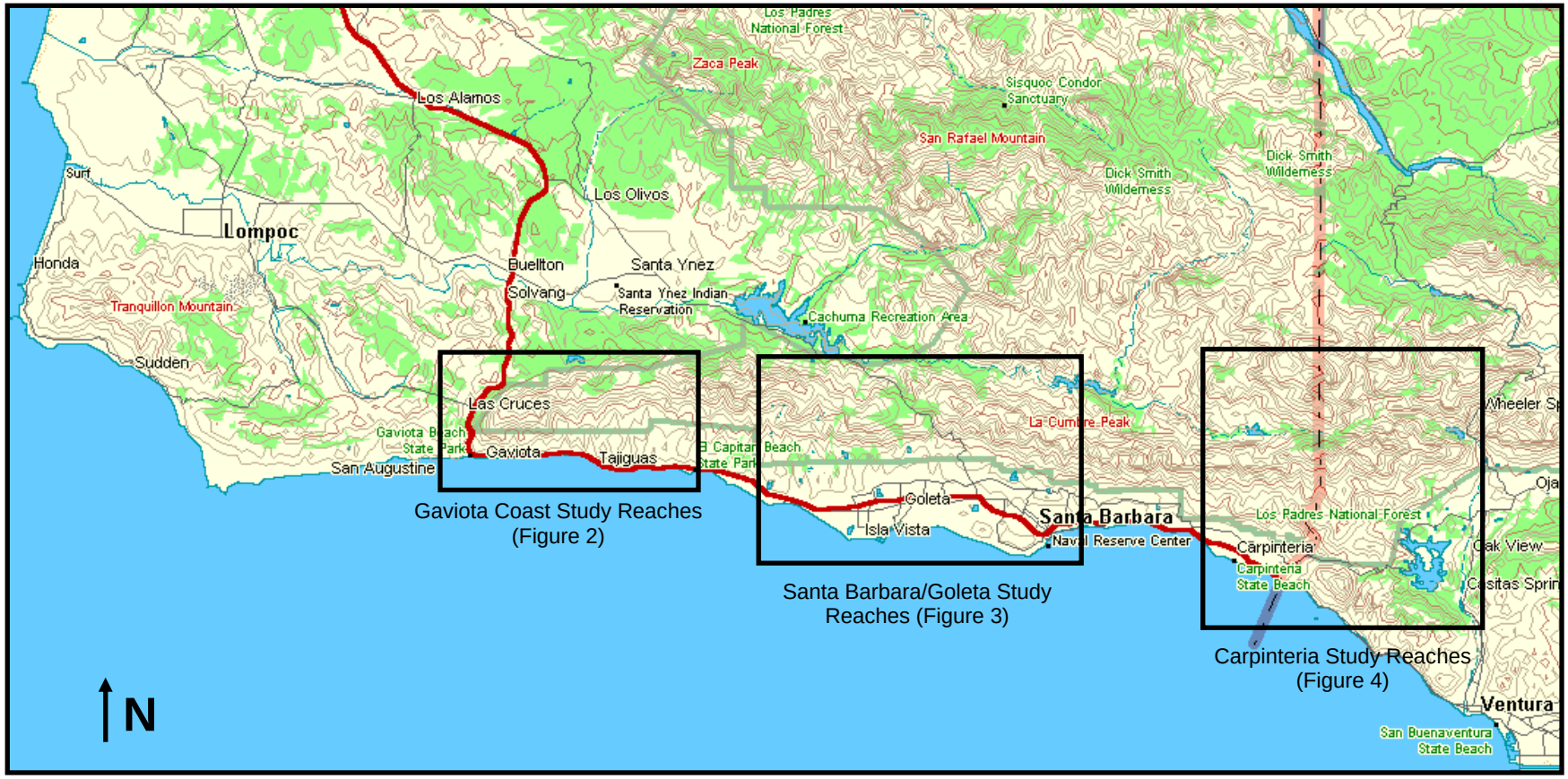


FIGURE 2: GAVIOTA COAST STUDY REACHES

FIGURE 3: SANTA BARBARA AND GOLETA STUDY REACHES

FIGURE 4: CARPINTERIA STUDY REACHES

A. Field Surveys

As in previous years of the bioassessment program, field surveys were conducted in the spring during base stream flow conditions (i.e., low flows). The sampling was conducted on April 18, 24, 25, 26, 27 and May 11, 24, 25 by County of Santa Barbara staff. Sampling in the spring during base flow conditions provides consistency in the sampling from year to year, as the local stream biota is known to undergo seasonal succession (Cooper et al., 1986). The following was completed during each field survey:

- General observations were recorded on a standardized field data sheet, including location, date, time, weather, stream flow conditions, water clarity, and human impacts.
- A 100-meter study reach was delineated along the stream. Stream habitat units (i.e., riffles, runs, pools, etc.) within the study reach were mapped and quantified as a percentage of the total reach length.
- Stream widths (wetted perimeter, channel bottom, and bank full) were measured at three transects in the study reach. Wetted perimeter width is defined as the cross-sectional distance of streambed that is inundated with surface water. Channel bottom width is defined as the cross-sectional distance between the bottoms of the stream banks. Bank full width is defined as the distance from the ordinary high water mark from one stream bank to the other, as evidenced by visible signs of stream flow such as water marks, stream-carried deposits of sediments and debris, and scour features.
- Stream discharge (Q) was estimated at a selected cross-section in the study reach. Q was estimated by multiplying the measured flow width times the average water depth and velocity, as measured at three to five equally spaced points along the cross-section. Velocity and depth were measured using a Global Water FP101 flow probe.
- Riparian canopy cover was estimated at the three transects using a spherical densitometer.
- Plant and wildlife species observed in the creek and riparian zone were noted.
- Water temperature, specific conductance, pH, and dissolved oxygen concentration were measured in the field using YSI and Oakton handheld meters. Two measurements of each parameter were made, one in a riffle and the other in a pool, and the two values were averaged.
- BMI samples were collected using a standardized method based on the "multi-habitat" approach described in the USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al., 1999). Three samples were collected per study reach: one sample from the downstream third of the reach, one from the middle third, and one from the upstream third. Each sample represents approximately one square meter of stream bottom, collected from 10 individual, 0.1-square meter locations (approximately 30 centimeters square). The 10 locations that constituted each sample were selected based on the relative area each stream habitat (i.e., riffles, pools, falls, etc.) covered in the section of stream sampled. For example, if a given stream reach contained approximately 50 percent riffles and 50 percent pools, five locations in riffles and five in pools were selected and sampled. Samples were collected using a D-frame net with 500 μm mesh. In locations with flowing water (e.g., riffles and runs), the net was held upright against the stream bottom, and substrata immediately upstream within the 0.1-square meter area was scraped and stirred up for approximately 15 seconds using feet and hands. Dislodged BMIs and stream bottom materials were carried into the net by the stream current. In areas with little or no current (e.g., pools), stream bottom material was stirred up by foot, followed by a quick

sweep of the net through the water column to capture dislodged BMIs. This was repeated three times in each pool sampling location.

- After each BMI sample was collected, it was rinsed with water in a 500 μm sieve to wash out fine sediments, transferred to a plastic container, and preserved in 70 percent ethanol for laboratory analysis.
- A semi-quantitative stream habitat assessment was conducted using the protocol provided in the USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers*. Per this protocol, habitat components were visually assessed and scored, including stream substrate/cover, sediment embeddedness, stream velocity/depth regime, sediment deposition, channel flow status, human alteration, channel sinuosity, habitat complexity/variability, bank stability, vegetative protection, and width and composition of riparian vegetation. Each study reach was assigned a total score of between zero and 200 based on the sum of scores assigned to each habitat component. Criteria from the USEPA protocol were used to guide the scoring.
- Quality control measures were incorporated into the field surveys to insure accurate and consistent data gathering. Water monitoring equipment was calibrated regularly. Field crew members were trained to properly operate equipment, take measurements, collect BMI samples, and conduct stream habitat assessments. Stream habitat assessment scoring was done as a group by the field crew.

B. Laboratory Analysis

BMI samples were processed in the laboratory to determine BMI community composition (i.e., taxa present and relative abundance) and overall density. Each BMI sample was strained through a 500-μm mesh sieve and washed with water to remove ethanol and fine sediments. The sample was placed in a plastic tray marked with equally-sized squares in a grid pattern. The entire sample was spread out evenly across the squares. Squares of material were randomly selected, and sorted one at a time under a dissecting microscope until a specified number of BMIs were located and picked out. The proportion of the sample sorted was noted. 110 specimens were picked out from each sample (i.e., three samples, 330 BMIs per study reach). 100 of the 110 BMIs picked from each sample (300 total per study reach) were randomly selected for identification. BMIs were identified using standard taxonomic keys. Insect taxa were identified to the family level. Non-insect taxa (e.g., oligochaetes, crustaceans, etc.) were identified to order or class. After processing and identification, sorted BMIs and sample remnants were bottled separately in 70 percent ethanol for storage.

Quality control measures were incorporated into the laboratory analysis to insure random selection and accurate enumeration and identification of BMIs. BMI sample processing methods were clearly established and strictly followed

C. Calculation of Core Metrics

The six IBI core metrics were calculated for each sample and study reach to reflect different aspects of BMI community structure including diversity, composition, trophic group representation, and sensitivity to human disturbance.

Insect family diversity was determined by summing the number of insect families found in the sample.

Percent non-insects + Diptera was determined by summing the individual non-insect BMIs and those from the insect order Diptera, dividing by the total number of BMIs in the sample, and multiplying by 100.

Percent EPT was determined by summing individuals from the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies), dividing by the total number of BMIs in the sample, and multiplying by 100. Most EPT taxa are sensitive to human disturbance.

Biotic index score and **percent sensitive BMIs** were calculated using disturbance tolerance values for individual BMI taxa provided in CDFG's *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort* (2002). This document assigns individual BMI taxa with tolerance values of between 0 and 10 based on their perceived ability to withstand human disturbance. A tolerance value of 0 indicates that a BMI is extremely intolerant of human disturbance, with increasing scores indicating greater tolerances to human disturbance. **Biotic index score** was determined by summing the tolerance values of all the individual BMIs in the sample, and dividing by the total number of BMIs in the sample. **Percent sensitive BMIs** was determined by summing the individuals with a tolerance value of two (2) or less, dividing by the total number of BMIs in the sample, and multiplying by 100.

Percent predators + shredders was determined by summing individual BMIs with predator or shedder functional feeding group designations, dividing by the total number of BMIs in the sample, and multiplying by 100. Functional feeding group designations were obtained from *An Introduction to the Aquatic Insects of North America* (Merritt and Cummins, 1996).

Although it is not one of the IBI core metrics, **BMI density** was determined by multiplying the number of BMIs picked by the proportion of the one square meter sampling area sorted through.

IV. IBI Scoring Ranges and Criteria

The IBI provides scoring ranges of between 2 and 10 for each of the six core metrics (see Table 3). For core metrics that decrease with increasing human disturbance (e.g., # insect families), higher values corresponded with higher scores. For core metrics that increase with increasing human disturbance (e.g., biotic index score), lower values corresponded with higher scores.

Table 3: Core Metric Scoring Ranges

Score	# Insect Families	% EPT	Biotic Index Score	% Sensitive BMIs	% Non-Insects + Diptera	% Shredders + Predators
10 (Excellent)	≥26	≥55	≤4.00	≥28	≤30	≥22
8 (Good)	20-25	41-55	4.01-4.74	21-27	31-47	16-21
6 (Fair)	13-19	28-40	4.75-5.48	14-20	48-63	11-15
4 (Poor)	7-12	14-27	5.49-6.22	7-13	64-80	5-10
2 (Very Poor)	≤6	≤13	≥6.23	≤6	≥81	≤4

Individual scores for the six core metrics are summed to provide a total score of between 12 and 60 for the study reach. The IBI provides classifications of biological integrity (i.e.,

Excellent, Good, Fair, Poor, and Very Poor) based on the total score. IBI classifications and scoring ranges are provided in Table 4.

Table 4: Classifications of Biological Integrity and Scoring Ranges	
Category	**Score Range**
Excellent	54-60
Good	48-53
Fair	36-47
Poor	24-35
Very Poor	12-23

V. Results

A. Physiochemical Data

Table 5 provides physiochemical data for the individual study reaches collected this year, and ranges in values collected in all years of study. Mean values and ranges among all the study reaches for this year are provided at the bottom of the table.

B. Biological Data

Table A-1 lists BMI taxa and their occurrence and abundance by sample and study reach for 2007. Core metric values are also provided in the table. Although not a core metric, BMI density is also provided. Over the years, insect taxa have composed the vast majority (about 95 percent) of BMIs found in the samples from local creeks. Common aquatic insect orders found in local creeks include Ephemeroptera (mayflies), Plecoptera (stoneflies), Tricoptera (caddisflies), Coleoptera (beetles), Diptera (true flies), Hemiptera (true bugs), Odonata (dragonflies and damselflies), and Megaloptera (dobson flies and alder flies). Non-insects found over the years include Gastropoda (snails); several types of crustaceans including Ostracoda, Copepoda, Decapoda, Amphipoda, and Isopoda; Acari (water mites); Turbellaria (flatworms); Oligochaeta (segmented worms); Hirudinea (leeches); and Nematomorpha (horsehair worms).

Table 5 Physiochemical Data											
Study Reach	**# years surveyed**	**Year**	**Wet width (ft.)**	**Habitat Assessment Score**	**Discharge (cfs)**	**Temp. (°C)**	**pH**	**Dis. O_2 (mg/l)**	**Conduct. (µS)**	**Specific conduct. (µS at 25°C)**	**% riparian canopy cover**
RIN1	3	Range	9.8-14.3	128-139	0.3-9.4	14.5-15.8	7.7-8.3	6.44-10.13	674-894	817-1108	100
		2007	9.8	139	4.6	14.5	8.3	6.44	813	1017	100
C1	7	Range	14.5-21.7	88-125	0.2-60.2	13.8-19.4	7.6-8.7	0-12.52	606-1240	712-1521	66-78
		2007	15.2	88	0.9	19.4	8.2	0	689	726	74
C3	7	Range	17.6-23.0	151-175	1.1-32.5	10.6-16.0	7.8-8.7	7.84-10.68	345-565	425-693	81-93
		2007	21.0	151	1.5	14.7	8.6	7.84	549	684	91
MONT2	2	Range	6.6-17.5	106-132	3.16-26.9	16.5-17.2	8.4-8.5	5.98-10.85	717-967	844-1141	74.2-79
		2007	6.6	106	3.16	16.5	8.4	5.98	967	1141	74
SA2	5	Range	7.1-15.4	125-163	0.2-13.8	13.2-20.2	8.0-8.9	6.01-10.68	534-1190	867-1310	68-94
		2007	8.2	125	0.2	14.7	8.3	6.01	534	1308	74
AT1	6	Range	18.0-32.8	60-88	0.46-18.6	14.1-20.7	7.7-8.7	1.87-12.01	134-2516	158-2744	18-41
		2007	32.8	84	0.46	17.6	8.3	1.87	134	158	27
AT2	6	Range	6.6-20.9	58-92	0.3-8.1	16.3-21.4	7.9-8.5	6.03-11.57	1402-1917	1586-2178	23-52
		2007	14.8	78	8.1	16.3	8.2	6.15	1558	1870	52
SJ2	7	Range	7.5-13.9	88-125	0.3-8.8	14.4-20.5	7.9-8.4	2.71-11.02	634-1395	772-1590	66-97
		2007	7.5	88	0.45	15.8	8.3	2.71	755	919	66
SJ3	7	Range	10.8-25.1	168-186	0.2-9.8	12.0-16.2	7.8-8.9	8.2-11.02	562-735	716-965	86-97
		2007	10.8	168	1.8	13.0	8.6	8.2	698	906	97
T2	3	Range	7.7-16.4	81-131	0.4-14.7	18.4-25.2	8.0-8.5	8.62-12.14	1043-1673	1131-1667	73-84
		2007	12.6	81	4.3	18.4	8.5	8.62	1175	1345	84
AH1	7	Range	11.6-23.0	168-188	0.3-14.8	11.6-18.4	7.5-8.8	7.05-10.10	603-887	730-1071	96-100
		2007	13.1	173	6.2	13.5	8.3	7.05	740	943	97
GAV1	4	Range	8.72-16.2	115-157	1.1-46.8	15.2-19.1	8.1-8.6	6.73-11.71	1006-1434	1240-1617	0-42
		2007	8.72	131	1.19	18.5	8.1	6.73	1310	1537	42
All		2007 Avg.	13.43	118	2.74	16.0	8.3	5.63	827	1021	73
		2007 Range	6.6-32.8	78-173	0.2-8.1	13.0-19.4	8.1-8.6	0-8.62	134-1558	158-1870	27-100

C. IBI Scores and Classifications

Table 6 lists core metric values, IBI scores, and classifications of biological integrity for the study reaches in 2007 based on the criteria in Tables 3 and 4. The means and ranges among the study reaches are also provided.

