County of Ventura
2013 Water Supply and Demand

Prepared for:
Ventura County
Watershed Protection District

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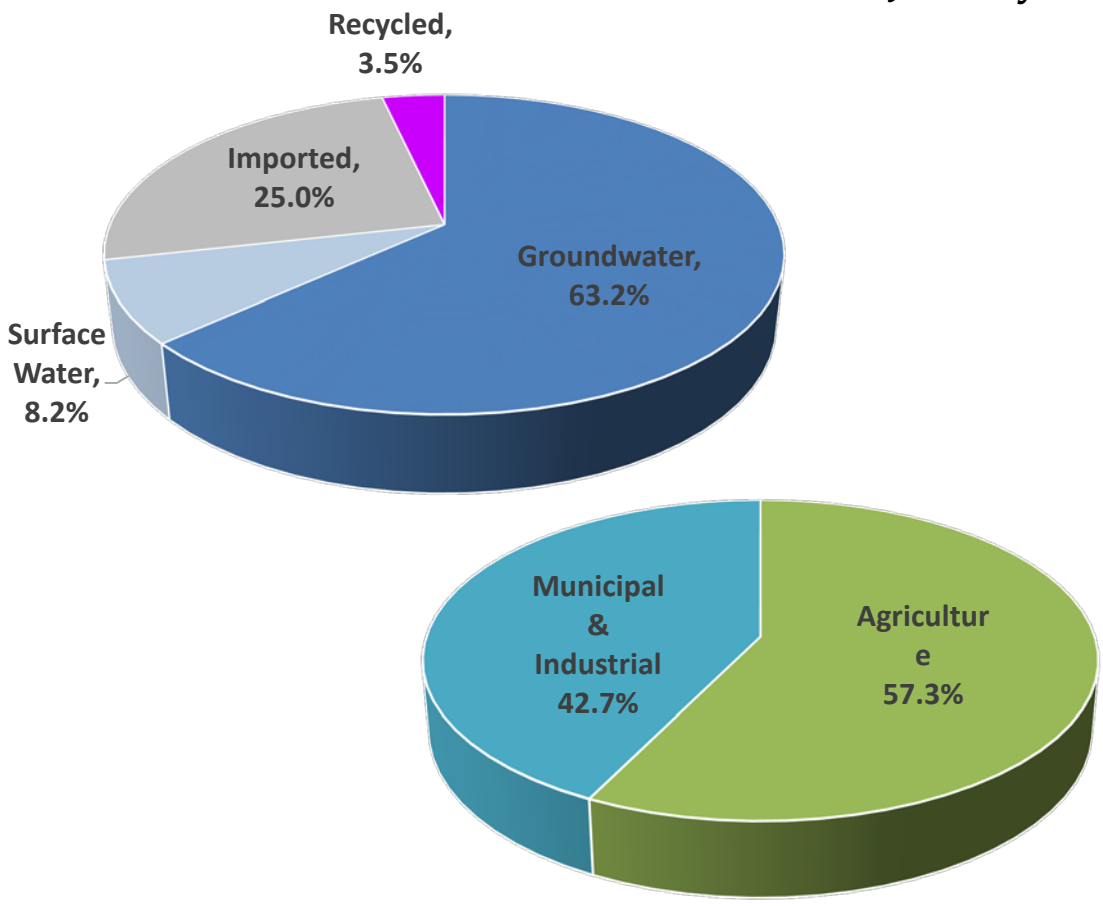

Prepared by:

HydroMetrics WRI

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

AF .....acre-feet
AFY.....acre-feet per year
AWPF.....Advanced Water Purification Facility
BO.....Biological Opinion
CDF .....California Department of Finance
cfs.....cubic feet per second
CIMIS .....California Irrigation Management Information System
CN .....curve number
DWR.....Department of Water Resources
eWRIMS.....Electronics Water Rights Information Management System
FCGMA.....Fox Canyon Groundwater Management Agency
GMA.....Groundwater Management Agency
IDC .....IWFM Demand Calculator
IWFM .....Integrated Water Flow Model
M&I .....municipal and industrial
MWD.....Municipal Water District
NA .....not available
NMFS .....National Marine Fisheries Service
NOAA.....National Oceanic and Atmospheric Administration
RWQCB .....Regional Water Quality Control Board
SWRCB .....State Water Resources Control Board
UWCD .....United Water Conservation District
WQCP .....Water Quality Control Plant
WRF.....Wastewater Reclamation Facility
WWTP.....Wastewater Treatment Plant

EXECUTIVE SUMMARY

INTRODUCTION

Ventura County's water supply and demand has been previously estimated for two different years. The first water supply and demand estimate was included in the Ventura County Water Management Plan (Ventura County, 1994) for calendar year 1992; the second estimate was completed in 2009 by Ventura County Watershed Protection District staff for calendar year 2007 (Ventura County 2009). In order to better manage available water resources, this report provides an updated countywide estimate of overall water supply and demand. These water supply and demand findings will be incorporated into the Watersheds Coalition of Ventura County's Integrated Regional Water Management Plan.

SOURCES OF DATA

Data on water used within Ventura County for 2013 were obtained from a number of local water and federal agencies. For the most part, adequate data are available to develop water supply and demand estimates, however all groundwater use outside of Fox Canyon Groundwater Management Agency (FCGMA), Ojai Groundwater Management Agency (OGMA), and United Water Conservation District (UWCD) jurisdiction is unreported and therefore no data are available.

To estimate this unknown usage, a demand calculator tool called the Integrated Water Flow Model (IWFM) Demand Calculator (IDC) was used (described on page 6). This tool estimates applied water requirements for agricultural irrigation based on crop type and climate data, and urban water demand based on population and per capita usage.

Surface water diversion data that is available from the State Water Resources Control Board's water rights database is not current for most private users and therefore estimates needed to be made of surface water use for these users. Recycled water use data was not available from the Los Angeles Regional Water Quality Control Board (RWQCB) but had to be requested from each individual recycled water user.

WATER SUPPLY

Four sources of water provide the water supply for Ventura County. The relative amount each of the four sources contributes to the County's overall water supply fluctuates each year due to climatic conditions and the availability of imported water. Each source's contribution to the water supply in 2013 is shown as a percentage of the total supply.

- Groundwater, 63.2%
- Imported water, 25.0%
- Surface water, 8.2%
- Recycled water, 3.5%

Groundwater is pumped by municipalities, private domestic users, public users, utilities, small mutual companies, water districts, and agricultural users from the underlying groundwater basins. State Water Project water is imported by Calleguas Municipal Water District and UWCD. Surface water is diverted from creeks and streams by municipalities, water districts, irrigation companies, and private users with water rights. Lake Casitas is a significant source of surface water within the Ventura River watershed, and Lake Piru provides surface water, when available, for irrigation within UWCD's service area overlying portions of the Santa Clara River and Ormond Beach watersheds. Recycled water is obtained from local water treatment facilities by water districts for sale to customers for agricultural and landscape irrigation, and dust suppression.

WATER DEMAND

Agricultural demand in the County is mainly focused in the Calleguas Creek, Santa Clara River, and Ventura River watersheds.

- 57.3% of water used in Ventura County in 2013 was for agricultural irrigation.
    - 84.8% is from groundwater,
    - 8.8% is from surface water,
    - 4.2% is from recycled water, and
    - 2.2% is from imported water.

The Calleguas Creek watershed has the greatest municipal, domestic, and industrial (M&I) water demand, with the Santa Clara River, Hall

Canyon/Arundell, Ormond Beach, Malibu Creek, and Ventura River watersheds comprising almost all the remaining M&I demand. There is some minor M&I usage in the Cuyama and Rincon watersheds.

- 42.7% of water used in Ventura County in 2013 was for municipal, domestic, and industrial (M&I) purposes:
    - 55.7% is imported water,
    - 34.2% is from groundwater,
    - 7.5% is from surface water, and
    - 2.7% is from recycled water for dust suppression and landscape irrigation.

There are some in-stream and environmental uses of surface water in the County. These uses require surface water flows to be set at minimum rates to provide optimal habitat for the protection of fish, wildlife, reptiles, and riparian habitat and vegetation. In-stream and environmental uses include:

1. United Water Conservation District's Freeman Diversion on the Santa Clara River is required to provide bypass flows for migration of steelhead trout.
2. City of Thousand Oaks' surface water diversion on Conejo Creek in the Calleguas Creek watershed is required to provide bypass flows for the protection of fish, wildlife, southwestern pond turtles, and riparian habitat and vegetation.
3. Casitas Municipal Water District's Robles Diversion on the Ventura River is required to provide bypass flows for migration of steelhead trout.
4. Additionally, the City of Ventura's Foster Park well field extracts shallow groundwater that is connected to the Ventura River. A draft biological opinion recommends restricting pumping the Foster Park well field to prevent Ventura River flows from falling below 11 to 12 cubic feet per second (cfs).

Table ES-1 summarizes the County's water supply sources and users.

Table ES-1: 2013 Ventura County Water Supply and Demand (Values in Acre-Feet)

	Water User/Agency	Agriculture	Municipal & Industrial	Total
Surface Water	Casitas MWD	*8,305*	*9,990*	*18,295*
	City of Ventura	*0*	*4,200*	*4,200*
	UWCD	*6,257*	*0*	*6,257*
	Private	*7,974*	*0*	*7,974*
	Surface Water Total	**22,536**	**14,190**	**36,726**
SWP	UWCD	*0*[1]	*0*	*0*
	Calleguas MWD	*5,537*	*105,747*	*111,283*
	Imported SWP Total	**5,537**	**105,747**	**111,283**
Groundwater	Ojai GMA[2]	*3,401*	*2,037*	*5,438*
	FCGMA[3]	*105,346*	*44,949*	*150,295*
	UWCD[4]	*83,243*	*13,115*	*96,358*
	Private (unreported)	*24,591*	*4,868*	*29,459*
	Groundwater Total	**216,581**	**64,969**	**281,550**
Recycled Water	Oak Park Water Service[5]	*0*	*790*	*790*
	Lake Sherwood CSD[5]	*0*	*484*	*484*
	California Water Service Co.[5]	*0*	*644*	*644*
	City of Simi Valley/ County Waterworks No. 8	*0*	*56*	*56*
	Camarillo San. District	*1,840*	*46*	*1,886*
	Camrosa Water District Non-Potable[6]	*4,687*	*1,372*	*6,059*
	Camrosa Water District Non-Potable to PVCWD[6]	*3,241*	*0*	*3,241*
	Camrosa Water District CWRF Recycled (Title 22)	*901*	*268*	*1,170*
	Moorpark WWTP/County Waterworks No. 1	*3*	*718*	*721*
	City of Ventura/Ventura Water Reclamation Facility	*0*	*700*	*700*
	Recycled Water Total	**10,672**	**5,078**	**15,751**
	TOTAL	**255,325**	**189,984**	**445,310**

Table ES-1 Notes:
[1] UWCD received 2,242.5 AF SWP water in 2013 but because of low levels in Lake Piru no conservation release was made in 2013, and therefore the SWP water remains in the lake until a conservation release is made.
[2] Groundwater production records provided by Ojai GMA are mostly estimated not metered.
[3] Groundwater production records provided by FCGMA are metered.
[4] Groundwater production records provided by UWCD are a combination of metered and estimates based on crop type or electrical usage.
[5] Imported by Calleguas MWD from Triunfo Sanitation District / Las Virgines MWD's Tapia WRF
[6] From Hill Canyon WWTP

COMPARISON OF 2013 WATER SUPPLY AND DEMAND WITH ESTIMATES IN THE 1994 WATER MANAGEMENT PLAN

The 1994 Water Management Plan provided water supply and demand estimates for 1992. A comparison of 1992 with 2013 estimates reveals that the four sources of water to the County have not changed, however, their individual contributions to the overall water supply and demand have changed. It should be noted that the 1992 estimate of agricultural groundwater demand may be overestimated due to duplicate production reported to both the FCGMA and UWCD.

The difference between 1992 and 2013 are summarized in the tables below.

Table ES-2: Comparison of Ventura County Water Supply between 1992 and 2013

Supply	1992	2013	Difference
Surface water	44,700 AF 10.5%	36,700 AF 8.2%	- 8,000 AF
Imported water	93,600 AF 22.0%	111,300 AF 25.0%	17,700 AF
Groundwater	285,100 AF* 67.0%	281,600 AF 63.2%	- 3,500 AF
Recycled water	2,100 AF 0.5%	15,700 AF 3.5%	13,600 AF
TOTAL	**425,500 AF**	**445,300 AF**	**19,800 AF**

* Groundwater supply may have been overestimated due to duplicate extractions reported to both the FCGMA and UWCD.

Table ES-3: Comparison of Ventura County Water Demand and Sources between 1992 and 2013

Demand	Supply	1992	2013	Difference
Agriculture	Surface water	Not provided	22,500 AF 8.8%	-
	Imported water	Not provided	5,500 AF 2.2%	-
	Groundwater*	248,800 AF 86%	216,600 AF 84.8%	-32,200 AF
	Recycled water	Not provided	10,700 AF 4.2%	-
	Total Ag Demand ***% of Total Demand***	***289,300 AF*** ***68%***	***255,300 AF*** ***57.3%***	***-34,000 AF***
Municipal & Industrial	Surface water	~ 90,300 AF ~ 66%	14,200 AF 7.5%	-
	Imported water		105,800 AF 55.7%	-
	Groundwater	~ 41,000 AF ~ 30%	65,000 AF 34.2%	24,000 AF
	Recycled water	2,100 AF 0.5%	5,000 AF 2.7%	2,900 AF
	Total M&I Demand ***% of Total Demand***	***136,200 AF*** ***32%***	***190,000 AF*** ***42.7%***	***53,800 AF***
TOTAL		**425,500 AF**	**445,300 AF**	**19,800 AF**

* Agricultural groundwater demand may have been overestimated due to duplicate extractions reported to both the FCGMA and UWCD.

