Cardno ENTRIX

Shaping the Future

Ventura River Watershed Protection Plan Report

February 2012

Prepared for

Ventura County Watershed Protection District

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Prepared for
Ventura County Watershed Protection District
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Acronyms

AF	acre-feet
AFY	acre-feet per year
ALERT	Automated Local Evaluation in Real Time
AMPA	aminomethylphosphonic acid
amsl	above mean sea level
ASFPM	Association of State Floodplain Managers
BMPs	Best Management Practices
Casitas	Casitas Municipal Water District
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
cfs	cubic feet per second
CIMIS	California Irrigation Management System
CIP	Capital Improvements Program
CRS	Community Rating System
CTP	Cooperating Technical Partners
CRWQCB-LA	California Regional Water Quality Control Board-Los Angeles Region
CWD	County Water District
cy	cubic yards
dbh	diameter at breast height
DBS&A	Daniel B. Stephens & Associates, Inc.
DDT	dichloro-diphenyl-trichloroethane
DFIRM	Digital Flood Insurance Rate Map
District	Ventura County Watershed Protection District
DO	dissolved oxygen
DWR	California Department of Water Resources
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
Forest	Los Padres National Forest
Forest Plan	Los Padres National Forest Land and Resource Management Plan
GWMP	groundwater management plan
HRU	hydrologic response unit
HSPF	Hydrological Simulation Program–FORTRAN

IRWM	Integrated Regional Water Management
IRWMP	Integrated Regional Water Management Plan
IWPP	Integrated Watershed Protection Plan
km	kilometer
LOMR	Letter of Map Revision
MCL	maximum contaminant level
mg/L	milligrams per liter
mm	millimeters
MO	management objective
MUN	municipal and domestic supply
NAVD	North American Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NCDC	National Climatic Data Center
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration Fisheries
NPDES	National Pollutant Discharge Elimination System
OVLC	Ojai Valley Land Conservancy
OVSD	Ojai Valley Sanitary District
PGA	peak ground acceleration
ppt	parts per thousand
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
Reclamation	Bureau of Reclamation
RM	River Mile
SCAG	Southern California Association of Governments
SR	State Route
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirements
WY	water year
µg/l	micrograms per liter, equivalent to parts per billion

Executive Summary

This Watershed Protection Plan Report was developed to summarize existing information and reports prepared for the Ventura River watershed, and to fulfill a requirement of an Integrated Regional Water Management grant from the State Water Resources Control Board (SWRCB). This report is largely focused on water supply and water resources and does not provide a comprehensive assessment of the watershed, but does provide information that can inform the development of a comprehensive Watershed Management Plan.

The Ventura River watershed is entirely dependent on local resources for water supply and is mostly undeveloped, with urban and suburban development mostly concentrated along the river, tributary streams, and valley floors. Prevailing storm patterns, along with steep topography and the east-west orientation of the mountains in the upper portions of the watersheds, frequently create the potential for significant precipitation. Dams, reservoirs, and diversion structures have been developed to capture runoff, which has enhanced the reliability of water supplies. Some of these structures, however, act as barriers to fish migration and have adversely affected some aquatic species, including anadramous fish.

Various structural improvements have been implemented on the Ventura River and tributary streams to address flood risks, but flood management deficiencies remain at various locations. The Ventura County Watershed Protection District (District) has proposed additional structural improvements, but their implementation is limited by the availability of funding. In addition, flood risks are also present at other locations in the watershed, including alluvial fans in the Ojai Valley, where traditional flood management methods are not effective. To address residual risks along floodplains, Ventura County has adopted a floodplain ordinance that limits development in these areas or imposes conditions upon such development. Nonetheless, property owners located in areas that at risk for flooding must be aware of and take appropriate precautions to minimize such risks.

Total annual water demand for the entire watershed is estimated at 35,905 acre-feet, although actual water demand varies considerably due to variable annual precipitation patterns. Development of a comprehensive water budget for the watershed is limited by the availability of data, although the major inputs and outputs for this balance have been estimated.