Table 6 Core Metric Values and IBI Scores, 2007														
Study Reach	**# insect families**		**% EPT**		**biotic index score**		**% sensitive BMIs**		**% non-insects + Diptera**		**% predators +shredders**		**IBI score**	**Classification**
	Value	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*	*Value*	*Score*		
RIN1	26	10	43	8	5.63	8	10	4	52	6	17	8	44	Fair
C1	10	4	1	2	7.01	2	0	2	90	2	3	2	14	Very Poor
C3	32	10	61	10	4.50	8	19	6	29	10	20	8	52	Good
MONT2	16	6	3	2	7.13	2	1	2	89	2	13	6	20	Very Poor
AT1	8	4	0	2	7.21	2	0	2	80	4	2	2	16	Very Poor
AT2	16	6	17	4	6.18	4	0	2	80	4	5	4	24	Poor
SA2	32	10	21	4	6.31	2	9	4	69	4	23	10	34	Poor
SJ2	24	8	10	2	6.02	4	1	2	82	2	8	4	22	Very Poor
SJ3	32	10	22	4	5.33	6	6	2	55	6	24	10	38	Fair
T2	18	6	14	4	6.65	2	1	2	77	4	9	4	22	Very Poor
AH1	24	8	41	8	4.68	8	13	4	51	6	25	10	44	Fair
GAV1	20	8	50	8	5.76	4	3	2	43	8	11	6	36	Fair
Mean	**21.5**	**7.5**	**23.6**	**4.8**	**6.03**	**4.3**	**5.2**	**2.8**	**66.4**	**4.8**	**13.3**	**6.2**	**30.5**	*Poor*
Range	8-32	4-10	0-61	2-10	4.5-7.21	2-8	0-19	2-6	29-90	2-10	2-25	2-10	14-52	*Very Poor- Fair*

Table 7 provides IBI scores for the study reaches since the beginning of the Bioassessment Program in 2000. The table also shows the range of IBI scores and classifications of biological integrity for each study reach in all years of study.

Table 7 IBI Scores and Classifications from 2000 to 2007								
Study Reach	**IBI Score**							**Classification Range**
	2000	**2001**	**2002**	**2003**	**2005**	**2006**	**2007**	
RIN1	-	-	40	-	-	48	44	Fair to Good
C1	20	16	14	18	30	30	14	Very Poor to Poor
C3	48	44	56	50	36	54	52	Fair to Excellent
MONT2	-	-	-	-	-	36	20	Very Poor to Fair
AT1	-	16	12	12	28	20	16	Very Poor to Poor
AT2	-	18	16	24	28	28	24	Very Poor to Poor
SA2	40	-	-	52	40	48	34	Poor to Good
SJ2	36	26	32	34	40	38	22	Very Poor to Fair
SJ3	48	52	48	48	48	50	38	Fair to Good
T2	42	-	-	-	-	40	22	Very Poor to Fair
AH1	60	36	54	60	40	60	44	Fair to Excellent
GAV1	-	-	-	42	38	32	36	Poor to Fair
Note: The Bioassessment Program was not conducted in 2004. - = study reach not surveyed in this year.								

VI. Discussion

Habitat conditions, biota, and IBI scores and classifications for the study reaches are discussed below.

RIN1

RIN1 is in the lowland stretch of Rincon Creek just upstream of the Highway 150 crossing and approximately two miles from the ocean. This reach of the creek passes through a rural area, and is abutted by a ranch home and horse pasture on the east side and Stanley Park Road to the west. The watershed of RIN1 is approximately 16 percent developed by agricultural and rural residential uses, with approximately 84 percent of the watershed being natural open space. Physical habitat conditions at this study reach are fair overall, as reflected by physical habitat assessment scores of 128 in 2002, 137 last year, and 139 this year - the only three years this reach has been studied. The creek channel is in a natural condition, with intact boulder, cobble, and gravel substrate in riffles, and some large, fairly deep pools, particularly at the top of the reach, where a deep plunge pool has formed underneath the private driveway that crosses the creek and continues to the ranch house. There appears to be a moderate increase in fine sediment deposition in this reach, particularly in pools. This is most likely from increased erosion of soils from creek banks and upstream orchards. The riparian corridor is narrow (approximately 20 feet wide) on both sides due to the abutting ranch property and Stanley Park Road, and has been infiltrated by invasive non-native understory plants. However, there are several mature alders, sycamores, and willows, which provide organic material including leaf litter and woody debris to the stream bottom. The mature trees shade the stream bottom, as evidenced by good riparian canopy cover, which was 100 percent in all years of study.

Due to the shade provided by the dense riparian canopy, RIN1 has low stream temperature, which was measured at 14.5°C this year. Field measured pH (8.3 this year, 8.2 last year) was normal for the region. Conductivity and specific conductance were slightly high this year (813 and 1017 µS), most likely due to significant agricultural areas in the watershed. Conductivity and specific conductance were higher at this reach in 2002 (894 and 1,108 µS).

This year RIN1 had an IBI score of 44 and Fair classification of biological integrity. This year's Fair classification is attributed to high insect family diversity and percent EPT, and low percent sensitive BMIs and percent non-insects + Diptera. Biotic index score and predators + shredders were moderate at this study reach. Last year this reach had an IBI score of 48 and a Good classification of biological integrity.

C1

C1 is in the lowland stretch of Carpinteria Creek in the City of Carpinteria, approximately a half mile from the ocean. This stretch of Carpinteria Creek passes through a residential area, and is abutted by homes and condominiums on both sides. The watershed of C1 is approximately 20 percent developed, primarily by agricultural uses with lesser coverage by residential uses and roads. Physical habitat conditions at this study reach are less than optimal, as reflected by physical habitat assessment scores that have ranged from 88 to 125 in seven years of study. Reasons for the somewhat low habitat assessment scores at this study reach include a narrow riparian corridor (generally 30 feet wide or less), infestation by non-native vegetation (40 percent non-native species), unstable, eroding creek banks, creek bank alteration (i.e., shoring

with rock and concrete), and increased deposition of fine sediments in pools. Decreased stream flow this year has degraded habitat conditions, and the habitat assessment score was 88 compared to 125 in both previous years. Higher discharge improves habitat scores in the channel flow status and velocity/depth regime categories.

Despite the degradation of the creek banks and riparian zone, the creek channel is still in a fairly natural condition, with intact cobble substrate in riffles, and some large, fairly deep pools. While the riparian corridor is narrow, there are several mature sycamores and willows, which provide organic material including leaf litter and woody debris to the stream bottom. The mature trees shade the stream bottom, as evidenced by good riparian canopy cover, which has ranged from 66 to 78 percent in the seven years of study.

Good canopy cover correlates with cool stream temperature, which was 19.4 °C this year and has ranged from 13.8 to 19.4 °C. Field pH (8.2) was normal in 2007 as in previous years. As is generally the case with streams having significant levels of watershed development, C1 has showed signs of water quality impairment in the form of high conductivity and specific conductance, which have been as high as 1,240 and 1,521 µS, respectively, in previous years. As was the case last year, conductivity and specific conductance were fairly low this year (689 and 726 µS).

This year C1 had an IBI score of 14 and Very Poor classification of biological integrity. IBI score has ranged from 14 to 30 in six previous years of study at this reach. The IBI score this year is attributed to moderately low insect family diversity, biotic index score, and percent EPT and non-insects + Diptera, and low percent sensitive BMIs and predators + shredders.

C3

C3 is in a high gradient stretch of Gobernador Creek, a mountain tributary of Carpinteria Creek. This reach is located in a narrow canyon with oak forest and chaparral vegetated slopes. The creek is relatively pristine, with only minor human disturbances from a road on the west side of the canyon. With the exception of the road, the watershed of C3 is undeveloped wilderness. Habitat conditions at C3 are excellent, as reflected by high physical habitat assessment scores, which have ranged from 151 to 175 in seven years of study. The stream has natural bedrock and boulder-dominated bed and banks, clean cobble and gravel deposits, well-developed riffles and cascades, deep pools, and abundant leaf litter and woody debris contributed by a mature canopy of native oaks, sycamores, alders, and willows. Riparian canopy cover has been high (81 to 93 percent) in the seven years of study.

Water quality has been very good at C3, with low temperature (10.6 to 16.0 °C), optimal dissolved oxygen levels (7.84 to 10.68 mg/l), normal pH (7.8-8.7), and low conductivity (345 to 565 µS) and specific conductance (425 to 693 µS). The presence of sensitive aquatic vertebrates including rainbow trout (*Oncorhynchus mykiss*) and California newt (*Taricha torosa*) in large numbers each year at this study reach is an indicator of excellent water quality and habitat conditions.

This year C3 had an IBI score of 52 and Good classification of biological integrity. This was the third highest IBI score for this study reach to date, and in-line with the score of 54 (Excellent) from last year. Last year IBI scores at undisturbed study reaches were generally much higher than this year, presumably due to higher flows during the spring. This year's score is attributed to high insect family diversity, percent EPT and percent non-insects + Diptera, moderate biotic index score and predators + shredders, and relatively low sensitive BMIs.

MONT2

MONT2 is located in a moderate gradient stretch of Montecito Creek just upstream of the Olive Mill Road crossing. This reach was studied for the second time this year as a substitute for MONT1, which cannot be surveyed due to access issues. MONT2 is approximately a mile downstream of MONT1, and has very similar habitat conditions. About 20 percent of the upstream watershed of MONT2 is developed, primarily by low density residential uses and roads. The study reach passes through a low density residential area consisting of large estate homes. Habitat conditions are fair in this stretch of the creek, as reflected by a physical habitat assessment score of 106. The creek has natural boulder-dominated bed and banks, cobble and gravel deposits, well-developed riffles, deep pools, and abundant leaf litter and woody debris contributed by mature native oaks, sycamores, alders, and cottonwoods. Riparian canopy cover (74 percent) is good in this study reach. The creek banks and riparian corridor has been infringed on by adjacent homes, and infiltrated by non-native plants which dominate the understory vegetation.

Water quality was fair overall at MONT2, with low temperature (16.5 °C), low dissolved oxygen (5.98 mg/l), normal pH (8.4), and slightly high conductivity (967 µS) and specific conductance (1141 µS).

MONT2 had an IBI score of 20 and Very Poor classification of biological integrity. This is well below the range of scores previously recorded for MONT1 (36-50), and a lower than anticipated given the habitat conditions. The IBI score for this reach is attributed to moderate insect family diversity and % predators + shredders and low biotic index score and percent EPT, sensitive BMIs, , and non-insects + Diptera.

SA2

SA2 is located in a moderate gradient stretch of San Antonio Creek just upstream of the San Marcos Pass crossing. The upstream watershed is largely undeveloped wilderness, with approximately five percent coverage by agriculture (i.e., orchards). Habitat conditions are good in this stretch of the creek, as reflected by physical habitat assessment scores of between 125 to 163 in five years of study (125 this year). The creek has natural bedrock and boulder-dominated bed and banks, cobble and gravel deposits, well-developed riffles, deep pools, and abundant leaf litter and woody debris. There is increased fine sediment deposition in the stream bed, presumably from increased erosion of creek banks and orchards upstream. The riparian corridor in this area is wide and relatively intact, with numerous mature oaks, sycamores, bays, and cottonwoods, and understory alders and willows. Riparian canopy has ranged from 68 to 94 percent, with some open areas where the channel is mostly bedrock.

Water temperature has been low to moderate at SA2, ranging from 13.2 to 20.2 °C, as have conductivity (534 to 1,190 µS) and specific conductivity (867 to 1,310 µS). Particularly in the case of conductance, this variability indicates the possibility of some water quality impairment due to runoff from upstream orchards. Dissolved oxygen (6.01 to 10.68 mg/l) and pH (8.0 to 8.9) have been normal.

This year SA2 had an IBI score of 34 and Poor classification of biological integrity. In previous years this study reach had IBI scores ranging from 40 to 52. This year's score is attributable to high insect family diversity and % predators + shredders, and low percent EPT and sensitive BMIs, biotic index score and non-insects + Diptera.

AT1

AT1 is located in a low gradient section of Atascadero Creek, approximately a half mile downstream of the confluence with Maria Ygnacio Creek and a half mile upstream of its outlet at Goleta Beach. The upstream watershed is approximately 50 percent developed, mostly by suburban and urban uses with some agriculture. AT1 is bordered by a road and open space area to the south, and a bike path/flood control easement and homes to the north. The creek and been widened and straightened, and has earthen banks and a flat bottom composed largely of sand and fine sediments, with scattered deposits of gravel and cobble. The northern bank has a riparian corridor of approximately 30 feet in width, while the riparian corridor along the southern bank is approximately 50 feet wide. The habitat in this study reach has been highly degraded by channelization and routine channel maintenance conducted for flood control purposes. Physical habitat assessment scores have ranged from 60 to 88 in six years of study.

While the riparian canopy is composed mainly of native willows and scattered sycamores and cottonwoods, the understory vegetation is generally dominated by non-native invasive species. Riparian canopy coverage is sparse (27 percent this year) due to the wide channel. Greater solar input causes variable and often elevated stream temperature, which was 17.6 °C this year and as high as 20.7 °C in previous years. Dissolved oxygen concentration has also been variable (1.87 to 12.01 mg/l), causing strain on aquatic vertebrate and invertebrate species. pH has appeared normal (7.7 to 8.7). Conductivity (138 to 2,516 µS) and specific conductance (158 to 2,744 µS) have been variable and often very high at AT1, reflecting pollution inputs from upstream development. Overall, water quality is impaired at AT1, which is expected given the high level of development in the watershed.

This year AT1 had an IBI score of 16 and Very Poor classification of biological integrity, which was a drop from the IBI score of 20 from last year. In years previous to 2005, IBI score ranged from 12 to 16 at this study reach. As in previous years, this site was characterized by low insect family diversity, predators + shredders, biotic index score and percent non-insects + Diptera, and an absence of sensitive BMIs and Percent EPT.

AT2

AT2 is in a low gradient stretch of Atascadero Creek just downstream of the confluence with Cienaguitas Creek, and about a half mile upstream of the confluence with Maria Ygnacio Creek. Compared to AT1, AT2 is much narrower, and has only about one sixth of the watershed area. The watershed of AT2 is approximately 85 percent developed, mostly by residential uses with some commercial uses and agriculture. AT2 is in suburban area, and is tightly abutted by adjacent homes and roads, which extend to the top of the creek banks. Physical habitat conditions at this study reach are very poor, as reflected by physical habitat scores that have ranged from 58 to 92 in six years of study (78 this past year). The creek banks are unstable and actively eroding despite the placement of pipe and wire revetment and concrete rip rap along them. There is noticeable increase in fine sediment deposition, filling pools and covering gravel and cobble riffle areas. Increased fine sediments have allowed cattails and bulrushes to take over much of the creek bottom, reducing the amount of open water habitat. The riparian corridor has been largely eliminated, and is confined to a narrow band of 5 to 10 feet along the creek banks. Vegetated areas along the banks are dominated by non-native vegetation, and riparian canopy cover has been consistently low (23 to 52 percent) even with the narrow creek channel.