The most significant changes in water demand since 1992 has been the increase in M&I use resultant from increased population in the County, and the increase in recycled water use which in 2013 was almost 7.5 times more than in 1992.

RECOMMENDATIONS

1. Development of new sources of water should continue to be pursued, along with more water efficient practices. These include:
    - Recycled water for non-potable purposes,
    - Desalination of seawater and brackish water, is another new source of water that should continue to be evaluated.
    - Replacing old irrigation technology with water efficient drip and micro irrigation, and
    - Research to develop less water intensive crops will lessen the stress on the groundwater basins while decreasing the agricultural water demand.

2. In collecting data for this study, the data that were the most difficult to obtain were recycled water use and unreported water use outside of the groundwater management agencies. The RWQCB should be encouraged to keep better records of recycled water that can be made available to the public.

3. To get a more accurate estimate of water demands in the future, all users of groundwater, regardless of whether they are within or outside of a groundwater management agency, should report their annual use to the County. All d*e minimis* users should be identified but should not have to report usage.

4. In-lieu of self-reporting groundwater extractions outside of the three groundwater management areas, this usage needs to be estimated. We recommend that the IDC be used in the future to estimate this unknown component of the water demand as it accounts for both agricultural and municipal/domestic demands.

5. Identifying water use records as being metered or estimated would also improve the understanding of the data, and improve confidence in the numbers.

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SECTION 1
BACKGROUND AND SCOPE

Ventura County's water supply and demand has been previously estimated for two different years. The first water supply and demand estimate was included in the Ventura County Water Management Plan (Ventura County, 1994) for calendar year 1992; the second estimate was completed in 2009 by Ventura County Watershed Protection District staff for calendar year 2007 (Ventura County 2009). The County requested that an updated countywide estimate of overall water supply and demand be developed to provide a current understanding of sources and uses of water in the County, and to better manage available water resources. Additionally, the findings of this report will be incorporated into the Watersheds Coalition of Ventura County's Integrated Regional Water Management Plan.

The project scope included:

1. Obtaining, reviewing, evaluating, and compiling water supply and demand data.
2. Identifying data gaps.
3. Calculating and estimating 2013 countywide water supply and demand.
4. Comparing estimates of 2013 water supply and demand to the County's 1994 Water Management Plan estimates.
5. Preparing a draft and final water supply and demand report.

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SECTION 2
DATA SOURCES, APPROACH, AND ASSUMPTIONS

2.1 DATA SOURCES

Water supply and demand, and other water-related data used in this study, were requested and obtained from a number of public agencies such as Ventura County, water management agencies and districts, federal and state agencies, and individual cities. Table 1 provides a summary of the data obtained for this study and their sources. After examining the available data, data gaps were identified. These data gaps are discussed in Section 2.2.

Table 1: Summary of Data and their Sources

Item	Source
Land use - General Plan	County of Ventura
Crops	Ventura County Agricultural Commission
Soils	SSURGO database from United States Department of Agriculture
Precipitation	National Oceanic and Atmospheric Administration (NOAA)
Evapotranspiration	California Irrigation Management Information System (CIMIS)
Recycled Water Use	Los Angeles Regional Water Quality Control Board (RWQCB)
	City of Simi Valley
	Camarillo Sanitary District
	Camrosa Water District
	Calleguas MWD
	City of Ventura
	City of Moorpark
Water diversions (water rights)	eWRIMS database from California State Water Resources Control Board (SWRCB)
	United Water Conservation District (UWCD)
	Casitas Municipal Water District (MWD)
	City of Ventura, Ventura Water (Foster Park)
	Camulos Ranch
	Piru Mutual Water Company

Item	Source
	Fillmore Irrigation Company
	Senior Canyon
Groundwater production	UWCD
	Fox Canyon Groundwater Management Agency (FCGMA)
	Ojai Groundwater Management Agency
State Water Project Deliveries	UWCD
	Calleguas Municipal Water District

2.2 DATA GAPS

Data gaps existed for various aspects of water supply and water demand in the County. Each of the data gaps is discussed below.

Groundwater production: Private well use outside of the groundwater management areas and UWCD's area is not reported.

Surface water use: The State Water Control Board's water rights database systems, eWRIMS, provides information on the surface water diversion licenses and annual reports of water diverted by licensed water rights holders. Data contained in this system is incomplete as water rights holders often do not self-report their annual water use. Private users do not use very much surface water, but irrigation mutual water companies, such as Piru Mutual Water Company and Fillmore Mutual Water Company divert and use surface water in the low thousands of acre-feet annually.

Recycled water use: Because recycled water use is permitted by the Regional Water Quality Control Board it was assumed that they would have records of the amount of use. However, we were informed by Regional Board staff to contact the producers of recycled water use directly because Regional Board staff did not have the data readily available. Ultimately all the data needed was obtained from the producers of recycled water.

2.3 ASSUMPTIONS

Assumptions were necessary for estimating some surface water diversions in the County. Diversion records from the larger diverters: UWCD, City of Ventura, and Casitas MWD, were readily available from the agencies directly. Diversion records from private and small irrigation districts or companies were not available for the majority of diverters for 2013. These water rights holders are required to report their diversions to the SWRCB through the electronics water rights information management system (eWRIMS), but many have not done so for 2013, or for some years prior to 2013. Because 2013, was a dry year that only received 23% of the average annual rainfall, it was assumed that only 20% of the face value of the water rights were used by these water rights holders.

Additional assumptions made for input into the demand calculator are described in Section 2.4.

2.4 WATER USE ESTIMATES

Water purveyors and cities falling within the in the boundaries of the UWCD, Ojai GMA, and FCGMA maintain adequate records of their drinking water sources and usage. Although agricultural groundwater production is reported to UWCD and Ojai GMA, its accuracy can be questionable because their water usage is often not metered but estimated based on electrical usage or crop type. The FCGMA requires that all agricultural groundwater production be metered and is therefore more accurate.

Those water uses that are not included in data reported by the UWCD, Ojai GMA, and FCGMA include groundwater pumped by small mutual water companies and for agricultural irrigation outside of areas where groundwater production reporting is required, and undocumented private domestic use[1] throughout the County.

To fill in the data gaps in groundwater use, a demand calculator is used to estimate usage in areas where agricultural irrigation and domestic use is not reported. The IWFM Demand Calculator (IDC) was selected for this purpose because of its non-proprietary nature and relative ease of use.

[1] Domestic use is water used for household purposes in homes that are not supplied water by a water purveyor. It is assumed these homes rely on groundwater pumped by private wells.

2.4.1 IWFM Demand Calculator Description

The IWFM Demand Calculator (IDC) is a root zone modeling tool that was developed by the California Department of Water Resources (DWR) to estimate applied water requirements needed for the Integrated Water Flow Model (IWFM). The IWFM is a DWR developed and maintained surface-subsurface hydrologic model that couples an integrated hydrologic modeling approach with a root zone component (IDC) which uses an irrigation-scheduling-type approach.

The IDC computes applied water demands for cropped areas using specified climatic and irrigation management settings. Areas of native vegetation are not included as they are not irrigated. The IDC also estimates urban water requirements and return flows based on population and per-capita water usage. Other input data required for IDC includes: precipitation, evapotranspiration, soils, rooting depth, irrigation types, and curve number.

2.4.2 Computational Grid

A computational grid is required when using the IDC to compute irrigation water requirements and route moisture through the root zone. The computational grid is defined similar to a finite element grid: with grid cells, and nodes that surround each cell. The IDC does not use the finite element method to solve hydrologic equations; instead, it operates on a grid to provide a better representation of spatially-distributed data such as potential evapotranspiration, precipitation, and soil characteristics. Elements are defined using watersheds, urban areas, and County boundaries. Elements are grouped into subregions which represent major County watersheds. Some of minor watersheds that flow out of the County, are consolidated into the nearest major County watershed for purposes of defining subregions. The IDC aggregates its output using the subregions. Figure 1 shows the resultant elements of the computational grid developed for Ventura County. There are 4,440 elements, and nine subregions.

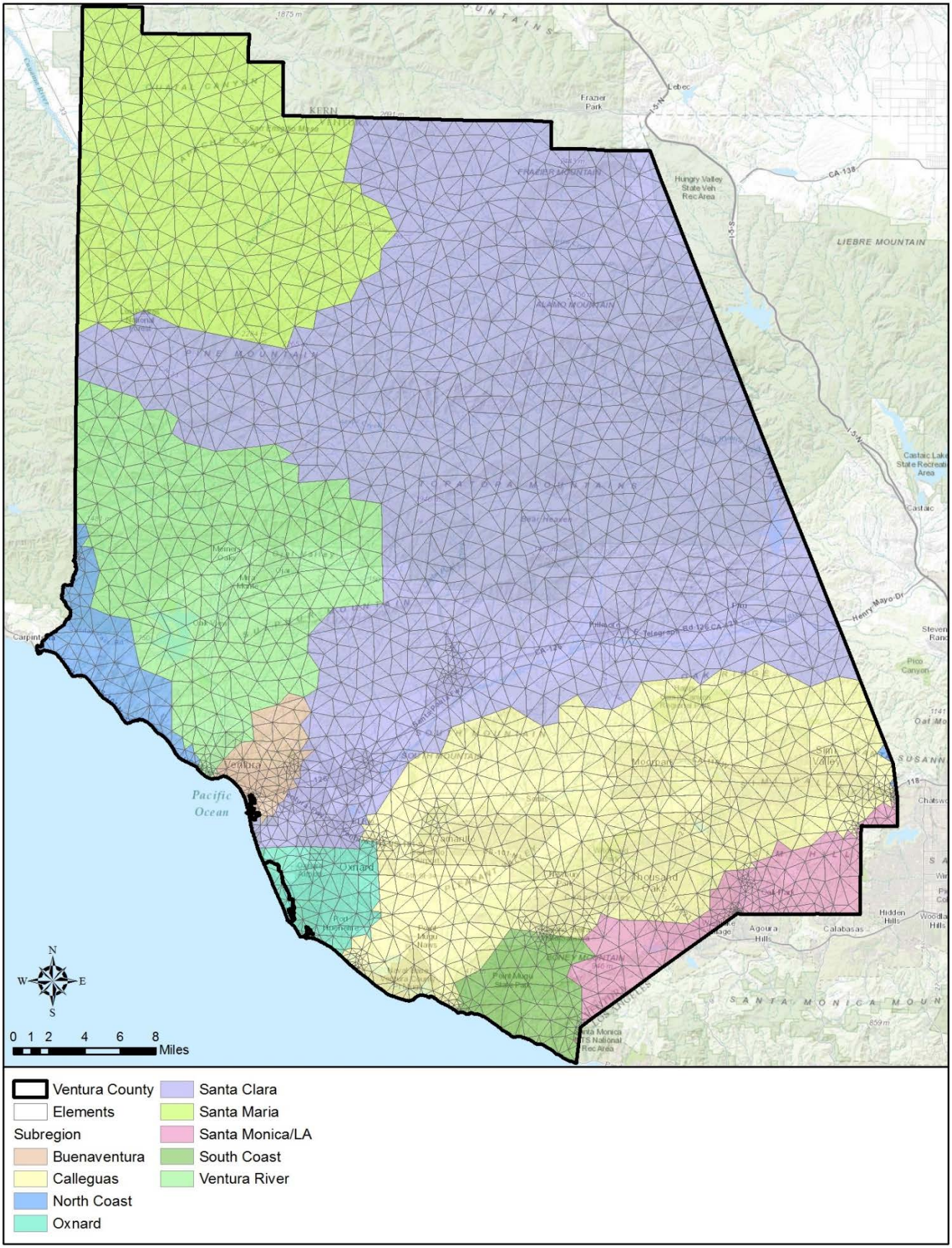

Figure 1: Ventura County IDC Elements and Subregions

2.4.3 INPUT PARAMETERS

LAND USE

The IDC relies on land use data to determine runoff processes and vegetative consumptive use. Land use broadly falls under the categories of agriculture, urban, and native vegetation. Agricultural areas are further classified by crop groups, as summarized in Table 2. Water demand for agricultural areas is based on climate, soils, crop type, and irrigation management settings. The water demand for urban areas is based on population and per-capita water usage. Native vegetation is not irrigated and therefore does not contribute to the total water demand.

Table 2: Crop Groups

Crop Group	Crops
Grains	Barley, grain, oat
Field	Beans
Alfalfa	Alfalfa
Pasture	Sudan grass, pasture, hay, sod
Truck	Rose, sage, vegetable seed, cherry, cucumber, fennel, lavender, mint, mushroom, bok choy, chicory, mustard, berries, squash, mixed greens, cherimoya, parsley, carrot, corn, chard, watercress, flower seed, kale, artichoke, pumpkin, spinach, herbs, broccoli, lettuce, blackberry, pepper, tomato, cilantro, blueberry, cabbage, celery, raspberry, strawberry
Deciduous	Fig, plum, nectarine, peach, pomegranate, pear, stone fruit, persimmon, apple, walnut, apricot
Citrus	Avocado, grapefruit, guava, kiwi, kumquat, lemon, lime, macadamia, mango, olive, orange, tangelo, tangerine
Vineyards	Grapes
Semi-agricultural	Farmsteads, livestock feedlots, poultry farms

CROP DISTRIBUTION

The spatial distribution of crops for 2013 was provided by the Ventura County Agricultural Commissioner. Some editing was required to ensure edges of polygons matched and that no overlaps occurred. The crops were grouped into nine crop types, as shown in Table 2. Figure 2 shows the distribution of the crop groups in the County. Subtropical crops of citrus/avocado and truck crops constitute the majority of crops grown in the County. Semi-agricultural is a group that includes farmsteads on farm lands and livestock related land use. The 2000 DWR land use survey was used to identify semi-agricultural land uses.