Watershed plans have been developed for many coastal watersheds in Southern California, and a review of three plans (Ballona Creek, Tujunga-Pacoima Wash, and Calleguas Creek) suggests that the proposed Ventura River watershed management plan would benefit from identifying the intended audience; finding ways to engage watershed stakeholders; clearly defining and stating the plan's goals and objectives; focusing the plan by addressing issues where stakeholders can make a meaningful difference; prioritizing projects to meet the plan's objectives; and identifying a process to gauge progress towards plan implementation.

Recent studies prepared for the development of a watershed runoff model and a groundwater budget identified data gaps that limit the effectiveness of the runoff model at some locations and hamper a more accurate assessment of groundwater in the upper and lower Ventura River groundwater basins. The installation and/or maintenance of additional gages and wells would provide additional data and improve the accuracy of the subsequent runoff modeling and enhance the understanding of the interaction between surface and groundwater flows.

Various state and local programs provide recommendations to enhance water supply, water quality, and habitat, and these are collectively termed Best Management Practices (BMPs). The compendium of BMPs identifies opportunities to improve the management of stormwater, expand water conservations, and to minimize adverse impacts to sensitive species and their associated habitats.

To improve water sustainability and ecosystem functions in the watershed, several key recommendations are provided, including continue meetings of the Ventura River Watershed Council; improve and update the Watershed Council’s webpage; identify a mechanism(s) to assure continued funding of a watershed coordinator; convene a technical advisory group to assess and prioritize data gaps that limit development of a comprehensive water budget and develop a scope of work for that effort; conduct a facilitated discussion about the opportunities and constraints for development of a groundwater management plan; and convene a technical advisory group to develop a scope of work to address alternative options for sediment management and water diversion for the Matilija Dam Ecosystem Restoration Study.

Chapter 1

Introduction

1.1 Background

In 2006, the State Water Resources Control Board (SWRCB) awarded the Watersheds Coalition of Ventura County a Proposition 50 Integrated Regional Water Management (IRWM) grant to fund the implementation of several projects identified in the Ventura County Integrated Regional Water Management Plan (IRWMP). Collectively, the projects funded by the grant located within the Ventura River Watershed were identified as the "V-1" projects, and included the development of a watershed runoff model, surface water quality monitoring, groundwater monitoring, removal of invasive plants, and the development of this Ventura River Watershed Protection Plan Report (Report).

The contents of this Report include:

- Chapter 2: A summary of existing watershed characteristics, based on existing, readily available documents.
- Chapter 3: Summaries of the other elements of the V-1 project, including the results or conclusions of those efforts.
- Chapter 4: An estimate of water demand for the entire watershed, and a discussion of issues related to the development of water budget and an estimate of safe yield.
- Chapter 5: A summary of lessons learned from a review of three watershed plans for coastal watersheds in Southern California, and recommendations that can guide development of a watershed management plan for the Ventura River.
- Chapter 6: A discussion of data gaps, primarily identified in the reports developed for the other V-1 projects, and recommendations on how to address those gaps.
- Chapter 7: A compendium of Best Management Practices (BMPs) for water quality, water supply and habitat.
- Chapter 8: Recommendations for key actions that can improve water sustainability and ecosystem functions.
- Chapter 9: A more detailed discussion of flood control issues in the watershed than is included in Chapter 2, along with a discussion of floodplain management strategies and future flood control projects.

Chapters 2 and 3, 6, and 9 summarize information from available sources, including reports developed for the V-1 projects (which are listed below in Table 1-1). Chapter 7 provides a compendium of BMPs which were derived from other sources, but compiled for this report. Chapters 4, 5, and 8 provide information that was developed specifically for this Report.

1.2 The IWPP and V-1 Projects

To support ongoing watershed protection efforts, the Ventura County Watershed Protection District (District) developed the Integrated Watershed Protection Plan (IWPP) as the culmination of a series of long-range planning efforts. The objectives of the IWPP include the provision of a systematic process for the inclusion of projects into the District's Capital Improvement Plan and to improve the long-range District planning process (District 2011a).