Stream temperatures have been moderate at AT2, ranging from 16.3 to 21.4 °C. Dissolved oxygen concentration has been variable (6.03 to 11.57 mg/l) over the years, while pH (7.9 to 8.5) has been fairly consistent and normal for the region. Conductivity (1,402 to 1,917 µS) and specific conductance (1,586 to 2,178 µS) have been high over the years. Overall, water quality is impaired at AT2, which is not surprising considering the high level of development in the watershed.

This year AT2 had an IBI score of 24 and a Poor classification of biological integrity. In previous years IBI score has ranged from 16 to 28 at this study reach. The poor IBI score at this reach is attributable to moderate percent EPT, predators + shredders, biotic index score and percent non-insects + Diptera. Insect family diversity was high at this study reach considering its level of impairment.

SJ2

SJ2 is upstream of SJ1 in a low gradient stretch of San Jose Creek, approximately a half mile upstream of Patterson Rd. and just downstream of the USGS gauging station. This study reach is situated at the interface of upstream agricultural lands (i.e., orchards) and the suburban edge of the City of Goleta. The watershed of SJ2 is approximately 20 percent developed, almost exclusively with orchards and a much smaller proportion of low density residential uses. SJ2 is abutted by a dirt road and homes on the west bank, and orchards on the east bank. Adjacent and upstream land uses have resulted in a moderate to high level of habitat disturbance at this site, as reflected by physical habitat scores that have ranged from 88 to 125 in seven years of study. The creek banks are composed of sand and soil, and are steep, approximately 15 to 20 feet high, and somewhat incised. The banks are unstable and actively eroding in some areas. Stabilization structures including pipe and wire revetment, rip rap, and concrete chunks have been placed in some areas. The creek bottom has alternating shallow riffles with cobble and gravel substrate and sand bottom pools that are between one and three feet deep. The riparian corridor is somewhat narrow and variable in width (approximately 20 to 80 feet) due to encroaching development, but supports many mature sycamores, oaks, cottonwoods, and willows. Understory vegetation is a nearly even mix of native and non-native plant species. Riparian canopy cover is excellent (66-97 percent) in this study reach.

Stream temperature has been variable at SJ2, ranging from 14.4 to 20.5 °C. Dissolved oxygen concentration was very low this year (2.71) compared with six previous years of study (9.99 to 11.02 mg/l). Measured pH (7.9 to 8.4) has been normal for the region. Conductivity (634 to 1,395 µS) and specific conductance (772 to 1,590 µS) have been variable and usually elevated. Water quality is somewhat impaired at SJ2, which is not surprising considering the moderate level of development in the watershed.

This year SJ2 had an IBI score of 22 and a Very Poor classification of biological integrity. In previous years IBI score has ranged from 26 to 40 at this study reach. The IBI score at this reach is attributable to high insect family diversity, moderate biotic index score and % predators + shredders, while percent EPT , percent sensitive BMIs, , and non-insects + Diptera remained low.

SJ3

SJ3 is in a very high gradient stretch of San Jose Creek in a steep narrow canyon with oak forest and chaparral vegetated slopes. The creek is relatively pristine, with only minor human disturbance. The upstream watershed is approximately 95 percent open space wilderness. Human land uses are roads and rural residential, including The San Marcos Trout Club, which is situated adjacent to SJ3 on the eastern side of the canyon, and is made up of approximately 30

homes. Habitat conditions at SJ3 are excellent, as reflected by high physical habitat assessment scores, which have ranged from 168 to 186 in six years of study (168 this year). The stream has natural bedrock and boulder-dominated bed and banks, clean cobble and gravel deposits, well-developed riffles and cascades, and several plunge pools of six to 12 feet in depth. Abundant leaf litter and woody debris are contributed by a mature canopy of native oaks, alders, sycamores, and bays. Native plant species are dominant in the riparian zone, and riparian canopy cover is very high (86 to 97 percent).

Water quality has been good at SJ3, with low temperature (12.0 to 16.2 °C), optimal dissolved oxygen levels (8.20 to 11.02 mg/l), normal pH (7.8 to 8.9), and low conductivity (562 to 735 µS) and specific conductance (716 to 965 µS). The presence of rainbow trout and California newt in large numbers each year at this study reach is an indicator of good water quality and habitat conditions.

This year SJ3 had an IBI score of 38 and Fair classification of biological integrity. IBI score has been very stable at SJ3 in the seven years of study, ranging from 48 to 52 in previous years. This year's score is attributable to high insect family diversity and predators + shredders, moderate percent EPT, biotic index score and percent non-insects + Diptera, with low percent sensitive BMIs.

T2

T2 is in Tecolote Creek just upstream of a residential area adjacent to Vereda Nueva, and approximately one and a half miles upstream of Highway 101. The reach is bordered on both sides by avocado orchards. The watershed of T2 is approximately 18 percent developed, almost exclusively with orchards. Adjacent and upstream land uses have resulted in a moderate to high level of habitat disturbance in this reach, as reflected by physical habitat scores of 81 to 131 in three years of study. The creek is of low gradient in this area, with a channel that meanders through a wide, sandy floodplain. The channel has alternating shallow riffles with cobble and gravel substrate and sand bottom pools that are between one and three feet deep. Creek banks are composed of sand and soil, and are variable in steepness (i.e., from laid back to steep) and height (i.e., from five to 15 feet). Portions of the creek banks are densely vegetated and stable, while others are unstable and actively eroding. The riparian corridor is variable in width (between 30 to 80 feet), having been encroached on by the adjacent orchards. The riparian zone is very densely vegetated however, and supports many mature sycamores, oaks, and willows. Understory vegetation is a nearly even mix of native and non-native plant species. Riparian canopy cover is excellent for a low gradient stream at 73-84 percent.

Typical of low gradient creeks in the study area, T2 has shown relatively warm temperature (18.4 to 25.2 °C), and elevated conductivity (1,043 to 1,673 µS) and specific conductance (1,131 to 1,667 µS). This indicates water quality impairment, which is not surprising considering the moderate level of agricultural development in the watershed. Dissolved oxygen concentration (8.62 to 12.14 mg/l) and pH (8.0 to 8.5) have been normal for the region.

This year T2 had an IBI score of 22 and a Very Poor classification of biological integrity. This year the IBI score for this reach is attributable to moderate insect family diversity, percent EPT, non-insects + Diptera, and predators + shredders, and low percent sensitive BMIs and biotic index score.

AH1

AH1 is in a moderate gradient stretch of Arroyo Hondo, which is among the most pristine streams along the southern Santa Barbara County coast. The upstream watershed is all within a protected nature preserve, and is undeveloped wilderness with the exception of a few dirt trails and roads. A large wild fire on the Gaviota Coast in June 2004 burned about half of the Arroyo Hondo watershed, presumably resulting in increased soil erosion and transport of fine sediments to the creek channel during strong rains the following winter. Despite the fire, the creek channel was not unusually high in fine sediments at the time of the 2005 field survey, nor since. Habitat conditions at AH1 remain optimal, as reflected a physical habitat assessment score of 173 this year. Habitat scores ranged from 168 to 188 in six previous years of study. AH1 has natural boulder-dominated bed and banks, clean cobble and gravel deposits, well-developed riffles and cascades, and pools of varying sizes and depths of up to four feet. Abundant leaf litter and woody debris are contributed by a mature canopy of native oaks, alders, sycamores, and bays. Native plant species are dominant in the riparian zone and riparian canopy cover is very high (96 to 100 percent).

Considering the absence of watershed development, it is not surprising that water quality has been very good at AH1, with low to moderate temperature (11.6 to 18.4 °C), optimal dissolved oxygen levels (7.05 to 10.10 mg/l), normal pH (7.5 to 8.8), and low conductivity (603 to 887 µS) and specific conductance (730 to 1,071 µS). The presence of rainbow trout and California newt in large numbers each year at this study reach is an indicator of excellent water quality and habitat conditions.

This year AH1 had an IBI score of 44 and Fair classification of biological integrity. This was a dramatic decrease from the perfect IBI score of 60 and Excellent classification last year, presumably due to decreased flow. In seven years of study, IBI score has ranged from 36 to 60 and classification of biological integrity from Fair to Excellent at this study reach, with a perfect score of 60 in three of the years. This years IBI score is attributable to high insect family diversity, percent EPT, biotic index score, and predators + shredders, and moderate sensitive BMIs and percent non-insects + Diptera.

GAV1

GAV1 is in Gaviota Creek at Gaviota State Beach, approximately a quarter mile from the ocean. This is a wide, low gradient stream with a wide floodplain, sandy banks and a somewhat braided channel. Highway 101 winds through Gaviota Canyon, crossing the creek in several locations upstream of GAV1. The watershed of GAV1 has only minimal urban development in the form of roads and rural residencies, but approximately 40 percent of the area is used for cattle grazing. Approximately 60 percent of the watershed is undisturbed wilderness. The wildfire in June 2004 burned much of the watershed, resulting in increased soil erosion and transport of fine sediments to the creek during strong rains the following winter. Sand deposition in the creek channel was noticeably increased in 2005 compared to the last survey in 2003, burying much of the cobble and gravel substrate that previously was exposed in riffles, and filling in pools that were once deeper. This factor resulted in a much lower physical habitat assessment score for GAV1 in 2005 (115) compared to 2003 (157) and 2002 (140). The creek appears to be recovering from this impairment with a higher physical habitat score of 131 this year.

The riparian corridor in GAV1 is wide and largely undisturbed on the west side, and supports many mature willows with scattered sycamores and cottonwoods. Riparian vegetation is similar in composition on the east side, but has been reduced to 50-100 feet in width by the Gaviota

State Beach access road and U.S. 101. The riparian understory is a mix of native and non-native plants. Riparian canopy cover was non-existent in 2005 due to the wide creek channel and dominance of short willows. The willows grew enough for a 42 percent canopy cover of this year.

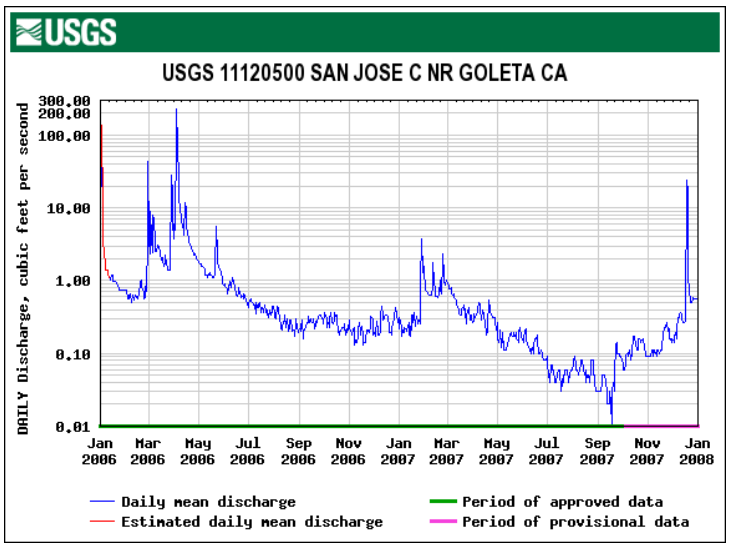
Stream temperature has been low to moderate at GAV1, ranging from 15.4 to 19.1 °C. Dissolved oxygen concentration (6.73 to 11.71 mg/l) and pH (8.1 to 8.6) have been normal for the region. Conductivity (1,006 to 1,434 µS) and specific conductance (1,240 to 1,617 µS) have been moderate to high. Elevated conductance is probably due to a combination of naturally hard ground water in the watershed, and polluted runoff from U.S. 101 and rural residences.

This year GAV1 had an IBI score of 36 and a Fair classification of biological integrity. Previous scores were 42 and Fair in 2003, 38 and Fair in 2005, and 32 and Poor in 2006. The higher score this year is due to high insect family diversity, percent EPT, and percent non-insects + Diptera and low biotic index score and percent sensitive BMIs.

Overall Trends

Last year (2006), there were notable differences in BMI community structure compared to previous years, namely higher percent EPT, higher biotic index scores, higher percentage of non-insects and Dipterans, and higher percentage of sensitive BMIs. These changes were presumably due lower flows from unusually light storm flows in local creeks this winter. The changes in BMI community composition had an affect on IBI scores, which tended to be lower at minimally disturbed study reaches (i.e., C3, SJ3, AH1) and highly disturbed study reaches (i.e., C1, AT1, and AT2) compared to the previous year. Lower stream flows can drastically affect aquatic life (e.g., algae, BMIs, fish, etc.) residing there, as well as Habitat Assesment Scores.

This past winter, storm flows in local creeks were not as intense as in 2006. Peak daily discharge this past winter at the USGS stream flow gauge in San Jose Creek just upstream of study reach SJ2 was approximately 4 cubic feet per second (cfs), and 100 cfs was never exceeded, as compared with twice the prior winter (see Figure 2).



The spread in IBI scores between minimally disturbed study reaches (i.e., C3, SJ3, AH1) and highly disturbed study reaches (i.e., C1, AT1, and AT2) narrowed this year compared to last year. The average IBI score for C3, SJ3, and AH1 was 45 this year, compared to 55 last year. The average IBI score for C1, AT1, and AT2 was 18 this year, compared to 26 last year. Classifications of biological integrity were again consistent with the ranges established for the individual study reaches in previous years, despite the environmental fluctuations that have occurred through time.

VII. Recommendations

Continued study is needed to monitor the biological integrity of local creeks, and help determine the effectiveness of creek restoration efforts. The combined bioassessment efforts of the County of Santa Barbara and City of Santa Barbara provide a good data set representing study reaches with a full range of stressors (i.e., agricultural, suburban, and urban uses) and impact intensity (i.e., from minimally to highly degraded), so additional study reaches are not necessary at this time. After perhaps another year or two of additional study, the IBI scoring system should be revisited and refined in light of the additional data collected.

VIII. References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Creeks and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition, EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

Burt, W.H., and R.P. Grossenheider. 1976. A Field Guide to the Mammals, North America North of Mexico. Third Edition. Houghton Mifflin Company. Boston, New York.

California Department of Fish and Game, Aquatic Bioassessment Laboratory. 2002. List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort. Revised April 30, 2002.

Cooper, S.D., Dudley T.L., and N. Hemphill. 1986. The Biology of Chaparral Streams in Southern California. Proceedings of the Chaparral Ecosystems Research Conference, May 16-17, 1985, Santa Barbara, California. California Water Resources Center, University of California Santa Barbara. Report No. 62. June, 1986.

County of Santa Barbara, Project Clean Water. 2002. Santa Barbara County Coastal Creeks Bioassessment Program, Annual Report, Year 2001.

Dale, N. 1986. Flowering Plants, the Santa Monica Mountains, Coastal and Chaparral Regions of Southern California. Published by Capra Press in cooperation with the California Native Plant Society.

Ecology Consultants, Inc. 2004. Santa Barbara County Creeks Bioassessment Program, 2003 Annual Report and Index of Biological Integrity.

Hickman, J.C. 1993. The Jepson Manual, Higher Plants of California. University of California Press. Berkeley, CA.

McAuley, M. 1996. Wildflowers of the Santa Monica Mountains. Second Edition. Canyon Publishing Company. Canoga Park, California.

Merritt, R.W. and K.W. Cummins. 1996. An Introduction to the Aquatic Insects of North America, Third Edition. Kendall/Hunt Publishing Company.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press.

Peterson, R.T. 1990. A Field Guide to Western Birds. Third Edition. Houghton Mifflin Company. Boston, New York.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Second Edition. Houghton Mifflin Company. Boston, New York.