URBAN AREAS

Urban areas were determined from the 2010 Ventura County General Plan. Editing was required to update and convert some areas from "open space" to urban areas based on current aerial photographs. Urban areas are shaded gray on Figure 2.

NATIVE VEGETATION

Areas of native vegetation were identified from the 2000 DWR land use surveys and 2010 General Plan. Where the 2013 crop or urban areas overlapped with native vegetation, the cropped and urban areas were retained and native vegetation areas were removed to ensure there were no overlapping land uses. The County comprises approximately 79% open space/native vegetation (Figure 2).

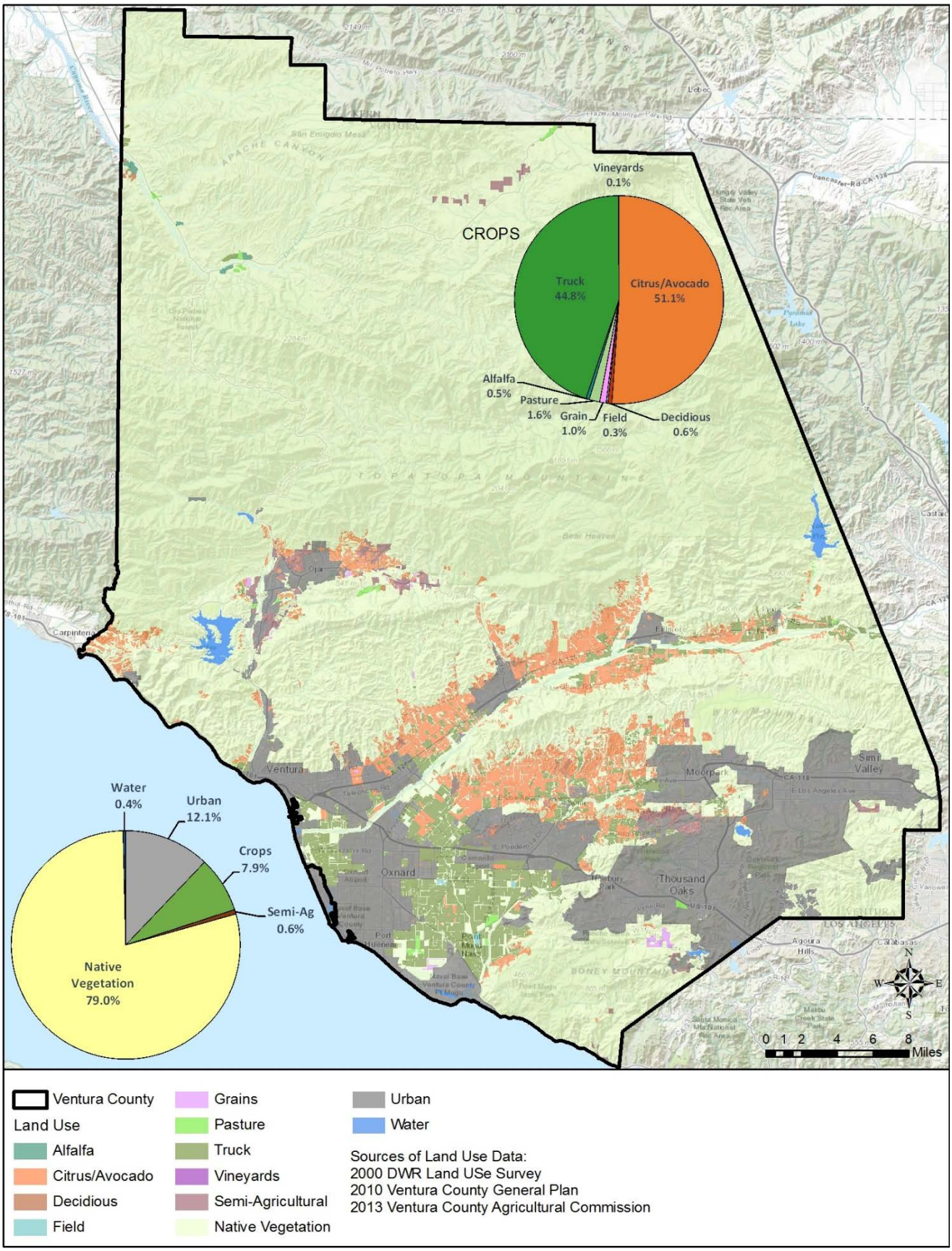

Figure 2: Land Use for IDC

PRECIPITATION

Daily precipitation data for 2013 were downloaded from NOAA. Of the seven active stations with available data, five were selected based on their spatial distribution (Figure 3). Zones around each of the five precipitation stations were created based on elevation and distance to the station. These zones were used to define areas with assumed similar precipitation patterns to the station and used to distribute precipitation across all the model elements as described below.

Daily precipitation for 2013 was distributed to each model element based on the 1981 to 2010 30-year normal annual distribution (PRISM Climatic Group, Oregon State University) as shown in Figure 3. Specifically this was achieved by assigning the element underlying the precipitation station an adjustment factor of 1, and all other elements in its zone assigned an adjustment factor calculated from the 30-year normal precipitation of the element divided by the 30-year normal precipitation of the element underlying the precipitation station. The adjustment factor was multiplied by the daily precipitation of the precipitation station to provide the daily precipitation for each model element.

EVAPOTRANSPIRATION

Evapotranspiration applied to the model was distributed across the County using reference evapotranspiration (ET_o) zones developed by the California Irrigation Management Information System (CIMIS). As shown on Figure 4, there are five ET_o zones in the County. Three of the five zones have a CIMIS stations with daily ET_o data. The stations are: Oxnard (Zone 3), Camarillo (Zone 4), and Santa Paula (Zone 9). Each IDC element is assigned an ET_o zone. Elements in Zones 3, 4, and 10 were given the daily ET_o rate of the CIMIS station falling in the zone. For Zones 10 and 14 where no CIMIS stations exist, an adjustment factor for each month (for each zone) was calculated based on the monthly average ET_o for the zone divided by the monthly average ET_o for Zone 9. Monthly average ET_o for the zones was obtained from the published CIMIS zone map. Zone 9 was selected as it is the most inland of the CIMIS stations used, and most likely to have ET_o that behaved similar to Zones 10 and 14 which are also inland. The monthly adjustment factors for each zone were multiplied by the corresponding month's daily ET_o from the Santa Paula station to derive daily ET_o values for Zones 10 and 14.

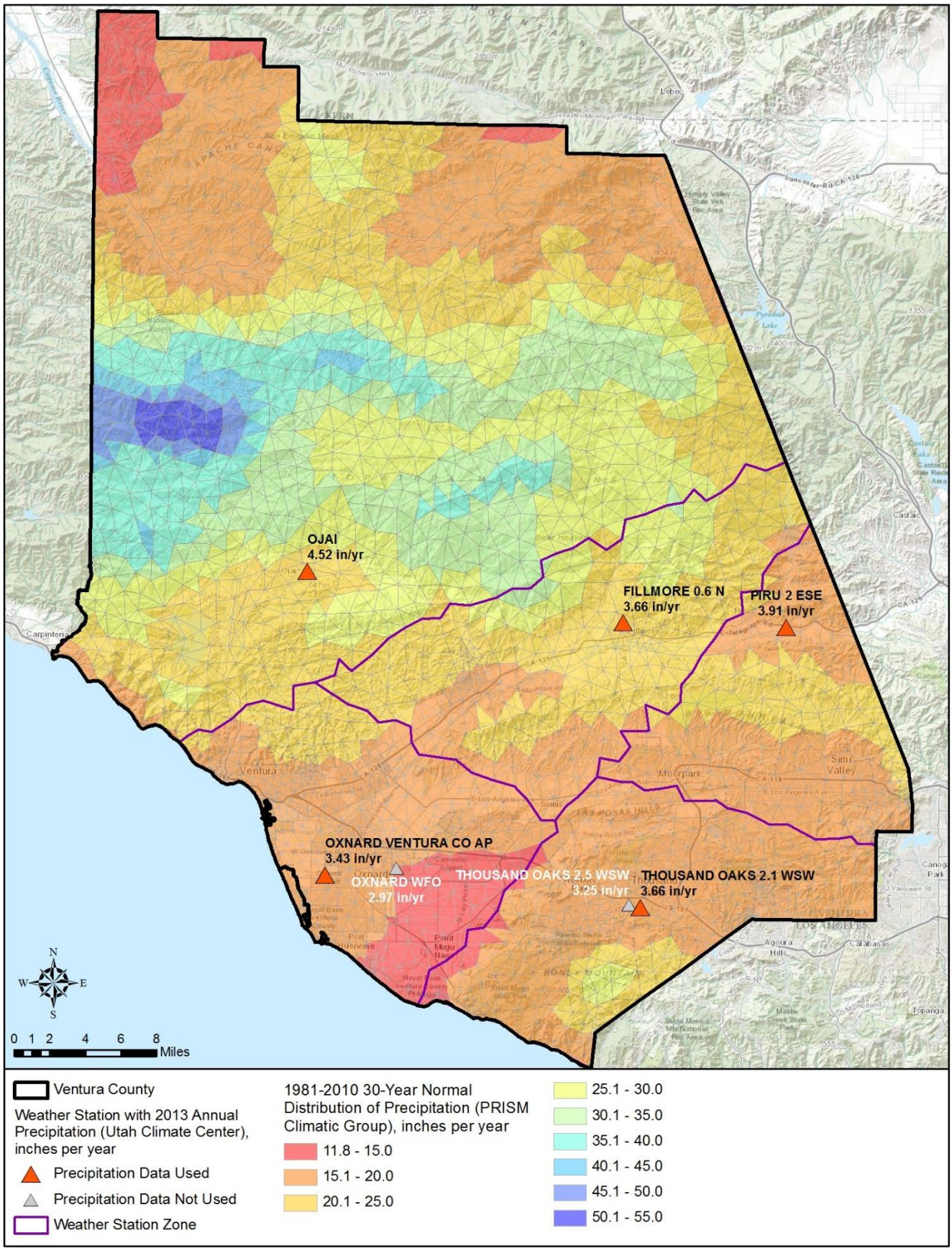

Figure 3: Precipitation Stations and Zones Applied to IDC Elements

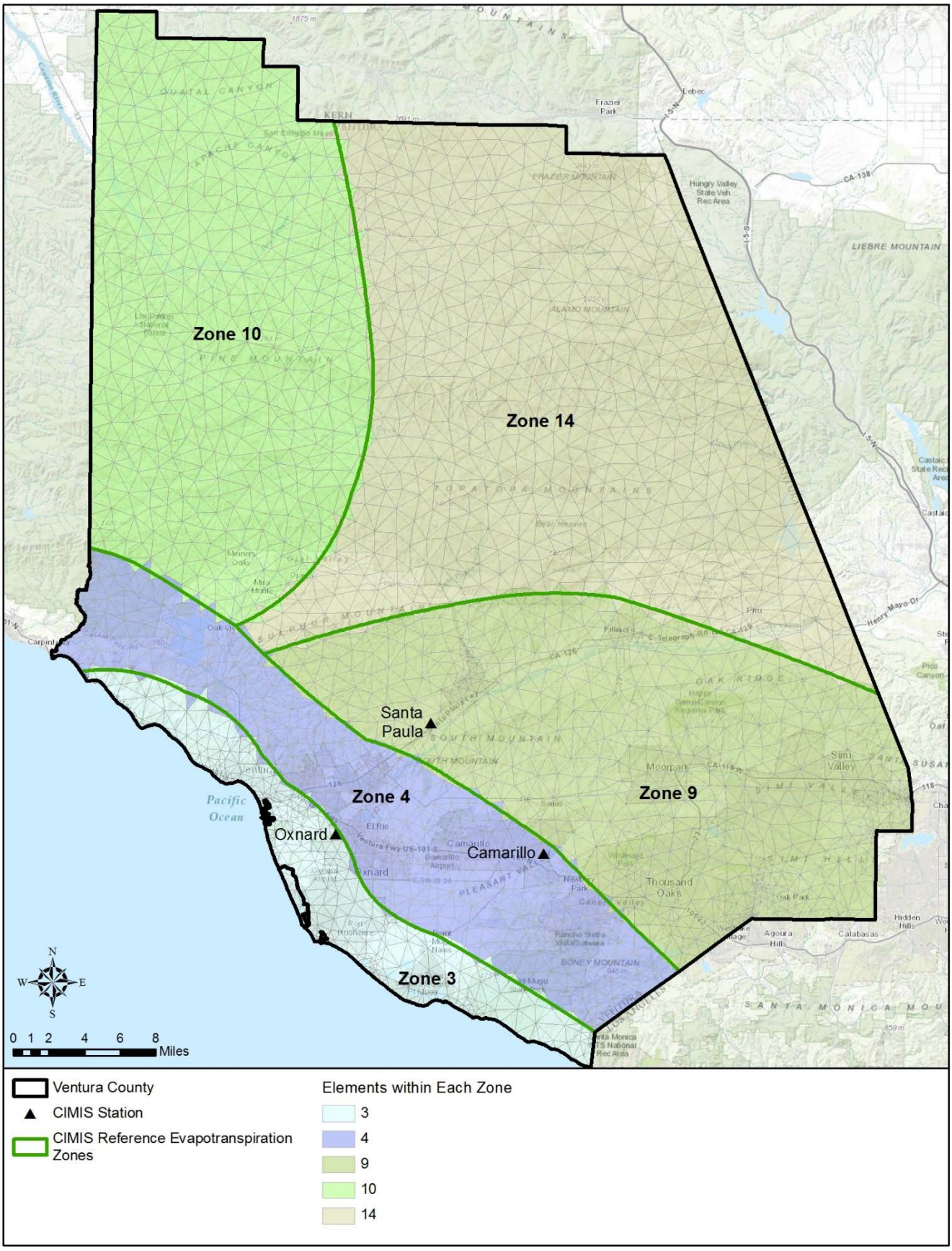

Figure 4: CIMIS ET_o Stations and Zones Applied to IDC Elements

For each crop type within each element, the reference evapotranspiration (ET_o) assigned to the element as described above was multiplied by a daily crop coefficient (K_c). Excepting grains, field, and truck crops, K_c was kept fixed over the entire year. For grains, field, and truck crops, K_c was increased over each of their respective growing seasons. Table 3 summarizes the crop groupings and range of coefficients used by the IDC.