The IWPP process achieves these objectives by gathering information about the existing flooding, operations and maintenance, drainage facility deficiency, access, or environmental concerns in the District and developing a prioritized project list based on the gathered information. Projects are proposed to address identified issues, and are ranked relative to each other using a scoring matrix. The highest priority projects are subjected to further study and, if the proposed alternative is found to be cost-effective and environmentally-friendly, the project can be selected for inclusion into the Capital Improvement Plan.

As part of the IWPP, a total of 33 projects were identified for Zone 1, which includes the Ventura River watershed. Project V-1 was proposed to include:

- Creation of the Ventura River Watershed Council.
- Data Gap Analysis.
- Existing Condition Studies.
  - Water Supply/Demand Study.
  - Ojai Groundwater Supply Reliability Study.
  - Development of Future Conditions Model.
  - Habitat Protection Plan.
  - Water Quality Study.
- Ventura River Watershed Protection and Supply Plan.

In 2007, the Watersheds Coalition of Ventura County, of which the District is a member, was awarded an Integrated Regional Water Management Proposition 50 implementation grant to complete elements of the V-1 project, including:

- Development and testing of the Ventura River Watershed Hydrology Model, which can simulate historic conditions on a continuous basis and will serve as the basis for water supply and water quality evaluations of the Ventura River watershed.
- Ojai Basin Groundwater Monitoring Plan.
- Upper and Lower Ventura River Basin Groundwater Budget and Approach to a Groundwater Management Plan.
- Upper San Antonio Creek Watershed Giant Reed Removal Project.
- Ventura River Watershed Protection Plan Report.

This Report fulfills a requirement of the IRWM grant from the State Water Resources Control Board and, therefore, the scope and content of this document, which is largely focused on water supply and water resources, was determined by the scope of the original grant application and a subsequent grant agreement with the SWRCB. Thus, this report is not intended to provide a comprehensive assessment of the watershed, but does provide information report that can inform the development of a comprehensive Ventura River Watershed Management Plan.

The reports produced to date under the V-1 grant are shown in Table 1-1. They are posted on the Ventura River watershed section of the District's website at: http://portal.countyofventura.org/portal/page/portal/PUBLIC_WORKS/Watershed_Protection_District/Watersheds/Ventura_River.

Table 1-1 V-1 Project Reports

Development of the Ventura River Watershed Hydrology Model		
Report Name	Preparer	Date
Data Summary Report, Ventura River Watershed Hydrology Model	Tetra Tech	June 2008
Simulation Plan, Ventura River Watershed Hydrology Model	Tetra Tech	June 2008
Baseline Model Calibration and Validation Report, Ventura River Watershed Hydrology Model	Tetra Tech	June 2009
Natural Condition Report, Ventura River Watershed Hydrology Model	Tetra Tech	July 2009
Surface Water Quality Monitoring Program		
Quality Assurance Project Plan for Ventura River Watershed Protection Project (V-1): Surface Water Quality Monitoring	District	June 2010
Ventura River Watershed Protection Project (V-1): Surface Water Quality Monitoring, Water Quality Monitoring Plan 2010	District	August 2010
Ventura River Watershed HSPF Model – Aluminum	Tetra Tech	June 2011
Groundwater Management and Monitoring		
Ojai Basin Groundwater Monitoring Plan	Daniel B. Stephens & Associates, Inc. (DBS&A)	December 2010
Groundwater Budget and Approach to Groundwater Management Plan, Upper and Lower Ventura River Basin	DBS&A	December 2010
Upper San Antonio Creek Watershed Giant Reed Removal Project		
Water Quality Monitoring Update, Upper San Antonio Creek Watershed Giant Reed Removal Project	District	April 2010
Quality Assurance Project Plan for Ventura River Watershed Protection Project (V-1): Upper San Antonio Creek Watershed Giant Reed Removal Project (SACGRRP)	District	May 2010
Upper San Antonio Creek Watershed Giant Reed Removal Water Quality Monitoring Plan	District	June 2010

Source: District, 2011

In addition to the documents listed in Table 1-1, this summary report also uses information generated during development of a proposed Multiple Species Habitat Conservation Plan for the Ventura River. Although that document is not yet complete, some of the appendices to that report were previously released to the Ventura River Watershed Council to inform ongoing planning efforts, and were therefore utilized to expand the description of watershed conditions in this summary report.