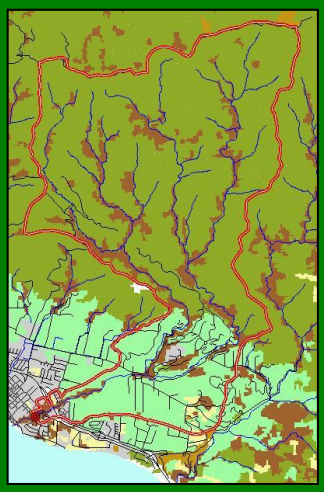
Stewart, B.P. and C.R. Nelson. 1994. Nymphs of North American Stonefly Genera (Plecoptera). University of North Texas Press. Denton, Texas.

United States Geological Survey. Various dates. 7.5 minute quadrangle topographic maps.

Appendix 3-D: South Coastal Santa Barbara County Creeks Bioassessment Program, 2009 Report and Updated Index of Biological Integrity

SOUTHERN COASTAL SANTA BARBARA CREEKS BIOASSESSMENT PROGRAM

2009 REPORT AND UPDATED INDEX OF BIOLOGICAL INTEGRITY



APRIL 2010

<u>Prepared for</u>:

City of Santa Barbara,
Creeks Division

County of Santa Barbara,
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Executive Summary

Introduction

This report summarizes the results of the 2009 Southern Coastal Santa Barbara Creeks Bioassessment Program, an effort funded by the City of Santa Barbara and County of Santa Barbara. Ecology Consultants, Inc. (Ecology) prepared the report, and serves as the City and County's consultant for the Program. The purpose of the Program is to assess and monitor the biological integrity of creeks in the study area as they respond through time to natural and human influences. The Program involves annual collection and analysis of benthic macroinvertebrate (BMI) samples and other pertinent physiochemical and biological data in study creek reaches using U.S. Environmental Protection Agency (USEPA) endorsed rapid bioassessment techniques. BMI samples are analyzed in the laboratory to determine BMI abundance, composition, and diversity.

This report presents data collected in 2009 and previous years, and an updated Index of Biotic Integrity (IBI) for streams in the study area. The updated IBI was developed by Ecology using the 10 years of Program data from 2000 to 2009. The previous IBI was developed in 2003 using four years of Program data (2000 to 2003). The IBI is a system that yields a numeric score and classifies the biological integrity of a given stream as Very Poor, Poor, Fair, Good, or Excellent based on the BMI community present in the stream, as determined by completing a bioassessment survey and associated laboratory and analytical work. Several "core BMI metrics" are calculated and used to determine the IBI score. Ideally, core metrics are highly sensitive to human disturbance, and collectively represent different aspects of BMI community structure including diversity, community composition, and trophic group representation. By condensing complex biological data into an easily understood score and classification of biological integrity, the IBI serves as an effective tool for the City and County in monitoring the overall condition of local creeks, and taking appropriate watershed management actions.

Study Area

The study area encompasses approximately 60 km of the southern Santa Barbara County coast from the Rincon Creek watershed at the Santa Barbara/Ventura County line west to Gaviota Creek. There are approximately 40 1st to 5th order coastal streams along this stretch of coast, all of which drain the southern face of the Santa Ynez Mountains. A total of 49 stream study reaches in 20 watersheds have been surveyed on one or more occasions during the springs and summers from 2000 to 2009. 24 stream study reaches were surveyed this year.

Methods

Physiochemical and biological data for the study reaches was gathered through a combination of methods including field surveys, laboratory analyses, spatial data analyses using geographic information system software, and review of United States Geological Survey (USGS) 7.5-minute quadrangle maps and recent aerial photographs. Numerous physiochemical and BMI parameters were calculated for each study reach based on the data collected.

Study reaches were separated into three groups based on physiochemical parameters including watershed land use patterns and physical habitat assessment score:

- REF (undisturbed to lightly disturbed by human development)
- MOD DIST (moderately disturbed by human development)
- HIGH DIST (highly disturbed by human development)

Statistical tests including analysis of variance (ANOVA) and linear regression were used to evaluate the data, including for differences in BMI metrics between the three study reach groups described above. The updated IBI was developed based on the statistical analyses.

Results and Discussion

Using the results of the statistical analyses, seven core BMI metrics were selected for inclusion in the updated IBI:

- # of insect families
- # of EPT families
- % EPT minus Baetidae
- % PT
- Tolerance value average
- % sensitive BMIs
- % predators + shredders

The core metrics were among the most sensitive to human disturbance among all the metrics tested, either increasing or decreasing from HIGH DIST to MOD DIST to REF groups. None had significant natural relationships with the group of physiochemical parameters among the REF sites. Collectively, the core metrics are diversified in that they represent different aspects of BMI community structure including diversity, disturbance sensitivity, and trophic structure. Scoring ranges for the core metrics and classifications of biotic integrity are provided in the report.

IBI scores were calculated for the study reaches, and classifications of biological integrity were compared to the *a priori* (i.e., prior to analyses of BMI metrics) designations as REF, MOD DIST, or HIGH DIST. The accuracy of the IBI in classifying biological integrity was determined to two and three classes of biological integrity using a Validation Set of 37 study reaches that were not used to develop the IBI. The IBI was accurate 81 percent of the time to two classes and 100 percent of the time to three classes of biological integrity for the Validation Set. These results indicate that the IBI is mostly reliable in classifying the biological integrity of streams in the study area. ANOVA and regression analyses results indicate highly significant relationships between IBI score and human disturbance metrics representing watershed land use patterns and localized physical habitat conditions.

Recommendations

The updated IBI is based on a set of streams that collectively represent a wide range of natural physiochemical variability and levels of human disturbance. In addition, significant fluctuations in rainfall and peak stream flow from year to year and their effects on the BMI communities of

study area streams have been documented over the past 10 years. This has allowed for the development of an IBI that serves as a very reliable tool for classifying the biological integrity of streams in the study area, monitoring their condition through time, and identifying any changes that may occur in the future from increased development, habitat restoration projects, and even long term climatic changes (e.g., global warming).

There are ways in which the collective data set could be diversified, for example by including some of the streams in the study area that have not yet been surveyed, and expanding the study area further west and north to the Hollister and Bixby Ranch areas, Point Conception, Santa Ynez River watershed, etc. The IBI should be updated every 5 to 10 years to account for the greater range of conditions observed.

The updated IBI represents an excellent tool for assessing and monitoring the biological condition of freshwater streams in the study area. However, there is no equivalent tool for estuarine waters in the study area, which could be assessed using similar bioassessment methodology as used in this Program. IBIs have been produced for estuarine waters in many regions, and with adequate data one could be produced in the study area as well. Given the ecological importance of estuarine waters, and their importance as they relate to commercial and recreational uses and the local economy, the City and County should consider implementing an estuarine bioassessment program if funding allows.

Acknowledgement

Special thanks go to Scott Cooper, Professor of Aquatic Biology at the University of California, Santa Barbara for reviewing this report and the Updated IBI, and for his invaluable input throughout the 10 years of this bioassessment program.

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I. Introduction

This report summarizes the results of the 2009 Southern Coastal Santa Barbara Creeks Bioassessment Program, an effort funded by the City of Santa Barbara and County of Santa Barbara. 2009 is the 10th year of the Program, which began in 2000. Ecology Consultants, Inc. (Ecology) prepared the report, and serves as the City and County's consultant for the Program. The purpose of the Program is to assess and monitor the "biological integrity" of southern coastal Santa Barbara County creeks as they respond through time to natural and human influences. Karr and Dudley (1981) defined biological integrity as "the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region." (Miller et al., 1988). "Bioassessment" is the science of assessing the biological integrity of aquatic ecosystems by evaluating the biological assemblages (e.g., benthic macroinvertebrates, fish, amphibians, diatoms, etc.) that inhabit them. Because different species or groups of species (i.e., genera, families, orders, etc.) have varying habitat requirements and abilities to withstand water pollution and other forms of habitat degradation, the presence, abundance, or absence of particular species or groups of species provides information regarding the biological integrity of a particular water body. In addition, measurements of biological community structure relating to overall abundance, diversity, and trophic structure have proven to be reliable indicators of biological integrity in water bodies (Rosenberg and Resh, 1993, Barbour et al., 1999).

The Program involves annual collection and analysis of benthic macroinvertebrate (BMI) samples and other pertinent physiochemical and biological data in study creek reaches using U.S. Environmental Protection Agency (USEPA) endorsed rapid bioassessment techniques. BMI samples are analyzed in the laboratory to determine BMI abundance and composition. This report presents data collected in 2009 and previous years.

This report also presents an updated Index of Biotic Integrity (IBI) for streams in the study area, which was developed using data from a wide range of study reaches surveyed from 2000 to 2009. The IBI provides a numeric score and classification of biological integrity of a given stream as Very Poor, Poor, Fair, Good, or Excellent. Determination of the IBI score of a given study reach starts with collection of BMI samples during a bioassessment survey. Laboratory and analytical work are completed to determine BMI abundance and taxonomic composition. The BMI data is used to calculate several "core metrics", which are the basis of the IBI scores and classifications. Ideally, core metrics are highly sensitive to human disturbance, and collectively represent different aspects of BMI community structure including diversity, community composition, and trophic group representation. By condensing complex biological data into an easily understood score and classification of biological integrity, the IBI serves as an effective tool for the City and County in monitoring the overall condition of local creeks, and making appropriate creek and water quality management decisions.

The IBI was updated to use the considerable data set now available, which collectively represents wide variability in physiochemical conditions, human impacts, and year to year fluctuations in rainfall and stream flow patterns. The current data includes surveys conducted during several drought years and wetter years, including one of the wettest rainfall years on record (2005). Because year to year variability in rainfall and stream flow has been linked to considerable differences in BMI community structure, the updated IBI is more representative of

the full range of the BMI community compared to its predecessor, which was produced in 2003 using the first four years of data (i.e., 2000 to 2003). More discussion of the IBI and its development is provided in III. Methods.

II. Study Area

The study area encompasses approximately 60 km of the southern Santa Barbara County coast from the Rincon Creek watershed at the Santa Barbara/Ventura County line west to Gaviota Creek (see Figure 1). There are approximately 40 1st to 5th order coastal streams along this stretch of coast, all of which drain the southern face of the Santa Ynez Mountains. A total of 47 stream study reaches in 20 watersheds have been surveyed on one or more occasions during the springs and summers from 2000 to 2009. Table 1 lists the study reaches and their locations.

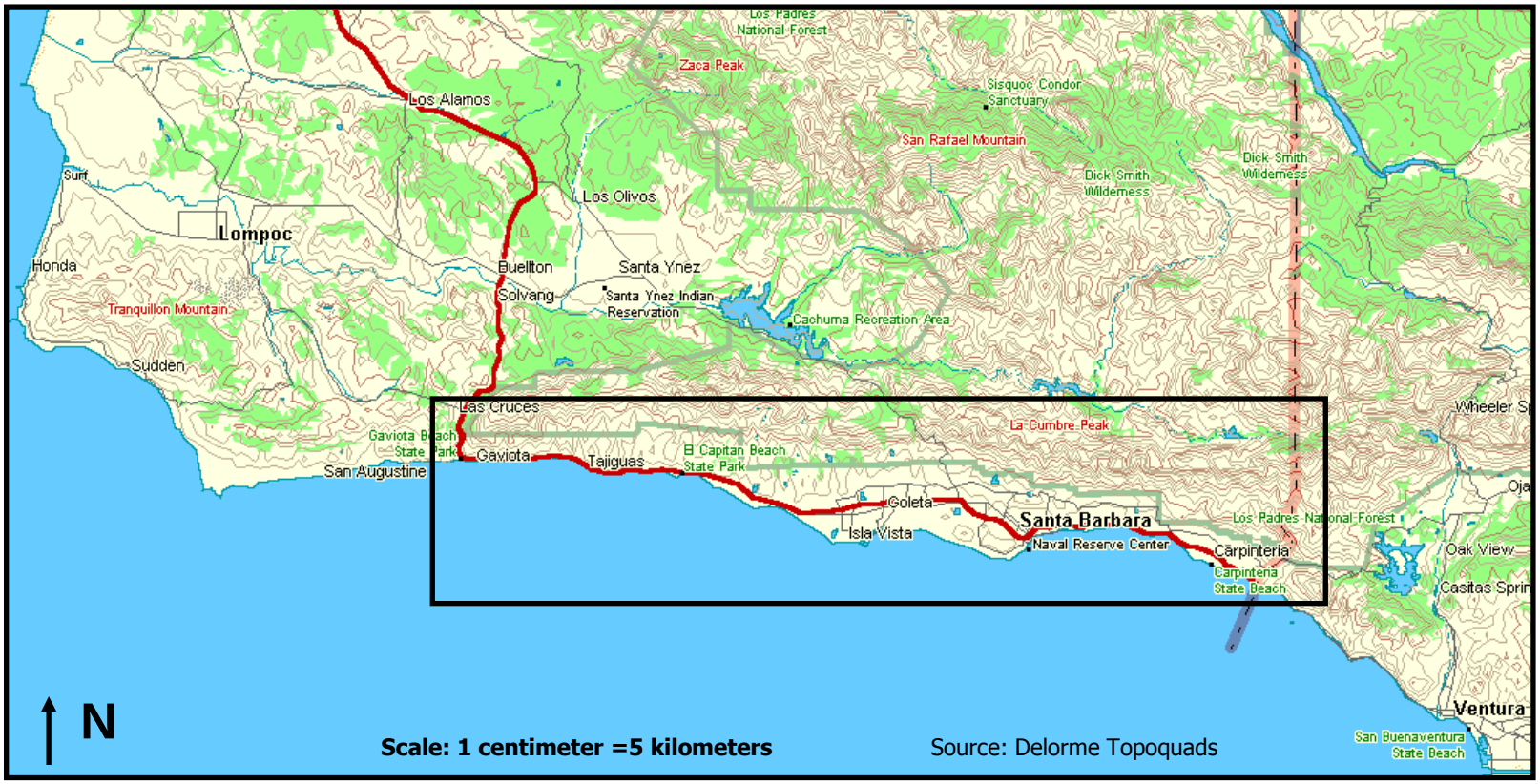
Table 1: Study Reaches

Study Reach	Location
RIN0	Rincon Creek just upstream of Rincon Rd. crossing
RIN1	Rincon Creek, just upstream of Highway 150 crossing at Gobernador Cyn Rd.
C1	Carpinteria Creek, 0.25 mi. downstream of Carpinteria Ave.
C2	Carpinteria Creek, approx. 0.25 mi. upstream of U.S. 101
C3	Gobernador Creek, approx. 0.25 mi. upstream of County detention basin
F1	Franklin Creek just upstream of entrance into Carpinteria Salt Marsh
SM1	Santa Monica Creek just upstream of entrance into Carpinteria Salt Marsh
MONT1	Montecito Creek at Val Verde prop., below Hot Springs/Cold Springs confluence
MONT2	Montecito Creek just upstream of Hot Springs/Olive Mill Rd.
SY1	Sycamore Creek just below Mason St. bridge
SY2	Sycamore Creek just below Highway 192 crossing and Coyote/Sycamore confluence
SY3	Sycamore Creek 300m below Highway 192 crossing and Coyote/Sycamore confluence
M1	Mission Creek at De la Guerra St.
M2	Old Mission Creek at Bohnet Park
M3	Mission Creek at upstream end of Rocky Nook Park
M4	Rattlesnake Creek, approx. 0.5 mi. upstream of Las Canovas Rd. crossing
M6	Mission Creek, at three falls above Jesuita Trail crossing
M7	Old Mission Creek just downstream of Anapamu St.
AB1	Arroyo Burro at upstream end of Alan Rd.
AB2	Arroyo Burro just downstream of Torino Rd.
AB3	San Roque Creek, 0.25 mi. upstream of Foothill Rd.
AB4	San Roque Creek just upstream of the confluence with Arroyo Burro
AB5	Mesa Creek at entrance to Arroyo Burro estuary
AB6	Arroyo Burro just downstream of U.S. 101
AT1	Atascadero Creek near Patterson Rd.
AT2	Atascadero Creek just downstream of Cieneguitas Creek confluence