Table 3: Crop Coefficients used by the IDC

Crop Group	Minimum K_c	Maximum K_c
Grains	0.03	1.14
Field	0.03	1.14
Alfalfa	1	1
Pasture	0.95	0.95
Truck	0.03	1.06
Deciduous	0.7	0.7
Citrus and Avocado	0.7	0.4
Vineyards	0.4	0.4
Semi-agricultural	0.03	0.03

SOILS

The IDC requires a number of soil parameters to be assigned to every element including wilting point, field capacity, total porosity, saturated hydraulic conductivity and lambda. This information is contained in the national SSURGO database, collected by the USDA Natural Resources Conservation Service. Figure 5 shows the distribution of soils used in the IDC. In locations where no soils are mapped, a generalized classification of "gravelly sandy loam" was applied to those elements in the IDC. There are very few cropped areas in these unmapped areas, however, there are some alfalfa fields in the northwest portion of the County. Soil parameters associated with gravelly sandy loam yielded water demands for these alfalfa fields that were similar to published demands.

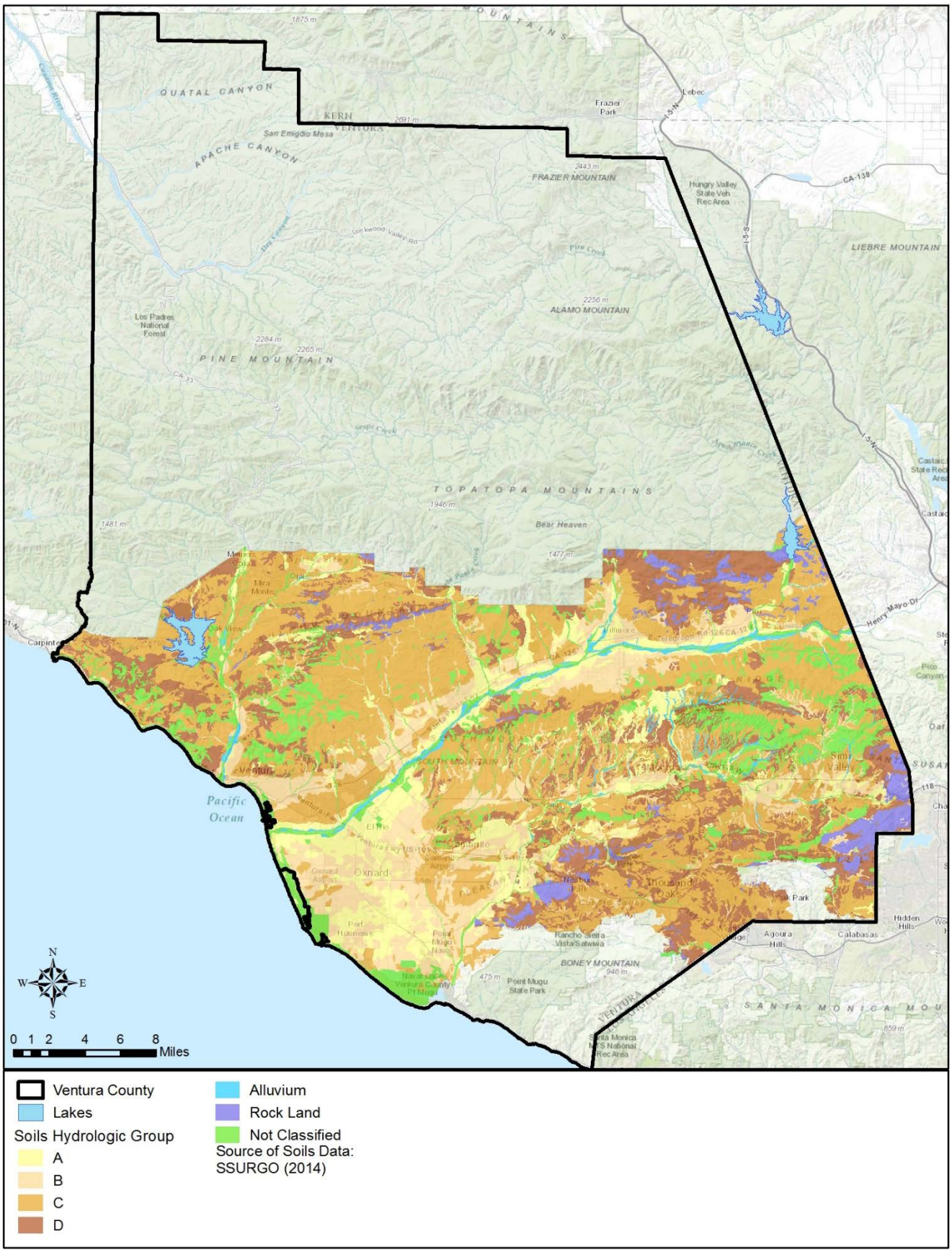

Figure 5: SSURGO Soils

CURVE NUMBER

The curve number (CN) is used to estimate runoff from rainfall. Determining a curve number depends on both the soil and land use cover conditions, including hydrologic soil group, cover type, treatment, and hydrologic condition.

The United States Department of Agriculture, Technical Release 55, *Urban Hydrology for Small Watersheds*, provides a table of runoff curve numbers for cultivated agricultural lands which are classified by cover type. The nine crops groups included in the model are assigned to one of the Technical Release 55 cover types to assign curve numbers.

Additionally, the Ventura County Watershed Protection District Hydrology Manual (2006) provides tables of curve numbers for undeveloped and developed land uses which include grassland, orchard, forest, shrub and urban. The range of curve numbers for urban land use is further categorized by percentage of effective imperviousness. The tables also split the four hydrologic soils groups A, B, C and D into soils types 1 – 7. For the purpose of the IDC, the assigned curve numbers are averaged by the hydrologic soil groups.

Imperviousness and land cover are determined from data obtained from the 2011 National Land Cover Dataset (NLCD) (Xian et al., 2011). An imperviousness percent for each city is based on the average of the NLCD impervious cells underlying the city. Land cover for each element is based on the majority land cover underlying the element.

POPULATION

The IDC requires population estimates for each urban area to calculate corresponding water demand. Population estimates for major cities within Ventura County were obtained from the California Department of Finance (CDF). The CDF data only lists populations for major cities and lumps the remainder of the population into a category called "balance of County". The TIGER cities database (2010) was used to assign population estimates to other cities not included in the CDF data. The 2010 estimates were increased by 3% each year to reflect 2013 population estimates. This adjustment increase was determined by comparing 2010 TIGER data for the larger cities with the CDF 2013 data for the same cities. Table 4 summarizes the urban population estimates used in the IDC.

Table 4: Population Assigned by City with Calibrated Per Capita Water Use

City	2013 Urban Population Estimate	Source	Per Capita Water Use (gallons per day)	Source of Per Capita Usage
Bell Canyon	2,254	TIGER	190	Estimate
Camarillo	66,485	CDF	255	2010 UWMP
El Rio	6,812	TIGER	163	Estimate from Oxnard
Fillmore	15,188	CDF	202	2010 UWMP
La Conchita	372	TIGER	190	Estimate
Meiners Oaks	4,619	TIGER	238	Estimate
Mira Monte	7,895	TIGER	238	Estimate
Moorpark	34,934	CDF	266	2010 UWMP
Oak Park	2,552	TIGER	277	2010 UWMP
Oak View	4,619	TIGER	238	Estimate
Ojai	7,554	CDF	339	2010 UWMP
Oxnard	223,072	CDF	163	2010 UWMP
Piru	1,316	TIGER	202	Estimate from Fillmore
City of Ventura	108,387	CDF	193	2010 UWMP
Santa Paula	29,979	CDF	184	2010 UWMP
Saticoy	1,132	TIGER	193	Estimate from City of Ventura
Simi Valley	125,667	CDF	232	2010 UWMP
Somis	3,241	TIGER	255	Estimate from Camarillo
Thousand Oaks	128,252	CDF	288	2010 UWMP
Total	774,330			

While most of the County's total population is accounted for within incorporated towns and cities, approximately 8% of the population lives outside urban boundaries in rural settings. This population has been included in the IDC by assigning a fraction of the rural population to six subregions. The subregions and fractions are chosen based on existing urban areas and existence of rural communities as observed on aerial photographs. Subregions with populations residing outside of major urban centers include Calleguas Creek, Rincon, Santa Clara River, Malibu Creek, South Coast and Ventura River (Figure 1). Table 5 summarizes the non-urban population estimates assigned to each subregion in the IDC. The County's total population used in the model is 836,154.

Table 5: Non-Urban Population Estimate and Calibrated Per Capita Use

Subregion	2013 Population Estimate	Per Capita Water Use (gallons per day)
Calleguas Creek	12,365	190
Rincon	6,182	190
Santa Clara River	21,639	190
Malibu Creek	3,091	190
South Coast	6,182	190
Ventura River	12,365	190
Total	61,824	

Per Capita Water Use

Per capita water use values are based on ten year baseline averages taken from each city's Urban Water Management Plan. These plans are prepared and submitted to the Department of Water Resources (DWR) every five years, with the most recent plans being those for 2010. Some of the cities and water districts in the County do not produce UWMPs as the plans are only required for water suppliers that either provide over 3,000 acre-feet of water annually, or serve more than 3,000 connections. The IDC assumes per capita water use for these cities based on water use in neighboring urban areas and observations of urban density from aerial photos.

2.4.4 CALIBRATION

To improve the accuracy of the IDC results, specific model input parameters were calibrated until the demand output resembled known recorded water use. The model was calibrated separately for agricultural and urban water demands.

AGRICULTURAL WATER DEMAND

Agricultural water demand was calibrated to the Calleguas Creek subregion. This subregion contained many of the wells for which groundwater production is reported to the FCGMA. Because the FCGMA requires groundwater extraction to be metered this was the most accurate dataset from which to work from. Agricultural groundwater production reported to FCGMA plus agricultural use of recycled water, imported water, and surface water within the subregion were used as the calibration target.

Agricultural demand is a direct function of soil parameters including wilting point, field capacity, total porosity, hydraulic conductivity and lambda – which is a measure of a soils pore size distribution. Of the parameters, lambda was chosen for adjustment during the calibration. Because soils do not have a standard lambda value, there are fewer constraints and a greater degree of flexibility when making adjustments. Since the original lambda values were producing a much higher agricultural demand than the recorded water use, lambda was decreased uniformly across all soil types until the agricultural demand in the Calleguas Creek subregion matched the corresponding recorded agricultural water use for the subregion.

MUNICIPAL/DOMESTIC WATER DEMAND

Municipal/domestic water demand was calibrated to match the total municipal/industrial/commercial water use for the entire County. The original input parameters produced a total urban water demand that was much lower than the recorded urban water use for 2013. Since the IDC calculates urban water use as a function of population and per capita water use, the latter was increased uniformly for all urban areas. The final per capita water use values are 19% higher than the per capita water use factors obtained from the UWMPs. Table 4 and Table 5 provide the calibrated per capita water use factors used for cities and rural areas, respectively.

2.4.5 IDC RESULTS

The output from the IDC is a total water demand estimate that is summarized by subregion and demand type. Table 6 presents the output from the IDC for both agricultural and municipal/domestic demands.

Table 6: IDC Output by Subregions for 2013

Subregion	Total Agricultural Demand (Acre-Feet)	Total Municipal/ Domestic Demand (Acre-Feet)	Total Demand (Acre-Feet)
Hall Canyon/Arundell	815	9,924	10,739
Calleguas Creek	112,701	89,335	202,037
Rincon	5,727	1,848	7,575
Ormond Beach	2,797	22,913	25,710
Santa Clara River	114,919	31,284	146,203
Cuyama	5,452	0	5,452
Malibu Creek	1,083	19,291	20,374
South Coast	86	2,035	2,121
Ventura River	11,745	13,351	25,096
Entire Model Area	255,326	189,982	445,308

The amount of unreported water used for agricultural irrigation and domestic purposes was estimated by subtracting reported agricultural usage (both groundwater and surface water) from the total agricultural demand estimate for the entire model area in Table 6; likewise, to estimate rural domestic usage, reported municipal and domestic usage (both groundwater and surface water) was subtracted from the total municipal/domestic demand estimate for the entire model area in Table 6. It was assumed that unreported use was met by groundwater.