Chapter 2

Watershed Characteristics

Overview

The Ventura River watershed is located primarily in western Ventura County, California, although a small portion is located in southeastern Santa Barbara County (Figure 2.1-1). The watershed drains an area of about 228 square miles. Major tributaries include San Antonio Creek, Coyote Creek, Cañada Larga, Cañada del Diablo, and Cañada de Rodriguez. Several smaller watersheds feed into the Ventura River upstream of San Antonio Creek. Coyote Creek enters the Ventura River from the west just downstream of the confluence with San Antonio Creek. Downstream, Cañada Larga enters from the east, and Cañada de Rodriguez and Cañada del Diablo enter from the west. The watershed also contains Lake Casitas, which serves as the primary water supply for the area within the watershed.

The Ventura River headwaters are in the San Rafael and Topatopa mountains on the north (maximum elevations of approximately 6,000 feet), the Santa Ynez Mountains in the west-central area (maximum elevations of approximately 4,600 feet), and Sulphur Mountain in the east (maximum elevation of 2,730 feet) (U.S. Bureau of Reclamation [Reclamation] 1954). The mainstem of the river flows southward, approximately 16.5 miles from the confluence of Matilija Creek and North Fork Matilija Creek, to the river mouth at the Emma Wood State Beach in the City of Ventura.

Over 75 percent of the Ventura River watershed is classified as rangeland covered with shrub and brush, and 20 percent of the watershed is classified as forested habitat. In general, the highest sediment-producing parts of the watershed are located in the upper parts of the watershed where slopes are greater and annual rainfall is larger. Topography in the watershed is rugged; and, as a result, the surface waters that drain the watershed have very steep gradients ranging from 40 feet per mile at the mouth to 150 feet per mile at the headwaters. Nearly 45 percent of the watershed may be classified as mountainous, 40 percent as foothill, and 15 percent as valley area (Reclamation 1954 and 2003). Lowland portions contain urban development and agriculture (including citrus, orchards, avocado, and pasture) (Tetra Tech 2008a).

Precipitation varies widely, both temporally and spatially. Most occurs as rainfall during just a few storms between November and March. Summer and fall months are typically dry. Although snow occurs at higher elevations, melting snowpack does not sustain significant runoff in warmer months. The erratic weather pattern, coupled with the steep gradients throughout much of the watershed, can result in high-flow velocities in the Ventura River and its tributaries during large storm events, with most runoff reaching the ocean.