Table 1: Study Reaches	
SA1	San Antonio Creek, approx. 0.5 mi. upstream of Tucker's Grove Park
SA2	San Antonio Creek, approx. 0.25 mi. upstream of Highway 154
MY1	Maria Ygnacio Creek, approx. 0.25 mi. below San Marcos Rd. crossing
MY2	Maria Ygnacio Creek, approx. 0.25 mi. upstream of FC detention basin
MY3	Maria Ygnacio Creek, approx. 0.25 mi. upstream of Highway 154
SJ1	San Jose Creek, approx. 0.25 mile downstream of U.S. 101
SJ2	San Jose Creek, approx. 0.25 mile upstream of Patterson Rd. crossing
SJ3	San Jose Creek at San Marcos Trout Club
T1	Tecolote Creek, approx. 50 meters upstream of Vereda del Padre
T2	Tecolote Creek, adjacent to Vereda Nueva
T3	Tecolote Creek, 100 m downstream from Vereda Parque access
DP1	Dos Pueblos Creek, approx. 50 meters downstream of U.S. 101
EC1	El Capitan Creek in State Park, approx. 100 meters upstream of mouth
R1	Refugio Creek, approx. 1.5 mi. upstream of U.S. 101
R2	Refugio Creek, approx. 0.25 mi. downstream of Circle Barbee Ranch
AH1	Arroyo Hondo, approx. 1 mi. upstream of U.S. 101.
AH2	Arroyo Hondo, approx. 2 mi. upstream of U.S. 101.
SO1	San Onofre Creek, just below U.S. 101 culvert
SO2	San Onofre Creek, approx. 1 mi. upstream of U.S. 101
GAV1	Gaviota Creek at State Beach/Park, just below access rd./US 101 junction
GAV2	Gaviota Creek, 200 meters downstream of Las Canovas Creek confluence

The study reaches range from narrow mountain tributaries to wider lowland streams, and from relatively pristine to highly disturbed. Common human impacts observed in study streams include: (1) altered hydrology and geomorphology due to water diversions, land development, and flood control projects; (2) sedimentation of pool and riffle substrata due to increased deposition of fine sediments from actively eroding agricultural fields and creek banks; (3) degraded water quality due to inputs of fertilizers, pesticides, petroleum hydrocarbons, heavy metals, and other pollutants; (4) elevated stream temperatures due to drainage from impervious surfaces and the removal of riparian vegetation; (5) habitat fragmentation due to the construction of in-stream barriers such as dams, road crossings, bridges, and culverts; (6) introductions of invasive, non-native plants and animals; and (7) disturbances to vegetation and/or wildlife associated with trampling, noise, lighting, air pollution, and predation by domestic pets.

FIGURE 1: STUDY AREA



III. Methods

Physiochemical and biological data for the study reaches was gathered through a combination of methods including field surveys, laboratory analyses, spatial data analyses using geographic information system (GIS) software, and review of United States Geological Survey (USGS) 7.5-minute quadrangle maps and recent aerial photographs. Numerous physiochemical and biological parameters were calculated for each study reach based on the data collected. After the data set was finalized, statistical tests including analysis of variance (ANOVA) were used to evaluate the data, and the IBI was developed. Further discussion of methods is provided below.

A. Field Surveys

As in previous years of the Program, field surveys were conducted in the spring during base stream flow conditions (i.e., low flows). The sampling was conducted in early May of 2009 by Ecology, City of Santa Barbara, and County of Santa Barbara staff. Sampling in the spring during base flow conditions provides consistency in the sampling from year to year, as the local stream biota is known to undergo seasonal succession (Cooper et al., 1986). The following was completed during each field survey:

- General observations were recorded on a standardized field data sheet, including location, date, time, weather, stream flow conditions, water clarity, and human impacts.
- A 100-meter study reach was delineated along the stream. Stream habitat units (i.e., riffles, runs, pools, etc.) within the study reach were mapped and quantified as a percentage of the total reach length.
- GPS coordinates were determined at the downstream end of each study reach using a Garmin E-Trex Venture handheld GPS unit.
- Stream widths (wetted perimeter, channel bottom, and bank full) were measured at three transects in the study reach. Wetted perimeter width is defined as the cross-sectional distance of streambed that is inundated with surface water. Channel bottom width is defined as the cross-sectional distance between the bottoms of the stream banks. Bank full width is defined as the distance from the ordinary high water mark from one stream bank to the other, as evidenced by visible signs of stream flow such as water marks, stream-carried deposits of sediments and debris, and scour features.
- Riparian canopy cover was estimated in the center of the stream channel at the three transects using a spherical densitometer.
- Plant and wildlife species observed in the creek and riparian zone were noted.
- Water temperature, specific conductance, pH, and dissolved oxygen concentration were measured in the field using YSI and Oakton handheld meters. Two measurements of each parameter were made, one in a riffle and the other in a pool, and the two values were averaged.
- BMI samples were collected using a standardized method based on the "multi-habitat" approach described in the USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour et al., 1999). Three samples were collected per study reach: one

sample from the downstream third of the reach, one from the middle third, and one from the upstream third. Each sample represents approximately one square meter of stream bottom, collected from 10 individual, 0.1-square meter locations (approximately 30 centimeters square). The 10 locations that constituted each sample were selected based on the relative area each stream habitat (i.e., riffles, pools, falls, etc.) covered in the section of stream sampled. For example, if a given stream reach contained approximately 50 percent riffles and 50 percent pools, five locations in riffles and five in pools were selected and sampled. Samples were collected using a D-frame net with 500 μm mesh. In locations with flowing water (e.g., riffles and runs), the net was held upright against the stream bottom, and substrata immediately upstream within the 0.1-square meter area was scraped and stirred up for approximately 15 seconds using feet and hands. Dislodged BMIs and stream bottom materials were carried into the net by the stream current. In areas with little or no current (e.g., pools), stream bottom material was stirred up by foot, followed by a quick sweep of the net through the water column to capture dislodged BMIs. This was repeated three times in each pool sampling location.

- After each BMI sample was collected, it was rinsed with water in a 500 μm sieve to wash out fine sediments, transferred to a plastic container, and preserved in 70 percent ethanol.
- A semi-quantitative stream habitat assessment was conducted using the protocol provided in the USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers*. Per this protocol, habitat components were visually assessed and scored, including stream substrate/cover, sediment embeddedness, stream velocity/depth regime, sediment deposition, channel flow status, human alteration, channel sinuosity, habitat complexity/variability, bank stability, vegetative protection, and width and composition of riparian vegetation. Each study reach was assigned a total score of between zero and 200 based on the sum of scores assigned to each habitat component. Criteria from the USEPA protocol were used to guide the scoring.
- Quality control measures were incorporated into the field surveys to insure accurate and consistent data gathering. Water monitoring equipment was calibrated regularly. Field crew members were trained to properly operate equipment, take measurements, collect BMI samples, and conduct stream habitat assessments. Stream habitat assessment scoring was done as a group by the field crew.

B. Laboratory Analyses

BMI samples were processed in the laboratory to determine BMI community composition (i.e., taxa present and relative abundance) and overall density. Each BMI sample was strained through a 500-μm mesh sieve and washed with water to remove ethanol and fine sediments. The sample was placed in a plastic tray marked with equally-sized squares in a grid pattern. The entire sample was spread out evenly across the squares. Squares of material were randomly selected, and sorted one at a time under a dissecting microscope (7X to 50X magnification) until a specified number of BMIs were located and picked out. The proportion of the sample sorted was noted. 110 specimens were picked out from each sample (i.e., three samples, 330 BMIs per study reach). 100 of the 110 BMIs picked from each sample (300 total per study reach) were randomly selected for identification. BMIs were identified using standard taxonomic keys. Insect taxa were identified to the family level. Non-insect taxa (e.g., oligochaetes, crustaceans, etc.) were identified to order or class. After processing and

identification, sorted BMIs and sample remnants were bottled separately in 70 percent ethanol for storage.

Quality control measures were incorporated into the laboratory analysis to ensure random selection and accurate enumeration and identification of BMIs. BMI sample processing methods were clearly established and strictly followed.

C. GIS Analyses

GIS Arcview software was used to calculate upstream watershed area and watershed land use coverages for each study reach. Watershed area was calculated based on watershed boundaries generated by the GIS with a 30 meter digital elevation model using hydrologic processing tools in Arcview GIS. Watershed land use coverages for each study reach were calculated by superimposing watershed boundaries over a digital land cover GIS layer for the region. The land cover layer was produced the California Department of Forestry and Fire Protection's (CDF) Fire and Resource Assessment Program (FRAP). The land cover layer is titled LCMMP Vegetation Data, 1994 to 1997. The CDF land use map for the region showed coverage by the following eight land use categories: urban, agriculture, herbaceous, hardwood, shrub, conifer, water, and barren/other. Recent aerial photographs (i.e., 2008 and 2009) of the region available on Google Earth were reviewed to check the accuracy of the GIS land use layer. The GIS and aerial photograph land use maps were in close agreement, and only minor adjustments to the GIS-based calculations were necessary.

The parameter "percent watershed disturbed" was calculated for each study reach by using the following equation:

Percent watershed disturbed = percent urban + percent agriculture + 0.5(percent herbaceous)

Herbaceous areas were counted as partially (i.e., half) disturbed to reflect that much of the herbaceous lands in this region are used for livestock grazing or are previously cleared land.

D. Review of Topographic Maps

USGS 7.5 minute quadrangle topographic maps (1:24,000 scale) for the study area were reviewed to determine stream order, elevation, and gradient for each study reach. Gradient was determined by dividing the elevation change between topographic contours immediately upstream and downstream of the study reach by the stream length between the contours. Stream length was determined by tracing a map wheel over the stream path.

E. Study Reach Grouping

The study reaches were placed into three different groups based on their perceived level of human disturbance. These disturbance groups were assigned to study reaches "a priori" (i.e., before the analyses of biological data) based on physical habitat assessment scores and GIS data on watershed land uses. The following criteria were used to group the study reaches:

REF = Reference stream reaches are minimally disturbed by human activities. Habitat assessment score was 150 out of 200 or greater, and five percent or less of the upstream watershed was disturbed.

MOD DIST = Stream reaches that are lightly to moderately disturbed by human activities. Habitat assessment score was between 120 and 149. This category also includes

stream reaches with a habitat assessment score of 150 or greater, but with greater than five percent of the upstream watershed disturbed.

HIGH DIST= Stream reaches that are heavily disturbed by human activities including agricultural and urban/suburban land uses. Habitat assessment score was less than 120.

F. Calculation of Physiochemical Parameters and BMI Metrics

Numerous physiochemical parameters and BMI metrics were calculated for each study reach using the data collected. Table 2 lists each parameter calculated for the study reaches and the method of calculation (e.g., lab, field, etc.).

Table 2
Physiochemical Parameters and BMI Metrics Calculated for Each Study Reach

Parameters	Units of Measurement	Method of Calculation
PHYSICAL PARAMETERS		
Stream order	None	USGS Quad Maps
Elevation	Feet (ft.)	USGS Quad Maps
Stream gradient	None	USGS Quad Maps
Watershed area	Acres	GIS
Percent of watershed area disturbed	None	GIS
Wet stream width	Ft.	Field
Habitat assessment score	None	Field
Percent riparian canopy cover	None	Field
WATER CHEMISTRY PARAMETERS		
Stream temperature	Degrees Celsius (°C)	Field
Ph	None	Field
Dissolved oxygen concentration	Milligrams per liter (mg/l)	Field
Conductivity	Microsiemens (µS)	Field
Specific conductance (corrected to 25° Celsius)	µS	Field
BIOLOGICAL PARAMETERS		
BMI density	# per sq. meter (#/m^2)	Field/lab
# of insect families	None	Field/lab
# of Ephemeroptera/Plecoptera/Tricoptera (EPT) families	None	Field/lab
Percent EPT	None	Field/lab
Percent EPT minus Baetidae	None	Field/lab
Percent Plecoptera/Tricoptera (PT)	None	Field/lab
Percent Coleoptera	None	Field/lab
Tolerance value average	None	Field/lab
Percent sensitive BMIs	None	Field/lab
Percent tolerant BMIs	None	Field/lab
Percent non-insect BMIs	None	Field/lab
Percent non-insects + Diptera	None	Field/lab
Percent non-insects + Chironomidae	None	Field/lab
Percent collector-gatherers	None	Field/lab
Percent scrapers	None	Field/lab
Percent shredders	None	Field/lab
Percent collector-filterers	None	Field/lab
Percent predators	None	Field/lab
Percent predators + shredders	None	Field/lab

Table 2
Physiochemical Parameters and BMI Metrics Calculated for Each Study Reach

Percent scrapers + shredders	None	Field/lab
Percent scrapers + shredders + predators	None	Field/lab
Percent collector-gatherers + scrapers + shredders	None	Field/lab
Percent collector-gatherers + collector-filterers	None	Field/lab
Percent collector-gatherers + predators	None	Field/lab

Numerous BMI metrics were calculated for each study reach to reflect different aspects of community structure, including overall BMI density, richness, composition (i.e., taxa present), the relative and absolute abundances of component taxa or groups, trophic group representation, and sensitivity to human disturbance. BMI metrics for each study reach were calculated by combining the data from the three samples.

BMI density (number of individuals per m^2) was calculated by dividing the number of specimens picked out of the sample by the sub sampled area. Richness parameters were determined by counting the number of specified taxa identified in each sample. Functional feeding group parameters (e.g., percent collector-gatherers, % scrapers, etc.) were determined using functional feeding group designations for individual taxa provided in Merritt and Cummins (1996).

Tolerance value averages, percent sensitive BMIs, and percent tolerant BMIs were calculated using disturbance tolerance values for individual BMI taxa provided in *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort* (California Department of Fish and Game, 2002). This document assigns tolerance values to individual taxa ranging from 0 to 10 based on their perceived ability to withstand human disturbance. A tolerance value of 0 indicates that a particular BMI is extremely intolerant of human disturbance, with increasing scores indicating greater tolerance to human disturbance. Composite tolerance value averages were calculated by adding the tolerance values for each BMI in the sample, and dividing by the total number of individuals. Percent sensitive BMIs was calculated by adding the number of BMIs in the sample with a tolerance value of 2 or less, dividing by the total number of individuals in the sample, and multiplying by 100. Percent tolerant BMIs was calculated by adding the number of BMIs in the sample with a tolerance value of 8 or greater, dividing by the total number of individuals in the sample, and multiplying by 100. Tolerance values were available for more than 95 percent of the taxa collected. BMIs without tolerance values were excluded from the calculations of tolerance value averages, percent sensitive BMIs, and percent tolerant BMI taxa.

G. Development of New Tolerance Values for Study Area BMI Taxa, and New Tolerance Value Average, Percent Sensitive BMIs, and Percent Tolerant BMIs Metrics

In completing 10 years of the Program, it has become apparent that tolerance values assigned to some of the individual BMI taxa in the *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort* do not agree with the occurrences observed in the study area. As an example, the mayfly family Caenidae is assigned a relatively high tolerance value of 7, yet it is rarely observed in significant numbers in highly disturbed creeks in the study area, and is

often observed in significant numbers in minimally and moderately disturbed creeks. In an attempt to refine the accuracy of the tolerance value average, tolerance values specific to the study area were developed using the data from all study reaches surveyed in four or more years. This included data from 153 surveys.

Tolerance values were determined for all BMI taxa having a mean abundance of at least one individual per study reach in at least one of the study reach groups (REF, MOD DIST, and/or HIGH DIST). For BMI taxa not meeting these criteria, tolerance values from *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort* were retained.