SECTION 3
WATER RESOURCES AND AVAILABILITY

Figure 6 summarizes the sources of water used in Ventura County in 2013. Each source is discussed separately in the following subsections.

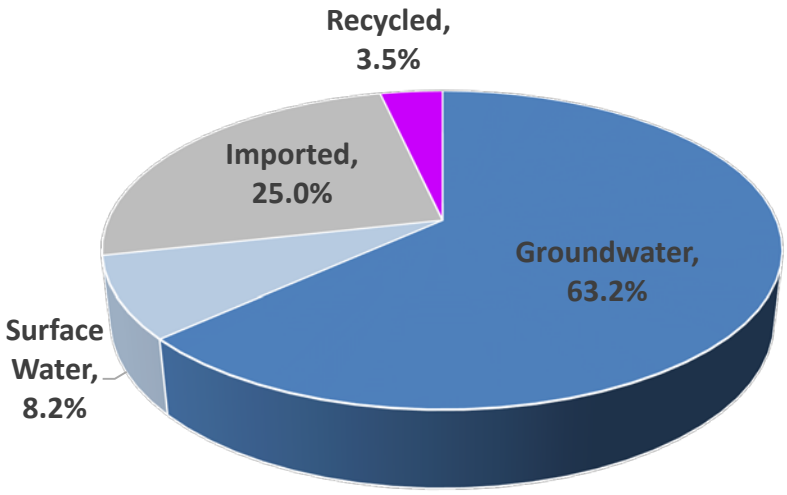

Figure 6: Ventura County Water Supply Sources

3.1 SURFACE WATER

Local surface water is diverted by holders of surface water rights from streams, creek, rivers, and springs within the County. Stream, creek, and river flows comprise runoff from precipitation and permitted effluent discharges. Spring flows are considered surface water but are actually surface expressions of groundwater. The majority of surface water diversions in the County occur in the Santa Clara River and Ventura River watersheds (Figure 7). Table 7 categorizes the number of licensed water rights holders by watershed and water right face value.

Water from Lake Casitas in the Ventura watershed is distributed by Casitas MWD to its private and agricultural customers (Figure 7). Lake Casitas reservoir can hold up to 254,000 AF of water, and is fed by flows diverted from Ventura River and Coyote Creek. Its annual "safe Yield" is approximately 21,900AF. The City of Ventura diverts surface flows of the Ventura River at Foster Park to supplement its water supply.

Table 7: Summary of Surface Water Diversion Water Rights

Watershed	Number of Licenses with Face Value >0 - 1 AFY	Number of Licenses with Face Value 1 - 10 AFY	Number of Licenses with Face Value 10 - 100 AFY	Number of Licenses with Face Value > 100 AFY
Calleguas Creek	0	0	0	1
Santa Clara River	26	10	10	9
Cuyama	1	2	1	0
Malibu Creek	0	0	2	0
South Coast	0	1	0	0
Ventura River	3	4	6	9
Minor watersheds draining out of the County	7	0	2	0
Total	**37**	**17**	**21**	**19**

In the Santa Clara River watershed, UWCD uses conservation releases from Santa Felicia Dam (which impounds Lake Piru which has a current capacity of 82,300 AF) to recharge the Piru, Fillmore, Santa Paula, and Coastal Basins, with typically less than 10% delivered to agricultural users (UWCD, 2014). Conservation releases since 1999 average 28,369 AFY with an annual minimum of zero and a maximum of 47,400 AF, dependent on environmental bypass flow requirements and climatic conditions (UWCD, 2014). In 2013, the natural runoff into the lake was less than the mandated environmental bypass flows and evaporation from the lake, and therefore no conservation release was made (UWCD, 2014). UWCD also has a right to divert Santa Clara River flows at the Freeman Diversion for both artificial recharge and direct delivery to agricultural users (Figure 7). To avoid double counting, surface water that is used for recharge has not be included in the water supply and demand estimates.

The amount of surface water available is strongly dependent on the amount of precipitation received during the year. 2013 was a particularly dry year that received 23% of the long-term average annual precipitation. In dry years, the water demand that is normally met by surface water is made up with increased groundwater production. In 2013, surface water provided the County approximately 8.2% of its water supply (36,726 AF). Table 8 summarizes the County's 2013 water supply together with the demand each sector had on the supply.

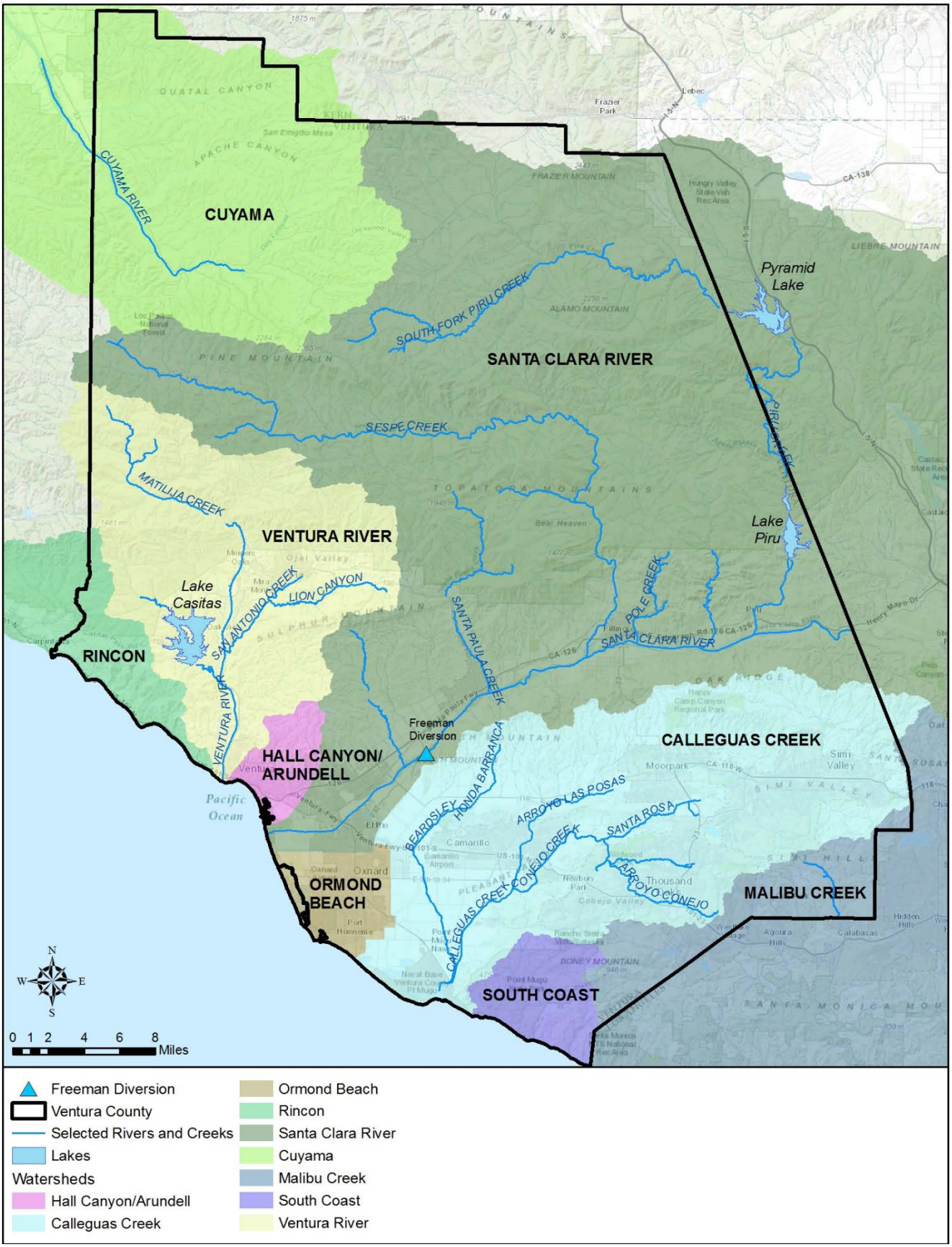

Figure 7: Ventura County Watersheds

Table 8: 2013 Ventura County Water Supply and Demand (Values in Acre-Feet)

	Water User/Agency	Agriculture	Municipal & Industrial	Total
Surface Water	Casitas MWD	*8,305*	*9,990*	*18,295*
	City of Ventura	*0*	*4,200*	*4,200*
	UWCD	*6,257*	*0*	*6,257*
	Private	*7,974*	*0*	*7,974*
	Surface Water Total	**22,536**	**14,190**	**36,726**
SWP	UWCD	*0*[1]	*0*	*0*
	Calleguas MWD	*5,537*	*105,747*	*111,283*
	Imported SWP Total	**5,537**	**105,747**	**111,283**
Groundwater	Ojai GMA[2]	*3,401*	*2,037*	*5,438*
	FCGMA[3]	*105,346*	*44,949*	*150,295*
	UWCD[4]	*83,243*	*13,115*	*96,358*
	Private (unreported)	*24,591*	*4,868*	*29,459*
	Groundwater Total	**216,581**	**64,969**	**281,550**
Recycled Water	Oak Park Water Service[5]	*0*	*790*	*790*
	Lake Sherwood CSD[5]	*0*	*484*	*484*
	California Water Service Co.[5]	*0*	*644*	*644*
	City of Simi Valley/ County Waterworks No. 8	*0*	*56*	*56*
	Camarillo San. District	*1,840*	*46*	*1,886*
	Camrosa Water District Non-Potable[6]	*4,687*	*1,372*	*6,059*
	Camrosa Water District Non-Potable to PVCWD[6]	*3,241*	*0*	*3,241*
	Camrosa Water District CWRF Recycled (Title 22)	*901*	*268*	*1,170*
	Moorpark WWTP/County Waterworks No. 1	*3*	*718*	*721*
	City of Ventura/Ventura Water Reclamation Facility	*0*	*700*	*700*
	Recycled Water Total	**10,672**	**5,078**	**15,751**
	TOTAL	**255,325**	**189,984**	**445,310**

Table 8 Notes:
[1] UWCD received 2,242.5 AF SWP water in 2013 but because of low levels in Lake Piru no conservation release was made in 2013, and therefore the SWP water remains in the lake until a conservation release is made.
[2] Groundwater production records provided by Ojai GMA are mostly estimated not metered.
[3] Groundwater production records provided by FCGMA are metered.
[4] Groundwater production records provided by UWCD are a combination of metered and estimates based on crop type or electrical usage.
[5] Imported by Calleguas MWD from Triunfo Sanitation District / Las Virgines MWD's Tapia WRF
[6] From Hill Canyon WWTP

3.2 GROUNDWATER

Groundwater is pumped and used extensively throughout the County. Aquifers beneath the Santa Clara Valley, Oxnard Plain, and Las Posas basins have the greatest density of wells extracting groundwater. Agricultural users, water districts, and cities are the largest users of groundwater. Other groundwater producers include a multitude of small mutual water companies, public entities, and private users who are not supplied by a water purveyor. Figure 8 shows the location of water purveyors throughout the County. In particular, there are a large amount of water purveyors outside of the FCGMA boundary in the southern portion of the County that do not report their groundwater production. The IDC results were used to estimate the amount of groundwater pumped by those users who do not report their production to a water management agency (Section 2.4.5).

In 2013, groundwater provided the County approximately 63.2% of its water supply, or a total of 281,550 AF.

3.3 IMPORTED WATER

The State Water Project (SWP) provides all the County's imported water. Calleguas MWD, as a member agency, purchases SWP water through the Metropolitan Water District of Southern California (Metropolitan WD). It distributes SWP on a wholesale basis to cities, local water agencies, and private and mutual water companies throughout southern Ventura County. Water that is not distributed directly to its customers is stored either at Lake Bard (capacity of 10,000 AF) or at the District's Las Posas Aquifer Storage and Recovery well field (total injection capacity of 63 cfs). Projections by Metropolitan WD allow for up to 147,013 AFY of SWP water to be allocated to Calleguas (Calleguas MWD, 2011).