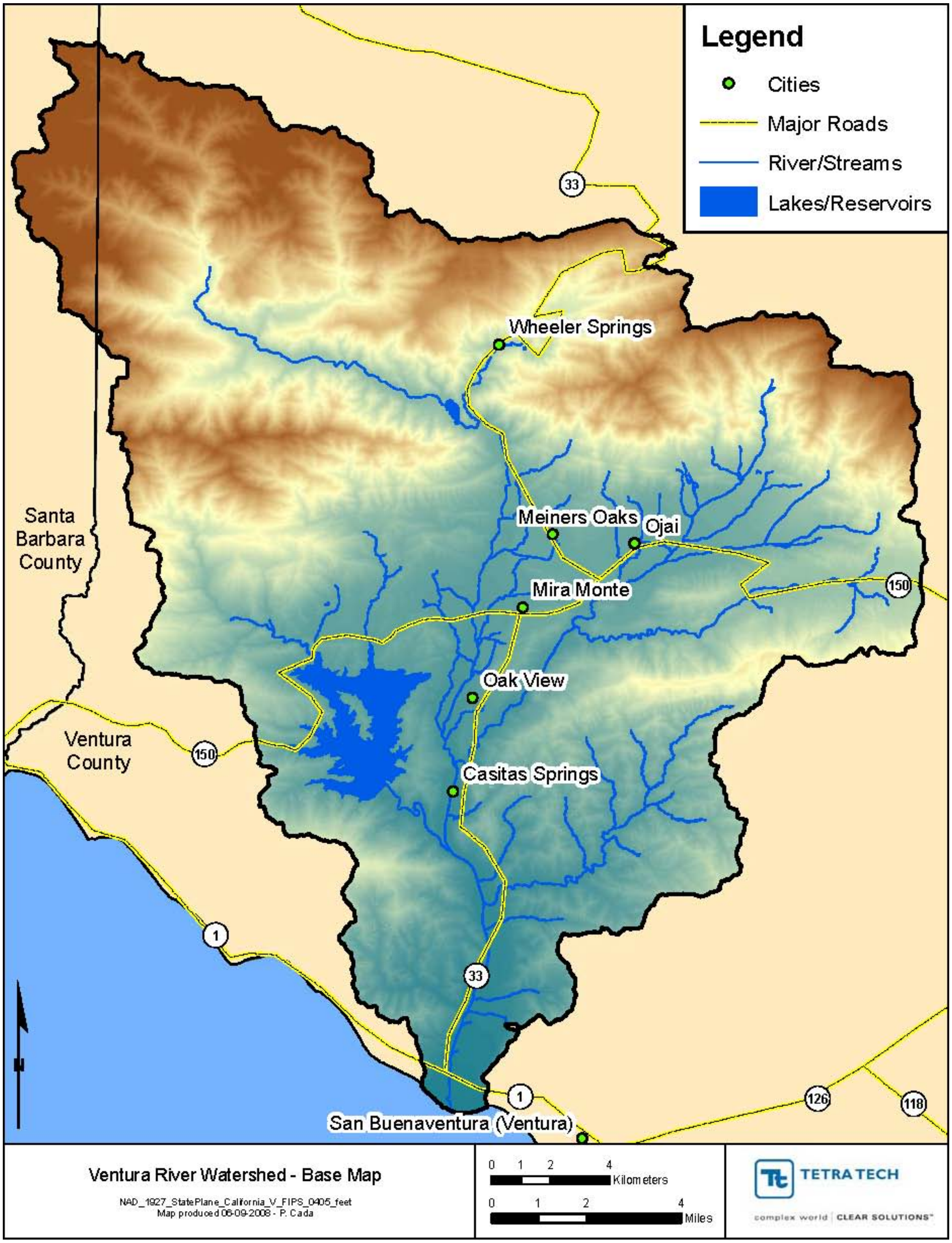


Figure 2.1-1 Ventura River Watershed

Source: Tetra Tech 2008a

2.1 Meteorology/Climate

The climate of the Ventura area is influenced primarily by the prevailing westerly transoceanic air currents, which often results in substantial cooling of the land surface at night. Dry and warm offshore winds (Santa Ana winds) may be generated in the fall and winter. Coastal fog is also an important characteristic of the Ventura River watershed. The coastline of Southern California is subjected to an inversion layer in the late spring and early summer that traps cool, moist air at low elevations, producing fog or low clouds during the night and early morning. The Ventura River Valley acts as a corridor through which moisture-laden marine air moves inland. As ocean temperatures increase during the summer, the occurrence of fog decreases (Ferren et al. 1990).

2.1.1 Air Temperature

Air temperature near the ocean generally has smaller seasonal and daily variations due to the regulating presence of the ocean than inland areas. The mean high varies between 64ºF in the winter months, to a mean high of 76ºF near the city of Oxnard (located approximately 8 miles southeast of Ventura). The mean low varies between 44ºF in the winter months and 60ºF in the summer months. Farther inland, at Ojai (located approximately 12 miles north of Ventura), the mean highs vary between 64ºF and 90ºF, while the mean lows vary between 36ºF and 56ºF (Reclamation 2003).

2.1.2 Precipitation

Rainfall gauging is available at multiple locations in and near the Ventura River watershed (Figure 2.1-2). Sources of locally observed weather data include (1) the District weather monitoring network, including both regular monitoring and Automated Local Evaluation in Real Time (ALERT) flood warning monitoring stations, and (2) National Climatic Data Center (NCDC). The District weather datasets provide a dense network of rainfall monitoring sites with daily, hourly, and 15-minute observations, as well as pan evaporation measurements at key locations in the watershed. The NCDC weather gages provided daily and hourly precipitation observations (Tetra Tech 2008a).