In order to evaluate their sensitivity to human disturbance, all qualifying BMI taxa were evaluated for differences between the REF, MOD DIST, and HIGH DIST study reach groups using analysis of variance (ANOVA). The results of the ANOVA tests were used to assign new tolerance values to the qualifying BMI taxa. An ANOVA test compares the means and distributions of a given metric among multiple sampling groups, and indicates the probability that the means for the groups are the same. The probability that the means are the same is expressed as p, which is between 0 and 1. The lower the p, the lower the probability is that the group means are the same. A p of 0.05 or less is generally accepted as indicating a statistically significant difference between group means. Rules for setting the new tolerance values are provided in Figure 2.

The revised tolerance values were used to calculate new versions of the tolerance value average, percent sensitive BMIs, and percent tolerant BMIs. The new version of percent sensitive BMIs was further revised to include BMIs with a tolerance value of 3 or less, while the new version of percent tolerant BMIs was revised to include those with a tolerance value of 7 or greater.

H. Development of the Updated IBI

Developing the updated IBI required the completion of several distinct steps, including (1) selection of study reaches to be included in the IBI test group and those to be included in a separate validation group, (2) screening and selection of core metrics, (3) defining scoring ranges for core metrics, (4) defining IBI scoring categories and ranges, and (5) testing the IBI for accuracy in classifying the biological integrity of individual study reaches. These steps are discussed below.

1. Partitioning of Study Reaches into IBI Test Group and Validation Group

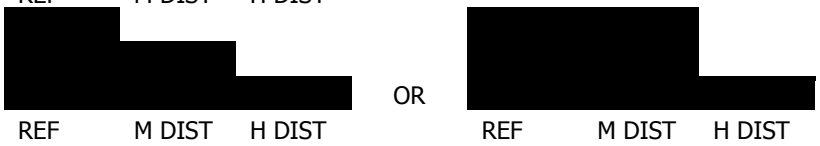
The IBI Test Group is composed of study reaches surveyed in four or more years. A total of 153 sampling replicates compose the Test Group, including 34 REF, 40 MOD DIST, and 79 HIGH DIST replicates, respectively. Data from these surveys was used to develop the IBI. All study reaches surveyed less than four times over the 10 year Program were held back, and included in a separate Validation Group composed of 37 surveys from 5 REF, 15 MOD DIST, and 17 HIGH DIST replicates, respectively. Since they were not used to develop the IBI, study stream reaches in the Validation Group can be used to independently test the accuracy of the IBI in correctly scoring and classifying biological integrity.

Figure 2: Tolerance Values Rules

Sensitive (0-3):

0, 1: abundance significantly ($p<0.05$) highest in REF. MOD DIST and HIGH DIST not sign. different from one another. 0 for greater differences in mean values and p between REF and MOD/HIGH DIST, 1 for lesser differences.

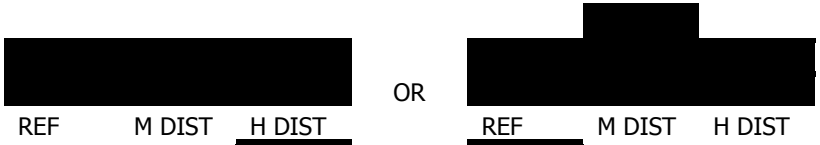
2,3: significant decrease in mean abundance from REF to MOD DIST to HIGH DIST, or from REF and MOD DIST to HIGH DIST. 2 for greater differences in mean values and p, 3 for lesser differences.



Moderate (4-6):

4: mean abundance significantly highest in MOD DIST, mean abundance in REF sign. higher than in HIGH DIST.

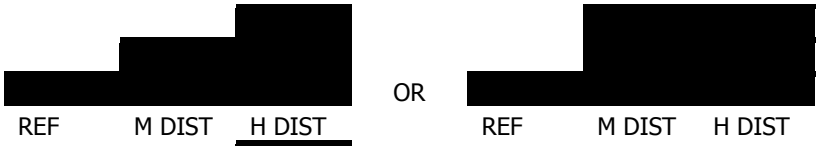
5: no significant difference in mean abundance between the three groups. Or mean abundance in MOD DIST sign. higher or lower, and REF and HIGH DIST means not sign. different from each other.



6: mean abundance significantly highest in MOD DIST, mean abundance in REF sign. lower than in HIGH DIST.

Tolerant (7-10):

7, 8: significant increase in mean abundance from REF to MOD DIST to HIGH DIST, or from REF to MOD DIST and HIGH DIST. 8 for greater differences in mean values and p, 7 for lesser differences.



9, 10: mean abundance significantly highest in HIGH DIST, REF and MOD DIST not significantly different from each other. 10 for greater differences in mean values and p, 9 for lesser differences.

2. Screening of BMI Metrics and Selection of Core Metrics

Sensitivity to Human Disturbance

In order to evaluate their sensitivity to human disturbance, all of the BMI metrics calculated (see Table 2) were evaluated for differences between the REF, MOD DIST, and HIGH DIST study reach groups using ANOVA. BMI metrics that most significantly change (i.e., increase or decrease) with increasing levels of human disturbance (i.e., from the REF to MOD DIST to HIGH DIST groups) have most potential to serve as measures biological integrity, and core metrics in the IBI.

Natural Relationships with Physiochemical Parameters

Multiple regression analyses were used to evaluate natural relationships (i.e., in the absence of human disturbance) between biological metrics and several physiochemical parameters using data REF study reaches group (n=39). It is important to screen potential core metrics on this basis, as significant natural relationships with physiochemical parameters could be difficult to separate from the effects of human disturbance. Such a situation may make a metric an unreliable indicator of biological integrity.

Multiple regression simultaneously evaluates and compares the effects of multiple independent variables (i.e., the physiochemical variables), or "regressors", on a single response variable (i.e., each biological metric). A best-fit equation is calculated that represents the response variable as a function of the independent variables. The correlation coefficient (r^2) and p-value (p) are calculated in regression analyses, and used to interpret the strength of the relationship between the response variable and the regressors. r^2 is given as a value between 0 and 1, and indicates the how well the equation fits the data. The higher the r^2, the better the fit of the equation. P indicates the probability that the response variable and regressors are not related as predicted by the best-fit equation, and is given as a value of between 0 and 1. A p of 0.05 or less is generally accepted as indicating a statistically significant relationship between the independent and response variables.

Landscape level, relatively constant physiochemical parameters including elevation, stream gradient, and watershed area were selected for use as regressors in the analyses. Stream temperature has been shown in many studies to have major effects on BMI community structure, and was also used as a regressor.

Core Metric Selection

Once the above screening analyses were complete, core metrics were selected for inclusion in the IBI. All potential core metrics showed (1) highly significant responses to human disturbance, either increasing or decreasing between REF to MOD DIST to HIGH DIST groups, and (2) less than significant relationships with physiochemical parameters at the REF study reaches. This in theory at least avoids a situation of confusing biological responses to human disturbance with responses to natural physiochemical gradients. Collectively, core metrics were chosen to represent three major aspects of biological community structure: diversity, disturbance tolerance/sensitivity, and trophic composition (i.e., functional feeding groups).

3. Defining Core Metric Scoring Ranges

Scoring ranges of were established for each potential core metric on a dimensionless scale of 0 to 10, 0 indicating the lowest biological integrity, and 10 indicating highest biological integrity.

For metrics that decrease with human disturbance (i.e., highest at REF sites), higher values corresponded with higher scores. For metrics that increase with human disturbance (i.e., highest at HIGH DIST sites), higher values corresponded with lower scores. The distributions of each metric in the REF, MOD DIST, and HIGH DIST groups were used to establish the scoring ranges. Scoring criteria is provided in Table 3.

Table 3: Core Metric Scoring Range Criteria

Score	Scoring Criteria
10	The 75th percentile or beyond of the REF group distribution for metrics that are highest in the REF group, or the 25th percentile or lower of REF group for metrics that are lowest in the REF group
9	The median (50th percentile) to 75th percentile of the REF group for metrics that are highest in the REF group, or the 25th percentile to the median of REF group for metrics that are lowest in the REF group
8	The range between the REF group and MOD DIST group medians is divided and evenly partitioned to provide each scoring range for 6, 7, and 8
7	
6	
5	MOD DIST median is the top of the scoring range for 5
4	The range between the MOD DIST group and HIGH DIST group medians is divided and evenly partitioned to provide each scoring range for 5, 4, 3, and 2
3	
2	
1	The median to 25th percentile of the HIGH DIST group for metrics that are lowest in the HIGH DIST group, or the median to the 75th percentile to the median of HIGH DIST group for metrics that are highest in the HIGH DIST group
0	The 25th percentile or less of the HIGH DIST group distribution for metrics that are lowest in the HIGH DIST group, or the 75th percentile or higher of the HIGH DIST group for metrics that are highest in the HIGH DIST group

4. Establishment of IBI Classifications of Biological Integrity

An overall IBI score was tabulated for each study reach by summing the respective scores of the core metrics. Based on the distribution of IBI scores for the REF, MOD DIST, and HIGH DIST groups, five categories of biological integrity were established: Excellent, Good, Fair, Poor, and Very Poor. Scoring criteria used to establish the categories is provided in Table 4.

Table 4: IBI Classifications of Biological Integrity and Scoring Criteria	
Classification of Biological Integrity	**Scoring Range**
Excellent	Median of REF group or higher
Good	From REF group median to 2/3 of way down to MOD DIST group median
Fair	Upper end of Fair range is MOD DIST group median to 1/3 of way up to REF group median. Lower end of Fair range is MOD DIST group median to 1/3 of way down to HIGH DIST group median.
Poor	From HIGH DIST group median to 2/3 of way up to MOD DIST group median
Very Poor	Median of HIGH DIST group or less

5. Testing the Accuracy of the IBI

Once the IBI was established, IBI scores were calculated for the study reaches, and classifications of biological integrity were compared to the *a priori* REF, MOD DIST, and HIGH DIST designations. This was done for:

1. the Validation Group only, or study reaches not used to develop the IBI (n=37), and;
2. all study reaches, including those used to develop the IBI (n=190).

The accuracy of the IBI in classifying biological integrity was determined to two and three classes of biological integrity. Table 5 provides criteria for correct classification by the IBI for these two levels of resolution. The percentage of sites properly classified (i.e., accuracy) was calculated for the IBI using these criteria.

Table 5: IBI Accuracy of Classification Criteria		
Study Reach Group	**Accurate to Two Classes**	**Accurate to Three Classes**
REF	Good to Excellent	Fair to Excellent
MOD DIST	Top half of Poor to bottom half of Good	Poor to Good
HIGH DIST	Very Poor to Poor	Very Poor to Fair

Additional statistical analyses were performed to evaluate the IBI's sensitivity to human disturbance. First, an ANOVA was completed to compare IBI scores for the three study reach groups (REF, MOD DIST, and HIGH DIST). Next, regression analyses were used to evaluate the relationships of IBI score with (1) percent of upstream watershed undisturbed, (2) habitat assessment score, and (3) a composite of percent of upstream watershed undisturbed and habitat assessment score. r^2 and p were calculated for these analyses.

IV. Results and Discussion

A. Data

Table A-1 in Appendix A provides physiochemical and BMI data collected at the study reaches in all years of study, and BMI metrics calculated using the data. New tolerance values determined for individual BMI taxa are also provided, as are previous tolerance values for comparison. Functional feeding groups for individual BMI taxa are provided as well.

B. New Tolerance Values

New tolerance values and sensitivity designations for individual BMI taxa are provided in Table A-1 of Appendix A. New tolerance values were assigned to 46 of 72 BMI taxa. Tolerance values from *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort* were retained for the remaining 26 taxa, which did not have mean abundance of 1 individual per study reach in at least one of the three disturbance groups. An additional six taxa did not have tolerance values in *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort*, and did not meet the minimum criteria for establishment of tolerance values in this study.

For 20 of the 46 taxa, new tolerance values were in close agreement with the tolerance values provided in *List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort*. There were notable changes for 26 taxa as follows:

Caenidae	7 (previous tolerance value) to 2 (new tolerance value)
Heptagenidae	4 to 0
Leptohyphidae	4 to 2
Nemouridae	2 to 0
Brachycentridae	1 to 3
Glossostomatidae	0 to 3
Helicopsychidae	3 to 1
Philoptomatidae	3 to 5
Polycentropodidae	6 to 2
Psychomiidae	2 to 5
Rhyacophilidae	0 to 2
Elmidae	4 to 0
Halipidae	5 to 9
Psphenidae	4 to 2
Chironomidae	6 to 8
Psychodidae	none available to 5
Stratiomyidae	8 to 3
Tipulidae	3 to 1

Veliidae	none available to 3
Coenagrionidae	9 to 5
Gomphidae	4 to 0
Lestidae	9 to 5
Acari	5 to 3
Gastropoda	8 to 5
Amphipoda	8 to 5
Oligochaeta	5 to 9

Changes in tolerance values and the criteria for sensitive and tolerant BMIs resulted in differences in new tolerance value average, percent sensitive BMIs, and percent tolerant BMIs compared to the previous versions of these metrics. This will be discussed in more depth later in the report.

C. Development of the Updated IBI

1. Screening and Selection of Potential Core Metrics

Sensitivity to Human Disturbance

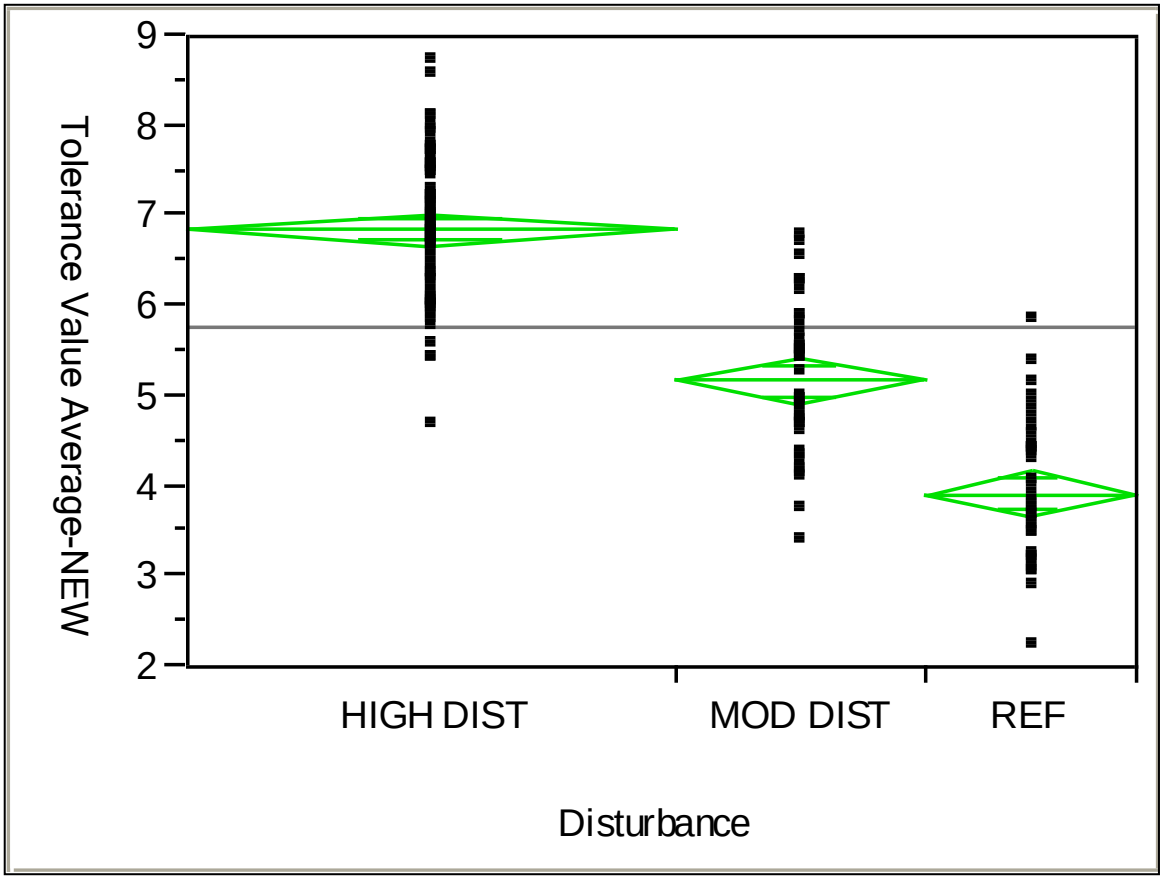
Table A-2 summarizes the results of the ANOVAs conducted to evaluate the sensitivities of the BMI metrics to human disturbance. As an example, Figure 3 illustrates the ANOVA for tolerance value average-new, which had a highly significant positive relationship with human disturbance ($p<0.0001$, $r^2=0.71$). Overall, 25 of the 27 BMI metrics evaluated had significant differences between the REF, MOD DIST, and HIGH DIST groups, many with $p<0.0001$. The only metrics evaluated that did not have significant differences between study reach groups were BMI density and percent scrapers.