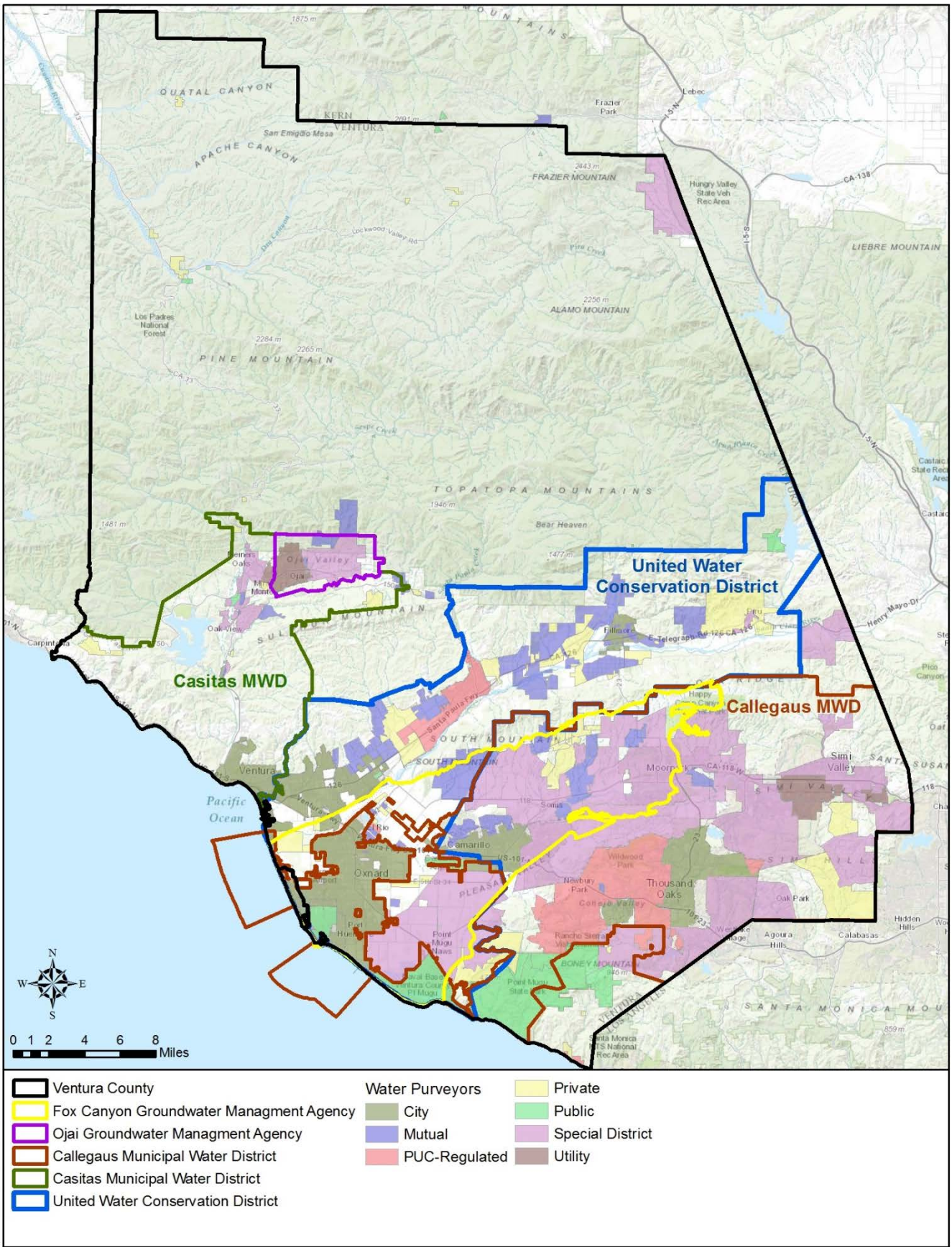

Figure 8: Water Purveyors and Management Agencies

Ventura County has an annual allocation of 20,000 AF of SWP. UWCD has access to 5,000 AFY of this SWP allocation. Port Hueneme Water Agency uses up to 1,850 AFY of UWCD's 5,000 AFY, which is provided through Calleguas MWD. Up to 3,150 AFY is available to UWCD between November and the end of February each year. UWCD receives its SWP deliveries through water released from Pyramid Lake which flows via Piru Creek to Lake Piru (Figure 7). The lake, which has a capacity of 82,300 AF, is impounded by the Santa Felicia Dam which allows for releases to the Santa Clara River. UWCD diverts water at the Freeman Diversion for use on the Oxnard Forebay and Plain. Much of UWCD's SWP water recharges the Piru, Fillmore, Santa Paula, and coastal basins. However in 2013, UWCD's SWP water purchased in 2013 remained in Lake Piru and was not released for use. In the Ventura watershed, Casitas MWD has a 5,000 AF allocation from the SWP, and the City of Ventura has a 10,000 AF allocation. Both agencies do not have infrastructure in place to deliver or make use of this potential supply.

As shown on Figure 6, imported water provided the County approximately 25.0% of its water supply in 2013 (111,283AF).

3.4 RECYCLED WATER

The use of recycled water is increasing in the County as traditional water sources experience increased stresses. In 2013, recycled water from wastewater treatment plants (WWTP) was used for agricultural and landscape irrigation by Oak Park Water Service, Lake Sherwood Community, California Water Service, City of Simi Valley, Camarillo Sanitary District, Camrosa Water District, Pleasant Valley County Water District (PVCWD), City of Moorpark, and City of Ventura. There are plans in the future for development of additional recycled water supplies as shown in Table 9.

As shown on Figure 6, recycled water provided the County approximately 3.5% of its water supply in 2013, or a total of 15,751 AF.

Table 9: Summary of Current, Future, and Potential Recycled Water Use

Wastewater Treatment Plant	Owner	Recycled Water (AFY)		
		2013 Use	Planned Future Use	Potential Capacity[1]
Camarillo San. District WWTP	Camarillo San. District	1,886	NA	7,600
Camrosa WRF	Camrosa Water District	1,170	2,044	2,500
Fillmore WWTP	City of Fillmore	0	2,000	2,700
Hill Canyon WWTP	City of Thousand Oaks	9,300	NA	12,000
Montalvo WWTP	Montalvo Community Services District	0	NA	NA
Moorpark WWTP	Ventura County Waterworks District No. 1	721	1,525	NA
Ojai WWTP	Ojai Valley Sanitary District	0	~900	NA
Oxnard AWPF	City of Oxnard	0	14,000	NA
Santa Paula Water Recycling Facility	City of Santa Paula	0	3,800	4,700
Saticoy WWTP	Saticoy San. District	0	0	NA
Simi Valley WQCP	City of Simi Valley/ Ventura County Waterworks District No. 8	56	1,170 (6,500 from SNP doc)	14,000
Tapia WRF[2]	Triunfo San. District, Las Virgenes MWD, and Calleguas MWD	1,918	NA	~2,300
Ventura Water Reclamation Facility	City of Ventura	700	13,400	~26,000
Total		**15,751**	**> 53,113**	**> 88,245**

[1] Potential capacity is assumed to be the capacity of the wastewater treatment plant.
[2] Only approximately one-third of recycled water from this plant is imported into Ventura County.
NA = not available. Where NA is shown in the Planned Future Use column, the value from 2013 Use is used. Where NA is shown in the Potential Capacity column, the value from the Planned Future Use is used.
WQCP = Water Quality Control Plant
WRF = Wastewater Reclamation Facility
WWTP = Wastewater Treatment Plant
AWPF = Advanced Water Purification Facility

3.5 WATER AVAILABILITY BY WHOLESALE DISTRICT

There are three wholesale water districts in Ventura County, that together spatially cover approximately half of the County (Figure 8). The following sections describe each District and their water supply availability.

3.5.1 CASITAS MUNICIPAL WATER DISTRICT

Casitas MWD is located in western Ventura County and supplies water to the Ojai Valley, the Ventura River Valley, the western portion of the City of Ventura, and the Rincon and beach area up to the Santa Barbara County line (Figure 8). Casitas MWD's water supply comes completely from local sources. Its main source of water supply is Lake Casitas, which has a full capacity of 254,000 AF. The source water for Lake Casitas is direct rainfall on the lake surface, local watershed runoff from Coyote and Santa Ana Creeks, and from diversions from the Ventura River made through the Robles Diversion Facility and canal.

Casitas MWD also maintains and operates one well with an approximately 300 AFY capacity. The water from the well exceeds the State's maximum contaminate level for nitrate and is blended with lake water to an acceptable level of nitrate before delivery to Casitas MWD customers.

Casitas MWD has contracted for up to 5,000 AF of Ventura County's 20,000 AFY SWP allocation. Casitas MWD has not yet made a physical connection to the SWP that allows for importation of SWP into its service area.

3.5.2 UNITED WATER CONSERVATION DISTRICT

The UWCD is a wholesale water district that conserves and enhances the water resources of the Santa Clara River Valley and Oxnard Plain (Figure 8). UWCD enhances water supplies through groundwater replenishment, and construction and operation of water supply and delivery systems.

UWCD's sources include surface water, groundwater, and imports from the SWP. UWCD's conserves runoff in the Santa Clara River and its tributaries by replenishing its underlying groundwater basins through spreading basins. Lake Piru stores SWP water and local runoff – its current capacity is 82,300 AF, and operational minimum pool of 20,000 AF. Water is released from the lake through the Santa Felicia Dam where it flows down Piru Creek and into the Santa Clara River. No direct use of the water, other than incidental streambed percolation and

recharge, is made until it is diverted at the Freeman Diversion. Some of the diverted water is recharged at spreading basins in the Oxnard Forebay and some is delivered directly to agricultural users via the Pumping Trough Pipeline and Pleasant Valley Pipeline and Reservoirs. The Oxnard-Hueneme Pipeline provides drinking water to the City of Oxnard, the Port Hueneme Water Agency, and a number of mutual water companies. Groundwater pumped from UWCD's wells near the spreading basins are used to supplement its water supplies.

3.5.3 CALLEGUAS MUNICIPAL WATER DISTRICT

Calleguas MWD is a member agency of the Metropolitan WD that distributes SWP water purchased from Metropolitan WD on a wholesale basis to 19 purveyors throughout southern Ventura County (Figure 8). Although its main source of supply is imported SWP water delivered directly to its customers, Calleguas MWD supplements this supply with groundwater and stored SWP water pumped from its Las Posas well field.

Calleguas MWD estimates water demands in the long-term (2035) ranging between 202,160 AFY and 210,205 AFY depending on climatic conditions. The total of local supplies (between 67,574 AFY and 75,310 AFY) and projected imported water allocation (between 143,777 AFY and 147,013 AFY) exceed the estimated demands.

SECTION 4
WATER DEMAND

4.1 AGRICULTURAL WATER DEMAND

4.1.1 AGRICULTURAL DEMAND SUMMARY

The agricultural water demand for 2013 was approximately 57.3% of the countywide water demand, or 255,325 AF (Figure 9). This demand is met by several sources of water. The majority of agricultural demand is met from groundwater which is pumped by individual growers or supplied by water agencies or irrigation mutual companies. There are three agencies in the County (Ojai GMA, UWCD, and FCGMA) which collect groundwater use records from pumpers within their management areas as shown in Figure 8. These three groundwater management areas cover the major agricultural areas in the County. In addition to groundwater, there are growers and some larger water agencies who have rights to use surface water for irrigation. Recycled water is another source of water used for agricultural irrigation. This alternative water supply for irrigation is increasing each year.

Groundwater supplied approximately 84.8% of the agricultural demand while surface water supplied 8.8% (Figure 9). Recycled water made up 4.2% of the agricultural demand. Due to its relative cost, imported SWP water services a very small portion of the County's agricultural demand (Figure 9).

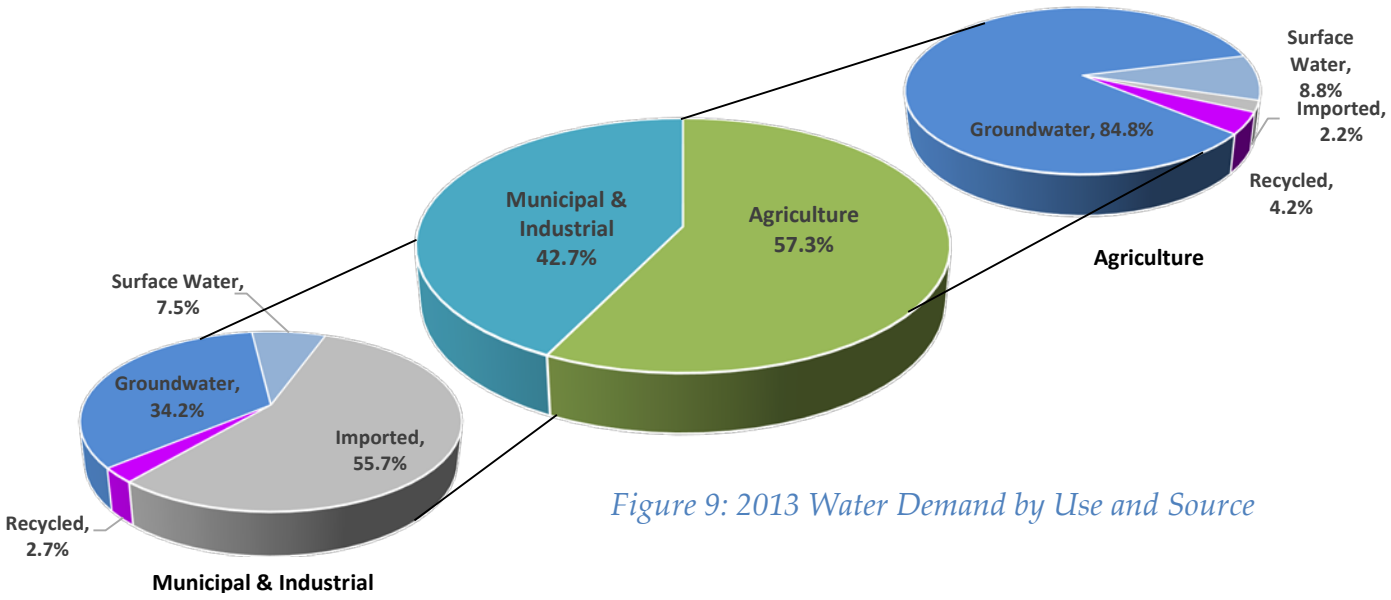

Figure 9: 2013 Water Demand by Use and Source

4.1.2 AGRICULTURAL DEMAND BY WATERSHED

The County's main agricultural areas are located in the Santa Clara River Valley, Conejo-Calleguas Basin, Ojai Valley, Oxnard Plain, and along the north coast (Figure 10). Agricultural water demands are described for watersheds with significant agricultural water demands below. Note that the demand numbers provided are not completely accurate because major water agencies often spanned more than one watershed and therefore the water demand data was estimated per watershed based on weighted area. Where demand values are not provided, it was not possible to separate the data provided into smaller geographic areas.

SANTA CLARA RIVER WATERSHED

Santa Clara River Valley

The Santa Clara River watershed has the greatest agricultural water demand of all the watersheds in the County. Agricultural demand depends heavily on groundwater (approximately 92,000 AF), with some surface water diversions supplementing the water supply for those growers with water rights (approximately 8,000 AF). Recent housing developments in the Piru, Fillmore, Santa Paula, and City of Ventura areas are reducing the amount of agricultural lands that require irrigation, however with the increase in population caused by urbanization, the water demand either remains the same or decreases slightly from agricultural to municipal. For example, one acre of avocado crop in Fillmore uses approximately 2.8 AF of water a year while one acre of low density housing (four dwelling units per acre) has a water demand of approximately 1.8 AF, assuming 400 gallons per day per dwelling unit. Higher housing densities can increase the municipal water demand.

Recycled water is not used for agricultural purposes in the Santa Clara River Valley although there are plans for its use in the near future by the unincorporated community of Piru, the City of Santa Paula, and Saticoy Sanitation District (Larry Walker Associates, in preparation).

Outer Portions of Santa Clara River Watershed

There are a few scattered agricultural locations in the northern part of the watershed (Figure 10). The water demand in these areas of several thousand acre-feet is generally met by groundwater.

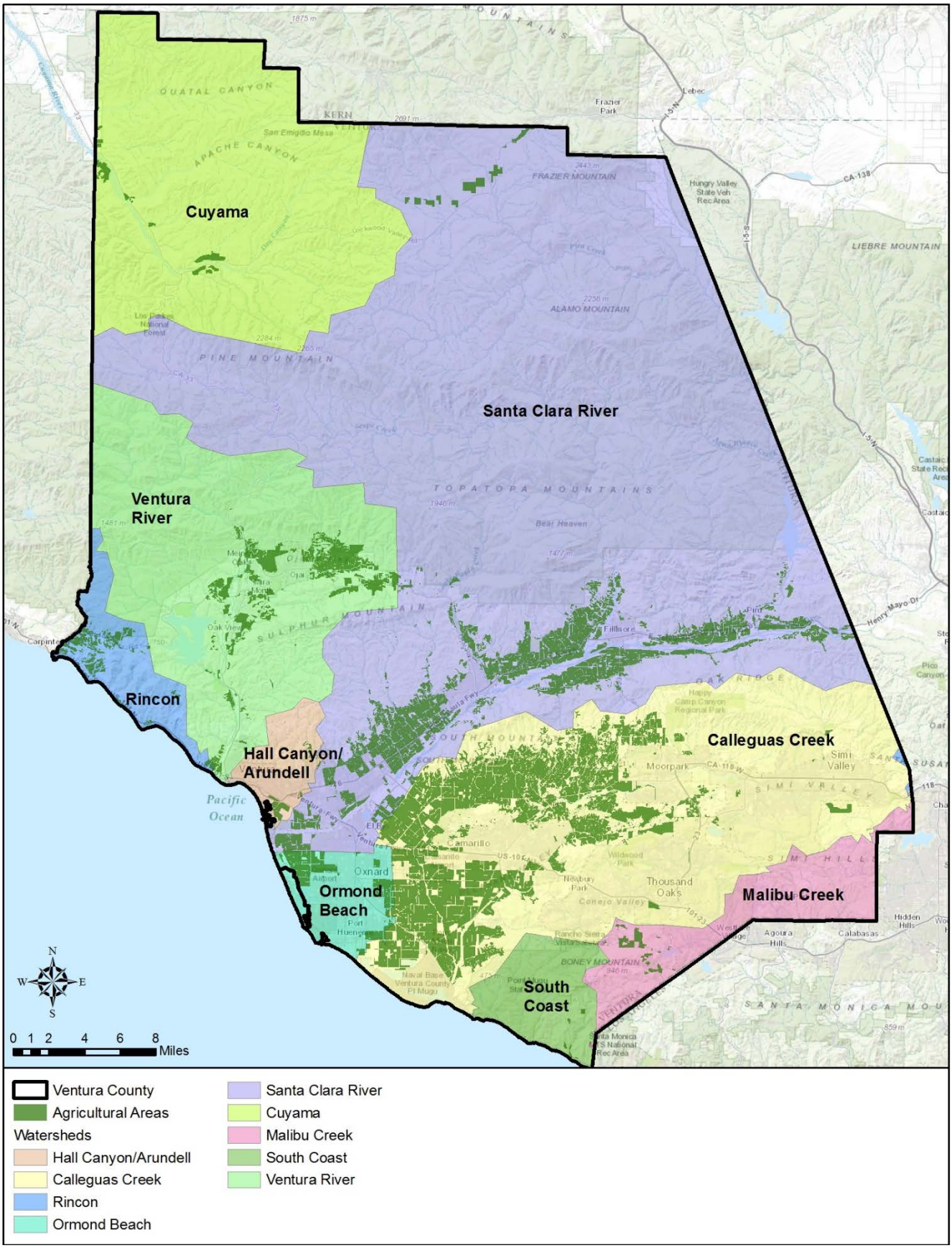

Figure 10: Agricultural Areas

CALLEGUAS CREEK WATERSHED

Agriculture in the Calleguas Creek watershed is concentrated in the Los Posas Valley, Pleasant Valley, Oxnard Plain, the Santa Rosa Valley, and Tierra Rejada areas. Primary agricultural water demand is met by groundwater (89,600 AF), with smaller amounts met by recycled (10,700 AF) and imported water (5,500 AF). Imported water is often used to blend groundwater where groundwater water quality is poor. Surface water provided 5,800 AF of irrigation water.

Agricultural users on the Oxnard Plain (not within the Ormond Beach watershed) primarily use groundwater for irrigation. Imported water, when available, and natural streamflow are diverted by UWCD from the Santa Clara River at the Freeman Diversion and distributed to growers via the Pump Trough Pipeline and Pleasant Valley Pipeline. Because of limited precipitation in 2013, even though UWCD purchased 2,242.5 AF of SWP water (delivered to Lake Piru in November 2013), they did not make any releases of SWP water from Santa Felicia Dam thus no imported water was used for irrigation. Although countywide recycled water use for irrigation has increased in recent years, its use on the Oxnard Plain has not yet been implemented.

VENTURA RIVER WATERSHED

Agriculture in the Ventura River watershed, focused in the Ojai Valley and along the Ventura River, relies on both locally pumped groundwater and surface water supplied by Casitas MWD from Lake Casitas. The Ojai GMA collects groundwater pumping data from agricultural and other users.

RINCON WATERSHED

Groundwater is limited in the Rincon watershed, and thus surface water from Lake Casitas (less than 1,000 AF) is the primary source of agricultural irrigation water for the mostly avocado crop grown along the coast.

4.2 MUNICIPAL AND INDUSTRIAL WATER DEMAND

4.2.1 MUNICIPAL AND INDUSTRIAL WATER DEMAND SUMMARY

The water demand under the municipal and industrial (M&I) category of use includes residential (municipal and private domestic), commercial, and industrial uses. The M&I demand in Ventura County for 2013 was 42.7% of the countywide water demand, or 189,984 AF. The most populated areas where M&I demand is

concentrated are in Camarillo, Moorpark, Oak Park, Thousand Oaks, and Simi Valley area, Oxnard Plain, Santa Clara River Valley, City of Ventura, and the Ojai Valley. Figure 11 shows the locations of urban areas within the County. More than half the County's M&I demand is met by imported water, roughly a third is met by groundwater, and less than 8% is met by surface water (Figure 9). Recycled water for M&I use is limited to dust suppression and landscape irrigation, contributing 2.7% to the M&I demand.

From the data provided by water agencies it was often not possible to identify how much water was distributed to and/or pumped by each city. Therefore volumes are not provided for most cities.

4.2.2 Municipal and Industrial Water Demand by Watershed

Santa Clara River Watershed

Santa Clara River Valley

The cities of Piru, Fillmore, and Santa Paula rely completely on local groundwater supplies to meet their M&I demand. There has been a marked increase in new residential developments in this area in the past few years. This is expected to cause a population increase which in turn will increase M&I demands.

City of Ventura

The City of Ventura spans three watersheds: Santa Clara River, Hall Canyon/Arundell, and Ventura River. The current total city water demand is approximately 18,000 AF (RBF, 2014) which is met by six sources that can supply a total of 19,600 AF:

- Casitas MWD delivery of Lake Casitas water (Ventura River watershed) ~5,000 AF,
- Ventura River Foster Park: surface water intake and groundwater/ subsurface intake (Ventura River watershed) ~ 4,200 AF,
- Mound Basin groundwater Santa Clara River/ Hall Canyon/Arundell watersheds) ~ 4,000 AF,
- Oxnard Plain groundwater (Santa Clara River watershed) ~ 4,100 AF,
- Santa Paula Basin groundwater (Santa Clara River watershed) ~1,600 AF, and
- Recycled water ~ 700 AF.

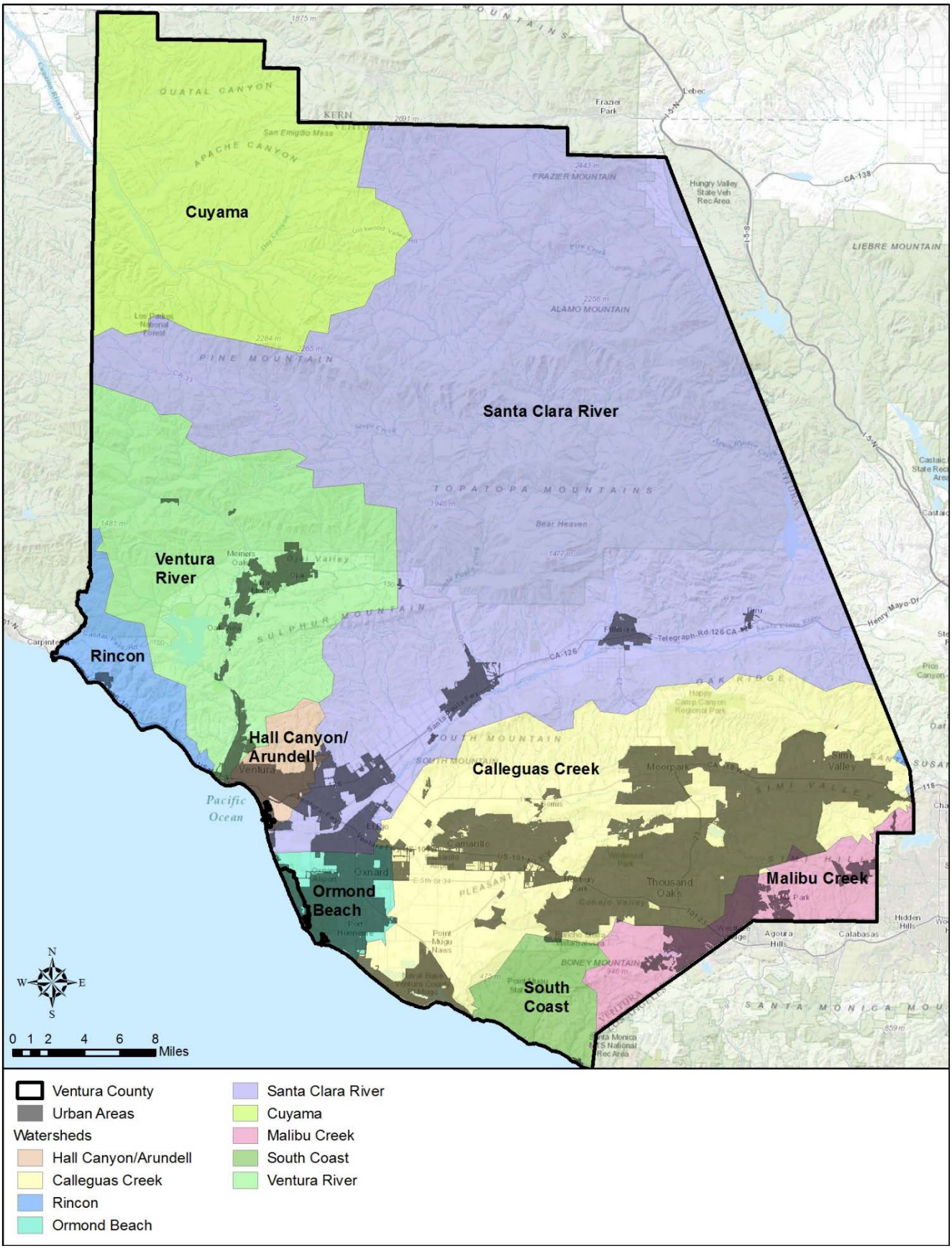

Figure 11: Urban Areas

The City of Ventura predicts that the M&I water demand based on near-term demand growth projections for under construction or approved projects will require an additional 1,000 AF of water (RBF, 2014). Given the City's current available water supply of 19,600 AFY, they predict they can meet their existing and approved development demands provided supply does not decrease (RBF, 2014). Additional opportunities may exist to develop new water supplies such as use of recycled water from the Ventura Water Reclamation Facility that is currently discharged to the Santa Clara River Estuary, reuse of the Ojai Valley Sanitary District's effluent that is currently discharged into the Ventura River, and ocean water desalination.