The new tolerance value average, % sensitive BMIs, and % tolerant BMIs metrics were more responsive to human disturbance compared to the previous versions. The new versions of these metrics had greater differences in means between study reach groups and better p and r^2 compared with the previous versions (see Table A-2). This was particularly the case for % tolerant BMIs and tolerance value average.

BMI metrics with the strongest negative responses to human disturbance were # EPT families ($p<0.0001$, $r^2=0.68$), % sensitive BMIs-NEW ($p<0.0001$, $r^2=0.67$), % sensitive BMIs-OLD ($p<0.0001$, $r^2=0.65$), % EPT minus Baetidae ($p<0.0001$, $r^2=0.62$), % PT ($p<0.0001$, $r^2=0.59$), # insect families ($p<0.0001$, $r^2=0.58$), and % shredders + predators ($p<0.0001$, $r^2=0.57$). BMI metrics with the strongest positive responses to human disturbance were tolerance value average-NEW ($p<0.0001$, $r^2=0.71$) and % tolerant BMIs-NEW ($p<0.0001$, $r^2=0.56$). These metrics were all considered for further analyses as potential core metrics, except for % sensitive BMIs-OLD, which was slightly less responsive to human disturbance compared to % sensitive BMIs-NEW, and would be redundant with the new metric.

Figure 3: ANOVA Comparison of Tolerance Value Average-NEW at REF, MOD DIST, and HIGH DIST Reaches

Means and distributions of tolerance value average-NEW for study reach groups are represented. Top and bottom of diamonds are the 95 percent confidence limits, and the center lines are the means. The lower and upper lines are the 25 percent and 75 percent quantiles. N=153, $p<0.0001$, $r^2 = 0.71$. The p value is for the ANOVA where IBI score is the dependent variable and disturbance category is the independent variable.



Natural Relationships with Physiochemical Parameters

Table 6 summarizes the results of the multiple regression analyses conducted to evaluate relationships between the eight potential core metrics and the group of physiochemical regressors at the REF study reaches (n=39). As discussed in Methods, this is an important step in screening the potential core metrics.

Table 6: Summary of Multiple Regression Analyses of Potential Core Metrics vs. Physiochemical Parameters (Elevation, Gradient, Watershed Area, and Stream Temperature) at REF Study Reaches (n=39)

Potential Core Metric	R^2	P
# insect families	0.10	0.39
# EPT families	0.23	0.06
% EPT minus Baetidae	0.03	0.86
% PT	0.12	0.33
Tolerance value average-NEW	0.15	0.18
% sensitive BMIs-NEW	0.06	0.72
% tolerant BMIs-NEW	0.26	0.03
% predators + shredders	0.09	0.46

The multiple regression for % tolerant BMIs was significantly related to the group of physiochemical regressors (r^2 = 0.26, p=0.03), with a positive relationship with elevation (p=0.01) being the strongest relationship with the individual regressors. Due to this statistically significant relationship, % tolerant BMIs was eliminated from consideration as a core metric. None of the other seven BMI metrics had statistically significant relationships (i.e., $p<0.05$) with the group of physiochemical regressors.

Core Metric Selection

Based on the results presented above, seven core metrics were selected for inclusion in the IBI:

- # of insect families
- # of EPT families
- % EPT minus Baetidae
- % PT
- Tolerance value average-NEW
- % sensitive BMIs-NEW
- % predators + shredders

The core metrics were among the most sensitive to human disturbance among all the metrics tested, either increasing or decreasing from HIGH DIST to MOD DIST to REF groups. None had statistically significant natural relationships with the group of physiochemical parameters among

the REF sites. Collectively, the core metrics are diversified in that they represent different aspects of community structure including diversity, disturbance sensitivity, and trophic structure.

2. Defining Scoring Categories and Ranges for Core Metrics

Scoring ranges were developed for the core metrics using the criteria presented in Methods. The scoring ranges are provided below in Table 7.

Table 7
Core Metric Scoring Ranges

Score	# insect families	# EPT families	% EPT-Baetidae	% PT	Tolerance value avg.	% sensitive BMIs	%shredders +predators
10	29+	15	49+	22+	3.21 or less	60+	27+
9	26 to 28	14	37 to 49	15 to 22	3.22 to 3.82	46-59	19 to 26
8	25	12 to 13	32 to 36	12 to 14	3.83 to 4.32	39 to 45	16 to 18
7	24	11	27 to 31	10 to 11	4.33 to 4.81	32 to 38	14 to 15
6	23	10	23 to 26	8 to 9	4.82 to 5.29	26 to 31	12 to 13
5	19 to 22	9	18 to 22	6 to 7	5.30 to 5.68	20 to 25	10 to 11
4	16 to 18	7 to 8	13 to 17	4 to 5	5.69 to 6.07	14 to 19	8 to 9
3	13 to 15	5 to 6	8 to 12	3	6.08 to 6.47	8 to 13	6 to 7
2	10 to 12	3 to 4	2 to 7	2	6.48 to 6.87	2 to 7	4 to 5
1	7 to 10	1 to 2	1	1	6.88 to 7.48	1	2 to 3
0	0 to 6	0 to 1	0	0	7.49+	0	0 to 1

3. Defining IBI Classifications and Scoring Ranges

IBI classifications and scoring ranges were developed using the criteria presented in Methods, and are provided in Table 8.

Table 8
Classifications of Biological Integrity and Scoring Ranges

Category	Scoring Range
Excellent	61 to 70
Good	48 to 60
Fair	31 to 47
Poor	9 to 30
Very Poor	0 to 8

4. Testing the IBI

Accuracy and Consistency of IBI Scores and Classifications

Table A-3 lists IBI scores and biological integrity classifications for each study reach in the Validation Group (n=37) and the Test Group (n=153). Since the Validation Group study reaches were not used to develop the IBI, they provide a means to independently assess the IBI's accuracy in classifying biological integrity. Using the criteria in Table 5, the IBI was accurate to two classes of biological integrity 81 percent of the time for the Validation Group, and to three classes 100 percent of the time. In theory, if the IBI is incorrect in classifying study reaches to two classes of biological integrity 19 percent of the time, the probability of being incorrect to this level of precision at a given study reach two years in a row would be less than 4 percent. Thus, the IBI appears to fairly reliable in determining biological integrity to two classes, which is the desired level of precision. All 37 study reaches in the Validation Set were correctly classified to three classes. It appears there is little chance for gross inaccuracies in classifying biological integrity with the IBI. Data from study reaches in future years of the Program can be used to further evaluate the IBI's accuracy in classifying biological integrity.

While use of the overall data set (i.e., all 190 study reaches) to validate the IBI's accuracy in classifying biological integrity would be circular (i.e., it includes the data used to develop it), it is useful to explore how the IBI's accuracy differed between study reach disturbance groups (i.e., REF, MOD DIST, and HIGH DIST). For the HIGH DIST study reaches (n=96), the IBI was accurate 94 percent of the time to two classes of biological integrity, and 100 percent of the time to three classes. For the REF study reaches (n=39), accuracy was 87 percent to two classes and 95 percent to three classes of biological integrity. Accuracy was lowest for the MOD DIST study reaches (n=55) at 73 percent to two classes and 93 percent to three classes of biological integrity.

Figure 4 provides a graphical illustration of IBI scores at the 12 study reaches that have been surveyed each and every year since 2002. Table 9 provides IBI scoring ranges and averages at the 12 study reaches for each year.

Figure 4
IBI Score by Year at 12 Study Reaches Sampled Each Year Since 2002

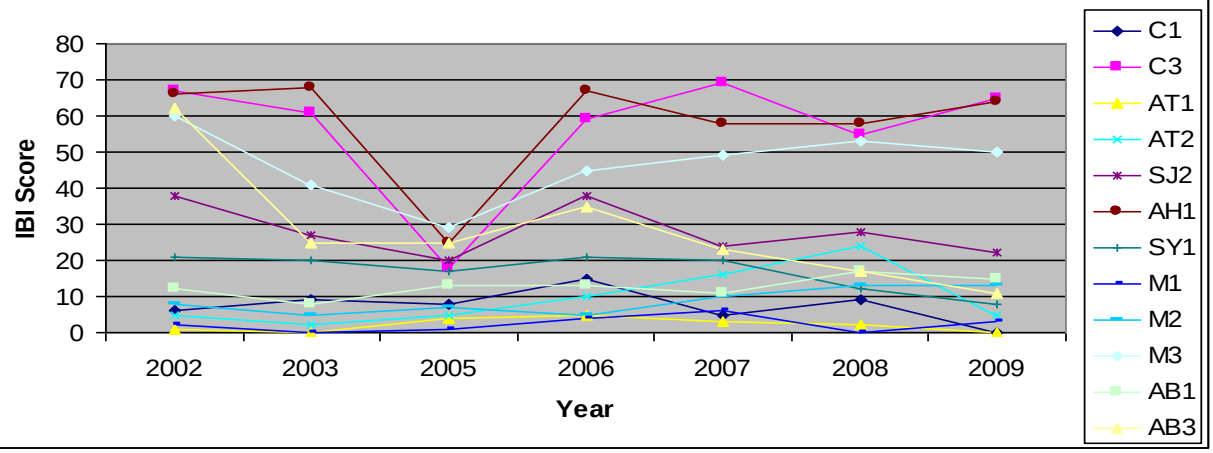


Table 9
IBI Score by Year at 12 Study Reaches Sampled Each Year Since 2002

Study Reach	2002	2003	2005	2006	2007	2008	2009
C1	6	9	8	15	5	9	0
C3	67	61	18	59	69	55	65
AT1	1	0	4	5	3	2	0
AT2	5	2	5	10	16	24	5
SJ2	38	27	20	38	24	28	22
AH1	66	68	25	67	58	58	64
SY1	21	20	17	21	20	12	8
M1	2	0	1	4	6	0	3
M2	8	5	7	5	10	13	13
M3	60	41	29	45	49	53	50
AB1	12	8	13	13	11	17	15
AB3	62	25	25	35	23	17	11
AVERAGE	29	22	14	26	25	24	21
RANGE	1 to 67	0 to 68	1 to 29	4 to 67	3 to 69	0 to 58	0 to 65

For the most part, IBI score ranges and averages were fairly consistent from year to year at the 12 study reaches. The exception to this was 2005, when the average IBI score was noticeably lower, and the scoring range was smaller and towards the lower end of the scale, with all 12 study reaches in the Very Poor and Poor range, including AH1 and C3, which are REF study reaches. Amongst all study reaches surveyed in 2005, accuracy of the IBI was relatively low at 74 percent to two classes of biological integrity and 84 percent to three classes.

2005 was the second heaviest rainfall year on record since rainfall data was first kept locally in 1867. Unusually high peak stream flows during the winter of 2004-2005 scoured out local creeks and significantly altered the BMI communities inhabiting them, which had much lower density and diversity at the time of the 2005 surveys as compared to other years. The scouring flows were followed by a biological succession where quick colonizers including Baetidae mayflies and Chironomidae midges were unusually dominant. Surveys were completed relatively early in 2005 (late April), which did not allow time for the BMI community to recover from this early state of biological succession. The accuracy of the IBI appears to have been impaired by this sequence of events. In future years with heavy rainfall and peak stream flows, field surveys should be delayed until late May or June to allow more recovery of the BMI community.

Sensitivity to Human Disturbance

ANOVA results indicate highly significant differences in IBI scores between the REF, MOD DIST, and HIGH DIST groups, with r^2 of 0.70 and $p<0.0001$ (see Figure 5). All of the group means were significantly different from one another. Linear regression analyses showed highly significant positive relationships between IBI score and percent watershed undisturbed ($r^2=0.54$, $p<0.0001$), habitat assessment score ($r^2=0.64$, $p<0.0001$), and the composite of

percent watershed undisturbed/habitat assessment score (r^2=0.66, p<0.0001). Exponential regressions provided slightly better r^2 for IBI score vs. percent watershed undisturbed (0.62), habitat assessment score (0.65), and the composite of percent watershed undisturbed/habitat assessment score (0.70). The regressions are illustrated in Figures 6, 7, and 8. The regressions of IBI score vs. the composite of percent watershed undisturbed/habitat assessment score and the ANOVA of IBI score amongst the study reach groups had the highest r^2 values. These results indicate that considering both watershed-level land use patterns and localized physical habitat conditions provided the best prediction of the biological integrity.

V. Recommendations

The updated IBI is based on a set of streams that collectively represent a wide range of natural physiochemical variability and levels of human disturbance. In addition, significant fluctuations in rainfall and peak stream flow from year to year and their effects on the BMI communities of study area streams have been documented over the past 10 years. This has allowed for the development of an IBI that serves as a reliable tool for classifying the biological integrity of streams in the study area, monitoring their condition through time, and identifying any changes that may occur in the future from increased development, habitat restoration projects, etc.

There are ways in which the collective data set could be diversified, for example by including streams in the study area that have not yet been surveyed, and expanding the study area further west and north to the Hollister and Bixby Ranch areas, Point Conception, Santa Ynez River watershed, etc. The IBI should be updated every 5 to 10 years to account for the greater range of conditions observed.

The updated IBI represents an excellent tool for assessing and monitoring the biological condition of freshwater streams in the study area. However, there is no equivalent tool for estuarine waters in the study area, which could be assessed using similar bioassessment methodology as used in this Program. IBIs have been produced for estuarine waters in many regions, and with adequate data one could likely be produced in the study area as well. Given the ecological importance of estuarine waters, and their importance as they relate to commercial and recreational uses and the local economy, the City and County should consider implementing an estuarine bioassessment program if funding allows.

Figure 5: ANOVA Comparison of IBI Score at REF, MOD DIST, and HIGH DIST Reaches

Means and distributions of IBI scores for study reach groups are represented. Top and bottom of diamonds are the 95 percent confidence limits, and the center lines are the means. The lower and upper lines are the 25 percent and 75 percent quantiles. N=190 (all study reaches), $p<0.0001$, $r^2 = 0.70$. The p value is for the ANOVA where IBI score is the dependent variable and disturbance category is the independent variable.

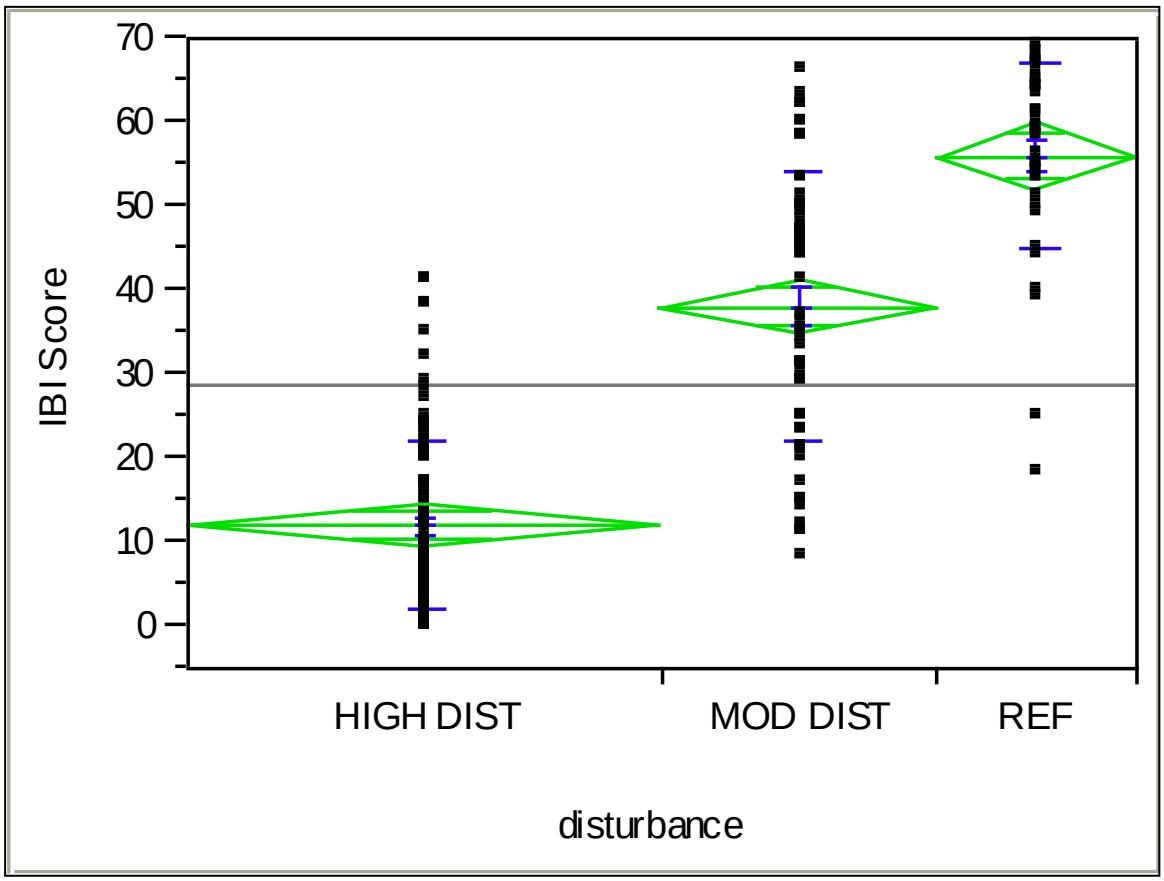
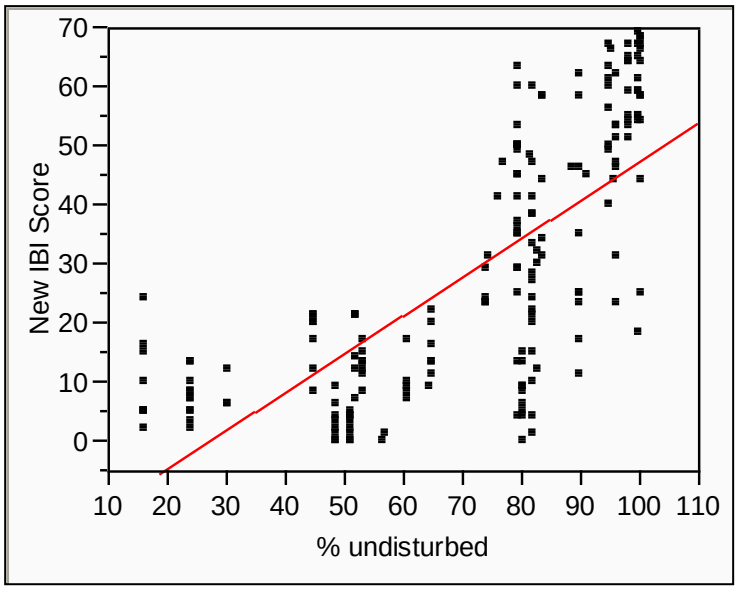


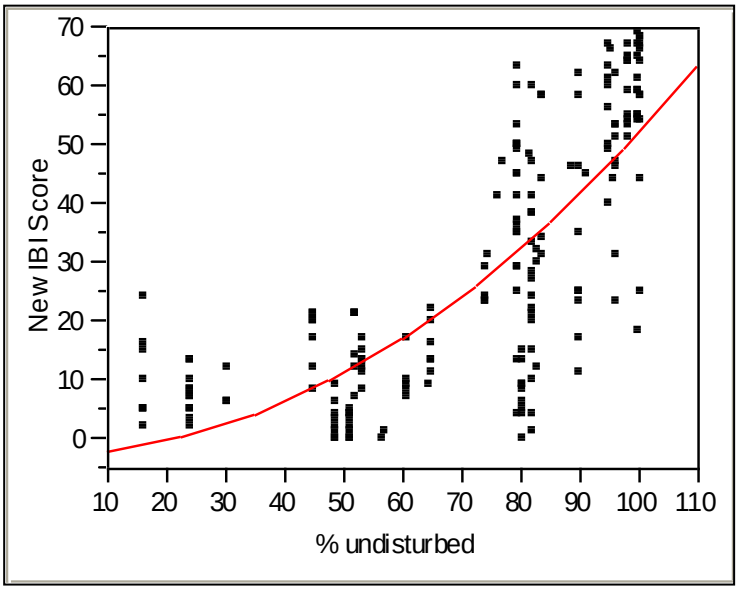
Figure 6: Regressions of IBI Score vs. Percent of Watershed Undisturbed

The graph shows the linear relationship between IBI score (dependent variable, y-axis) and % watershed undisturbed (independent variable, x-axis) amongst all of the study reaches (n=190). A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.54$). The best-fit line represents the relationship between the variables, the equation for which is:



IBI Score = -17.27667 + 0.6471196 (% watershed undisturbed)

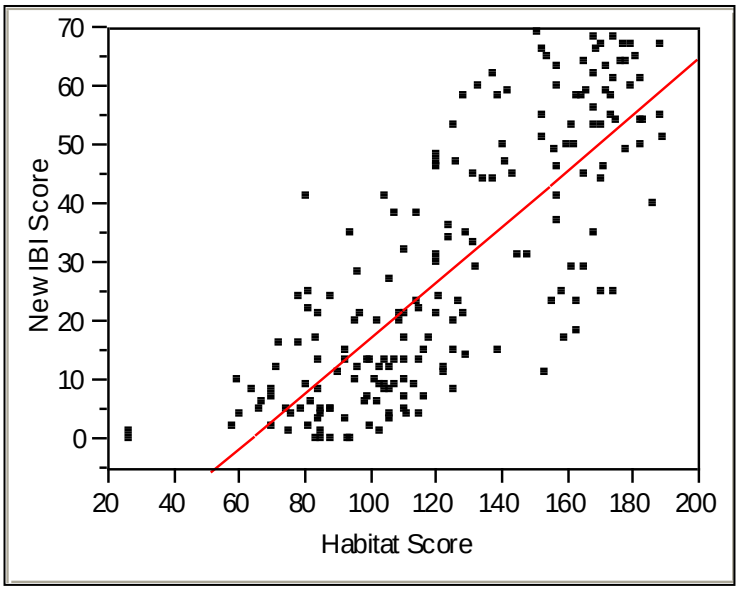
The graph shows the relationship between IBI score (dependent variable, y-axis) and percent of watershed undisturbed (independent variable, x-axis) amongst all of the study reaches (n=190) using an exponential transformation of the independent variable. A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.62$). The best-fit line represents the relationship between the variables, the equation for which is:



IBI Score = -2.290715 + 0.0054781 (% undisturbed)^2

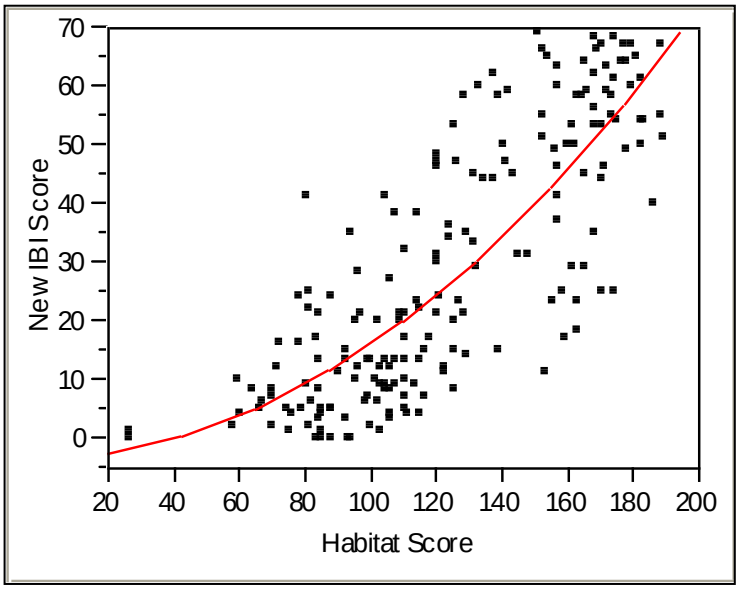
Figure 7: Regressions of IBI Score vs. Habitat Assessment Score

The graph shows the linear relationship between IBI score (dependent variable, y-axis) and habitat assessment score (independent variable, x-axis) amongst all of the study reaches (n=190). A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.64$). The best-fit line represents the relationship between the variables, the equation for which is:



IBI Score = -29.69897 + 0.4737229 Habitat Score

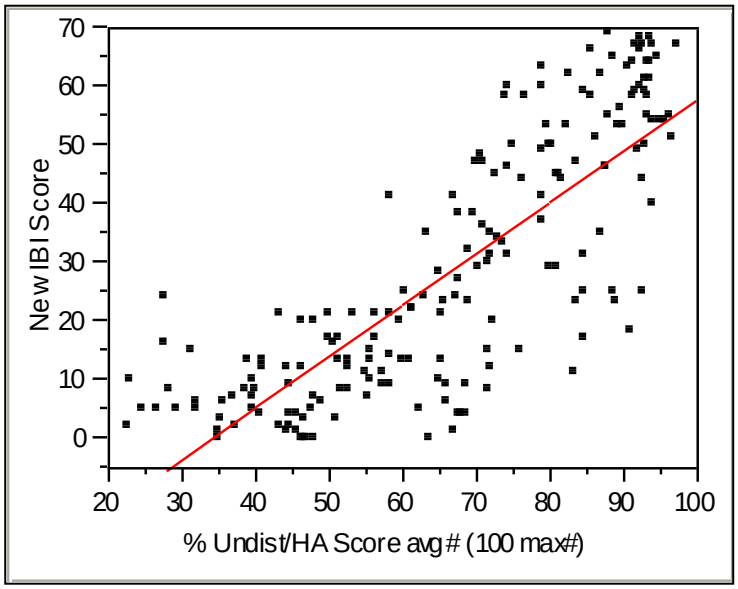
The graph shows the relationship between IBI score (dependent variable, y-axis) and percent of habitat assessment score (independent variable, x-axis) amongst all of the study reaches (n=190) using an exponential transformation of the independent variable. A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.65$). The best-fit line represents the relationship between the variables, the equation for which is:



New IBI Score = -2.928329 + 0.0019125 $(\text{Habitat Score})^2$

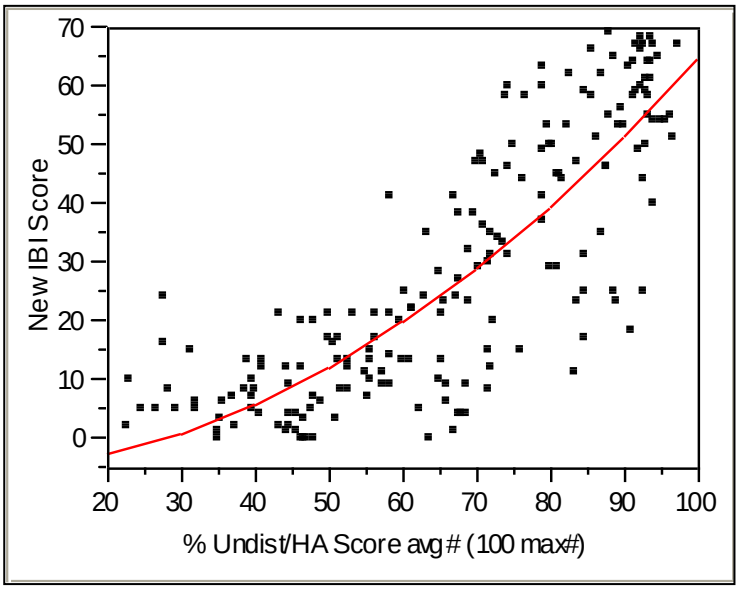
Figure 8: Regressions of IBI Score vs. Percent Watershed Undisturbed/Habitat Assessment Score

The graph shows the linear relationship between IBI score (dependent variable, y-axis) and the percent watershed undisturbed/habitat assessment score composite (independent variable, x-axis) amongst all of the study reaches (n=190). A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.66$). The best-fit line represents the relationship between the variables, the equation for which is:



IBI Score = -29.70958 + 0.8800597 (% Undist/HA Score avg)

The graph shows the relationship between IBI score (dependent variable, y-axis) and percent watershed undisturbed/habitat assessment score composite score (independent variable, x-axis) amongst all of the study reaches (n=190) using an exponential transformation of the independent variable. A significant positive relationship is indicated by the regression analysis ($p<0.0001$, $r^2 = 0.70$). The best-fit line represents the relationship between the variables, the equation for which is:



New IBI Score = -5.089113 + 0.0070268 (% Undist/HA Score avg)^2

VI. References

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Creeks and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition, EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

Burt, W.H., and R.P. Grossenheider. 1976. A Field Guide to the Mammals, North America North of Mexico. Third Edition. Houghton Mifflin Company. Boston, New York.

California Department of Fish and Game, Aquatic Bioassessment Laboratory. 2002. List of Californian Macroinvertebrate Taxa and Standard Taxonomic Effort. Revised April 30, 2002.

Cooper, S.D., Dudley T.L., and N. Hemphill. 1986. The Biology of Chaparral Streams in Southern California. Proceedings of the Chaparral Ecosystems Research Conference, May 16-17, 1985, Santa Barbara, California. California Water Resources Center, University of California Santa Barbara. Report No. 62. June, 1986.

County of Santa Barbara, Project Clean Water. 2002. Santa Barbara County Coastal Creeks Bioassessment Program, Annual Report, Year 2001.

Dale, N. 1986. Flowering Plants, the Santa Monica Mountains, Coastal and Chaparral Regions of Southern California. Published by Capra Press in cooperation with the California Native Plant Society.

ECORP Consulting, Inc. 2005. Results of 2004 Benthic Macroinvertebrate (BMI) Surveys Conducted for the City of Santa Barbara BMI Monitoring Program.

Ecology Consultants, Inc. 2004. Santa Barbara County Creeks Bioassessment Program, 2003 Annual Report and Index of Biological Integrity.

Hickman, J.C. 1993. The Jepson Manual, Higher Plants of California. University of California Press. Berkeley, CA.

McAuley, M. 1996. Wildflowers of the Santa Monica Mountains. Second Edition. Canyon Publishing Company. Canoga Park, California.

Merritt, R.W. and K.W. Cummins. 1996. An Introduction to the Aquatic Insects of North America, Third Edition. Kendall/Hunt Publishing Company.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press.

Peterson, R.T. 1990. A Field Guide to Western Birds. Third Edition. Houghton Mifflin Company. Boston, New York.

Stebbins, R.C. 1985. A Field Guide to Western Reptiles and Amphibians. Second Edition. Houghton Mifflin Company. Boston, New York.

Stewart, B.P. and C.R. Nelson. 1994. Nymphs of North American Stonefly Genera (Plecoptera). University of North Texas Press. Denton, Texas.

United States Geological Survey. Various dates. 7.5 minute quadrangle topographic maps.

APPENDIX A

DATA
AND
STATISTICAL ANALYSES SUMMARY

Figure 2: Daily Discharge, Mission Creek at USGS

Insert data and statistical analyses