Calleguas Creek Watershed

Calleguas MWD provides approximately 78,200 AF of imported water for M&I use to the cities of Moorpark, Oak Park, Thousand Oaks, Camarillo, Simi Valley, and Oxnard. Purveyors include: California American Water Company, Camrosa Water District, Pleasant Valley Mutual Water District, Golden State Water Company, Ventura County Water Works Districts # 1 and #19, and several small mutual water companies. Imported water is the primary source of water to the area. Groundwater pumping by smaller water agencies and cities supplements the M&I demand.

Ormond Beach Watershed

The Ormond Beach watershed includes the urban areas of Oxnard and Port Hueneme. In 2013, this area's population was approximately 223,000, with Port Hueneme experiencing the largest population increase from 2012 to 2013 of all County cities (2% increase). M&I use is mostly imported water supplied by Calleguas MWD, with UWCD providing groundwater pumped from the Oxnard Forebay, and the City of Oxnard pumping from the Oxnard Plain. Given the historic increase in population in this area, M&I demands are likely to increase over time. Part of this demand increase will be met by recycled water for landscape irrigation and industrial use. In 1999, the City of Oxnard launched the Groundwater Recovery Enhancement and Treatment (GREAT) Program to improve water supply reliability and water quality, and to reduce reliance on imported water. The GREAT Program combines wastewater recycling, brackish groundwater desalination, groundwater injection, storage and recovery, and restoration of local wetlands to provide an additional water supply source to the Oxnard Plain through the year 2030. The city's Advanced Water Purification

Facility and some recycled pipelines have been completed as part of that program, however, use of the recycled water has not yet been finalized.

VENTURA RIVER WATERSHED

City of Ventura

The M&I demand for the City of Ventura is discussed in the Santa Clara River watershed section on page 35.

Ojai Valley

The two primary sources of M&I water in the Ojai Valley are from groundwater (approximately 2,000 AF) and Lake Casitas surface water (approximately 500 AF).

HALL CANYON/ARUNDELL WATERSHED

The M&I demand for the City of Ventura is discussed in the Santa Clara River watershed section on page 35.

4.3 IN-STREAM AND ENVIRONMENTAL USES

In-stream water uses include uses that require flows in rivers and creeks to be set at minimum rates for specific periods of time in order to provide optimal habitat for the protection of fish, wildlife, reptiles, and riparian habitat and vegetation. In particular, stream flows are regulated to protect the endangered southern California steelhead trout (*Oncorhynchus mykiss*) that is native to the Santa Clara River, Ventura River, and Cuyama watersheds. Diversions from water courses in which endangered species live and spawn may impact the habitat needed for them to survive. Countywide, there are several biological opinions or water use permit conditions that have been made by protection agencies in an effort to protect steelhead trout and other species, thereby effecting water supply and demand.

4.3.1 SANTA CLARA RIVER WATERSHED

Based on the findings of a 2008 NOAA/NMFS Biological Opinion (BO), the Freeman Diversion on the Santa Clara River provides bypass flows for the upstream and downstream migration of steelhead trout. As outlined in the BO, UWCD is permitted to divert up to 375 cfs as long as 40 cfs is provided through the fish ladder for 48 hours after total river flow subsides below 415 cfs (UWCD, 2014). The flow requirements are limited to storms that occur between February 15 and April 31 of each year, and are not to exceed an annual average loss of

diversion of 500 AF (UWCD, 2014). For 2013, no storms produced enough runoff to trigger the bypass flow requirement.

4.3.2 CALLEGUAS CREEK WATERSHED

The City of Thousand Oaks owns and operates the Hill Canyon Wastewater Treatment Plant, from which recycled water is discharged to Conejo Creek. They are permitted by a SWRCB water rights permit (Permit No. 20952) to divert surface water, some of which comprises the discharged recycled water, from the Conejo Creek and North Fork Arroyo Conejo. As part of this Permit, they are required to allow bypass flows at their point of diversion on Conejo Creek for the protection of fish, wildlife, southwestern pond turtles, and riparian habitat and vegetation. The following flow requirements are in place:

a) 2.0 cfs of treated waste water dedicated to fish and wildlife is to be bypassed at all times;
b) An additional 0.82 cfs is to be bypassed when the holder of License 12598 (Application 25247) is diverting water from Conejo Creek; and
c) A minimum flow of 6.0 cfs (including 2.0 cfs of treated waste water dedicated to fish and wildlife) shall be bypassed at all times that Permittee diverts any water which is not attributable to the portion of treated waste water discharged from the Hill Canyon Waste Water Treatment Plant which is available for diversion after accounting for 2.0 cfs for channel losses and the 2.0 cfs dedicated to fish and wildlife.

4.3.3 VENTURA RIVER WATERSHED

In 2003, a BO on Casitas MWD's on the then proposed Robles Diversion Fish Passage Facility project on the Ventura River was published by National Marine Fisheries Service (NMFS). Flow requirements in the BO state a minimum of 50 cfs is to be provided through the fish ladder during the first 10 days of each migratory storm event (i.e., storms generating flows of 150 cfs or greater measured at the Robles Diversion). Flow requirements are limited to storms that occur between January 1 and June 30. Between storm flows, flow is to be maintained at 30 cfs. Under these flow requirements, the fish-ladder constructed by Casitas MWD in 2005 allows steelhead to travel upstream of the Robles Diversion to their spawning areas and downstream to the ocean.

In 2007, NMFS published a draft BO regarding repairs to the Foster Park well field in a reach of the Ventura River that serves as critical habitat for steelhead. According to NMFS, because of the connectivity of the Ventura River to shallow

groundwater from which the wells extract water, pumping the wells has a direct impact on flows in the river. The draft BO recommends restricting pumping at the Foster Park well field to prevent Ventura River flows at the USGS flow gage 11118500 (Ventura River near Ventura) from falling below 11 to 12 cfs. This draft BO was never finalized or implemented.

SECTION 5
COMPARISON OF 2013 WATER SUPPLY AND DEMAND WITH ESTIMATES IN 1994 WATER MANAGEMENT PLAN

The 1994 Ventura County Water Management Plan (Ventura County, 1994) presented four sources of water supply: surface water, groundwater imported water, and recycled water. In calendar year 1992, groundwater provided approximately 67.0% of the County demand, surface water supplied 10.5%, and imported water supplied 22.0%.

If the 1992 groundwater usage has been overestimated, the overall increase in demand in 2013 compared to 1992 is greater than 19,800 AF (Table 10). At the time, recycled water only provided approximately 0.5% of the total supply. Although the main sources of the County's water supplies have remained the same, the 2013 supply estimates demonstrate slightly different distribution of use. Groundwater remains the largest source of water supply. Surface water has decreased to almost 8.0% of the total supply while recycled water has increased to 3.5% from 0.5%. Recycled water use in 2013 has most likely replaced imported water due to imported water's high costs compared to other sources. Also, because 2013 was a dry year compared to 1992, less surface water was used in 2013 than in 1992, which had higher rainfall and streamflow.

We estimate that the annual water demand in Ventura County has increased by 19,800 AF since 1992 (Table 11). A population increase of 25% from 1992 to 2013, from a population of 669,000 to 836,000, has had the most significant impact on the County's water demand, increasing the M&I demand from 32% in 1992 to 43% of the total water demand in 2013. This represents an increase in M&I demand of 53,800 AF over 22 years. The increase in overall demand would have been greater if per-capita use remained constant over the past 20 years.

In comparing agricultural groundwater usage from the 1994 Water Management Plan and 2013, groundwater demand has decreased by 32,200 AF since 1992 (Table 11). This indicates that the 1992 data used in the 1994 Water Management Plan could be questionable. It should be noted that 8,772 of farmland was converted to urban use in Ventura County between 1992 and 2012, for an average of 439 acres per year. There may be an increase in agricultural water demand as there has been a steady replacement of citrus with strawberry fields, which use

almost an acre-foot more water per acre than orange trees. This replacement has occurred because an acre of strawberries can fetch over ten times the price of a comparable acre of citrus. The change to more water intensive crops likely has a greater impact on water demand than loss of agricultural land to urbanization[2]. Sources of data used for the 1994 Water Management Plan were not specified in the plan, which limits the amount of verification that can be done. A comparison query of agricultural groundwater extraction from the current FCGMA database indicated extractions of 83,500 AF for 1992, which is 24,700 AF less than the 108,100 AF reported for 2013. Even though the FCGMA only includes a portion of the 1992 agricultural groundwater extractions for the County, the data appear more reasonable than reported in the 1994 Water Management Plan.

It is possible that when the 1992 agricultural groundwater demand was estimated, the area of overlap between the FCGMA and UWCD was not taken into account thereby causing an overestimation. For example, in 2013, the duplicate extractions reported to both agencies totaled approximately 68,000 AF. If the overlap was not accounted for, there would be a 68,000 AF overestimation.

If the 1992 groundwater usage has been overestimated, the overall increase in demand in 2013 compared to 1992 is greater than 19,800 AF.

Table 10: Comparison of Ventura County Water Supply between 1992 and 2013

Supply	1992	2013	Difference
Surface water	44,700 AF 10.5%	36,700 AF 8.2%	- 8,000 AF
Imported water	93,600 AF 22.0%	111,300 AF 25.0%	17,700 AF
Groundwater	285,100 AF* 67.0%	281,600 AF 63.2%	- 3,500 AF
Recycled water	2,100 AF 0.5%	15,700 AF 3.5%	13,600 AF
TOTAL	**425,500 AF**	**445,300 AF**	**19,800 AF**

* Groundwater supply may have been overestimated due to duplicate extractions reported to both the FCGMA and UWCD.

[2] The Ventura County Agricultural Commissioner estimates there are 600 acres of farmland lost to development each year.

Table 11: Comparison of Ventura County Water Demand and Sources between 1992 and 2013

Demand	Supply	1992	2013	Difference
Agriculture	Surface water	Not provided	22,500 AF 8.8%	-
	Imported water	Not provided	5,500 AF 2.2%	-
	Groundwater*	248,800 AF 86%	216,600 AF 84.8%	-32,200 AF
	Recycled water	Not provided	10,700 AF 4.2%	-
	Total Ag Demand ***% of Total Demand***	***289,300 AF*** ***68%***	***255,300 AF*** ***57.3%***	***-34,000 AF***
Municipal & Industrial	Surface water	~ 90,300 AF ~ 66%	14,200 AF 7.5%	-
	Imported water		105,800 AF 55.7%	-
	Groundwater	~ 41,000 AF ~ 30%	65,000 AF 34.2%	24,000 AF
	Recycled water	2,100 AF 0.5%	5,000 AF 2.7%	2,900 AF
	Total M&I Demand ***% of Total Demand***	***136,200 AF*** ***32%***	***190,000 AF*** ***42.7%***	***53,800 AF***
TOTAL		**425,500 AF**	**445,300 AF**	**19,800 AF**

* Agricultural groundwater demand may have been overestimated due to duplicate extractions reported to both the FCGMA and UWCD.

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SECTION 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

In 2013, water supply to Ventura County was dominated by groundwater (62.9%), followed by imported SWP water (25.2%), surface water (8.3%), and recycled water (3.6%). In 1992, recycled water contributed 0.5% to the County's water supply, equating to a 13,700 AF increase from 1992 to 2013. In 1992, imported water made up 22% of the supply, equating to a 17,700 AF increase from 1992 to 2013, or 7.5 times the 1992 usage. The increase in imported water use is due to urbanization and increased population in the southern portion of the County, where municipal supply is mostly from imported SWP water distributed by Calleguas MWD.

The amount of groundwater used in the County in 2013 was approximately 3,500 AF less than in 1992. This comparison may be incorrect as we think the 1992 groundwater extractions were overestimated. There has been a continual replacement of orange groves with more water intensive strawberries that has increased water demand significantly in the County. In reality, the amount of groundwater extracted in 2013 for agriculture should be more than in 1992.

The breakdown of water demands by different sectors: in 2013 are: 57.3% is used for agriculture, and M&I accounts for 42.7% of the water demand. The majority of the County's agricultural use is in the Calleguas Creek, Santa Clara River, and Ventura River watersheds. Urbanization in the County is focused along the coast and within the Calleguas Creek, Santa Clara River, and Ventura River watersheds.

6.2 RECOMMENDATIONS

Assuming continuation of urbanization already taking place, and the uncertain future availability of imported water, alternative sources of water need to be developed to sustain the County's growth. There has been some progress made on the use of recycled water for non-potable purposes, however there is more capacity for additional recycled water production from the County's wastewater treatment facilities that needs to be taken advantage of. Desalination of seawater and brackish water is another new source of water that should continue to be evaluated. Replacing old irrigation technology with water efficient drip and micro

irrigation, and research to develop less water intensive crops will lessen the stress on the groundwater basins while decreasing the agricultural water demand.

In collecting data for this study, the data that were the most difficult to obtain were recycled water use and unreported water use outside of the groundwater management agencies. Ultimately, recycled water use was requested from each individual producer of recycled water, however, even though the RWQCB permits recycled water use, they did not have the data centrally available for public use. The RWQCB should be encouraged to keep better records of recycled water that can be made available to the public.

Unreported water use by all users outside of the three groundwater management areas is the most difficult component of water demand to obtain because they are currently not required to report their groundwater use to anyone. It is recommended that to get a more accurate estimate of water demands in the future, all users of groundwater should report their annual use to the County. All d*e minimis* users should be identified but should not have to report usage.

In-lieu of self-reporting groundwater extractions outside of the three groundwater management areas, this usage needs to be estimated. We recommend that the IDC be used in the future to estimate this unknown component of the water demand as it accounts for both agricultural and municipal/domestic demands.

Identifying water use records as being metered or estimated would also improve the understanding of the data, and improve confidence in the numbers.

SECTION 7
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