In general, the higher elevations receive more rain. The average annual rainfall for the drainage basin upstream of Matilija Dam is 23.9 inches per year, while the average annual rainfall near the mouth of the Ventura River is approximately 16.9 inches per year. The average for the entire watershed is approximately 20 inches per year. There is extreme seasonal variation in the rainfall, and over 90 percent of the rainfall occurs between the months of November and April. The peak historic rainfall intensity is approximately 4.04 inches per hour measured during a 15-minute period at the Wheeler Gorge gage in the mountains adjacent to Ojai (District 2011b).

Figure 2.1-3 is a graph of average annual precipitation totals sorted by gage elevation. On average, precipitation totals increase by about a factor of two from the lowest elevation areas to the highest. Among gages located at or near the same elevation, the major factor influencing precipitation total appears to be the slope aspect (Tetra Tech 2008a).

2.1.3 Evaporation

Figure 2.1-4 shows evaporation measured within the Ventura River watershed at Casitas Dam and Recreational Area and Matilija Dam, as well as nearby locations outside of the watershed, including Cachuma, El Rio Spreading Grounds, and Piedra Blanca Guard Station.

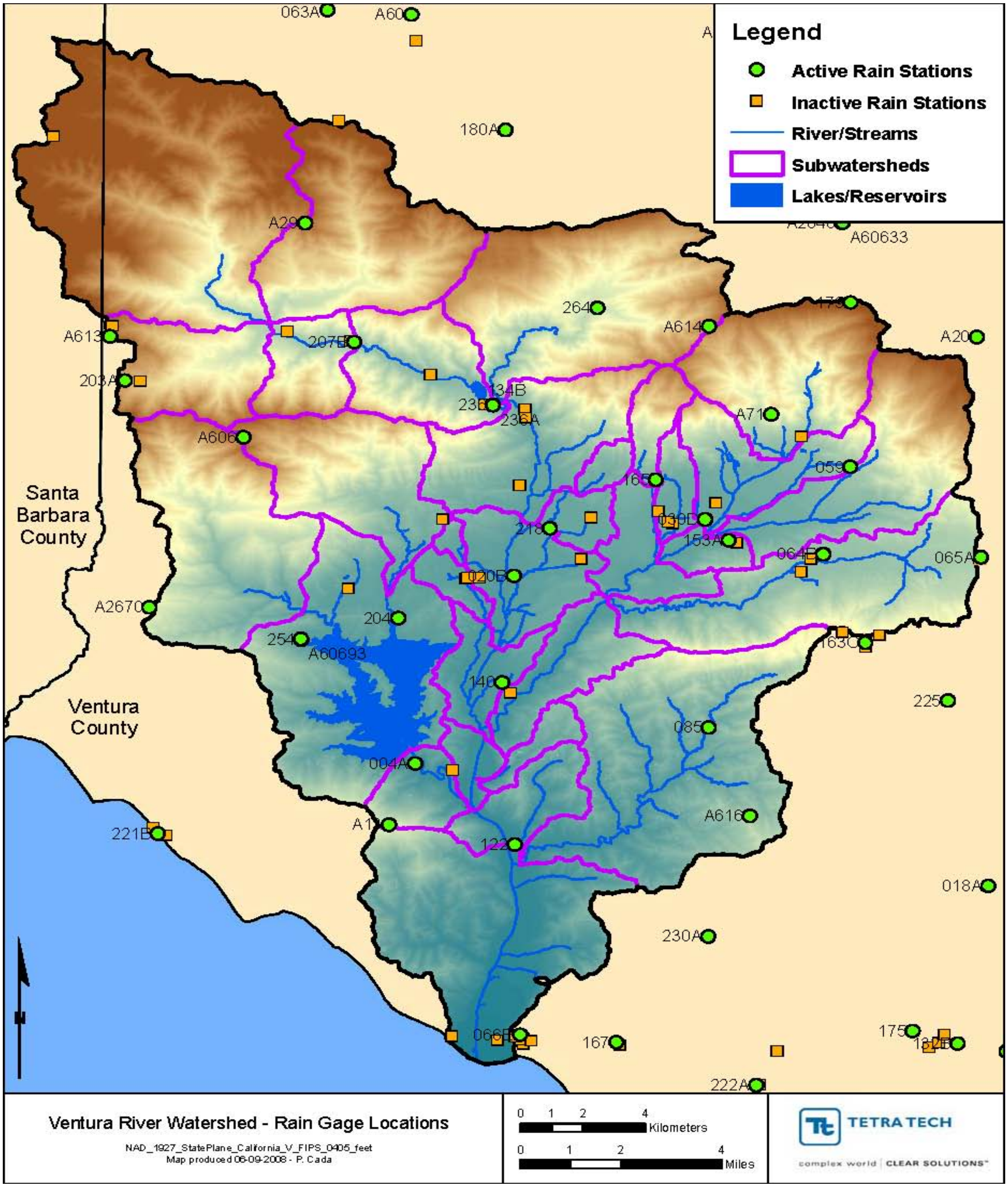


Figure 2.1-2 Precipitation Station Locations for the Ventura River Watershed

Note: Only active stations are labeled.
Source: Tetra Tech 2008a

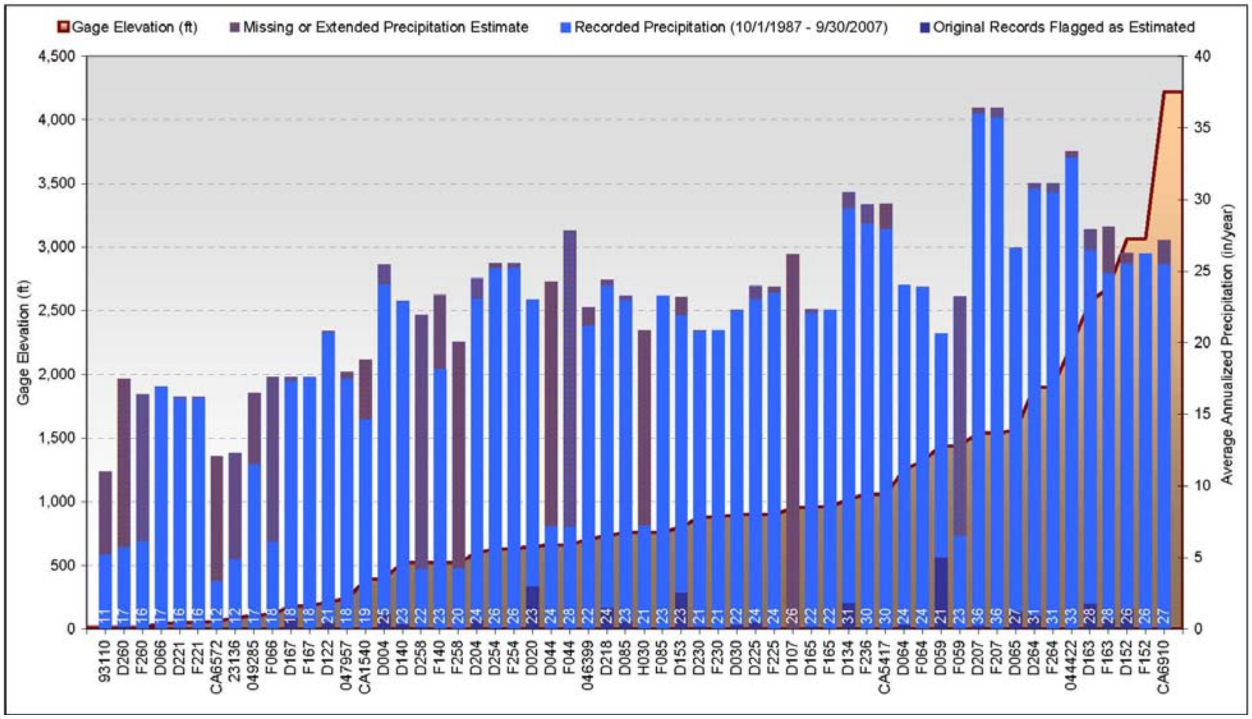


Figure 2.1-3 Average Annual Precipitation Totals versus Gage Elevation

Source: Tetra Tech 2008a

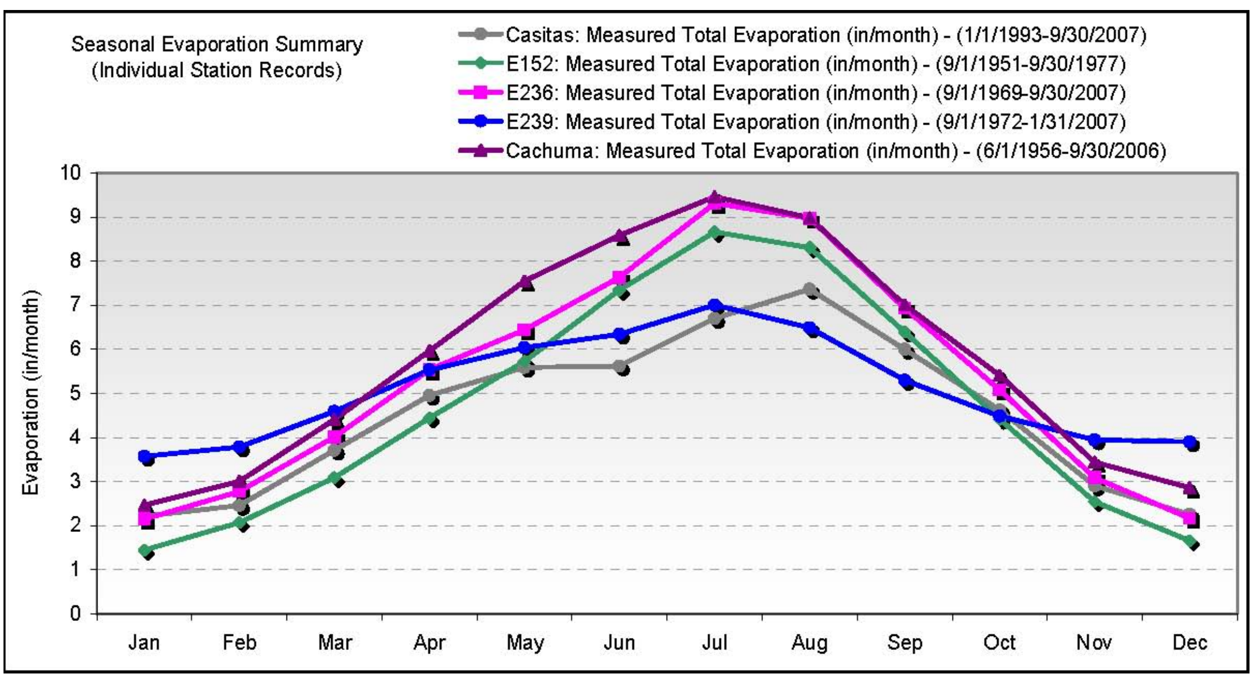


Figure 2.1-4 Seasonal Evaporation Trends at Stations in and around the Ventura River Watershed

Source: Tetra Tech 2008a

In terms of observed seasonal variability at the gages, the data follow similar seasonal trends, with the exception of El Rio Spreading Grounds (239), which had a flatter annualized pattern with higher winter evaporation and lower summer evaporation. Among the stations within the Ventura River watershed, the Matilija Dam station (236) on average reported 25 percent higher evaporation than the Casitas Dam station (Tetra Tech 2008a).

2.2 Land Use and Land Cover

2.2.1 Land Cover

Undeveloped land cover in the Ventura River watershed is shown in Figure 2.2-1, along with developed areas. Numerous plant communities are found within the Ventura River watersheds: Venturan coastal sage scrub, chaparral, coast live oak woodland, three types of riparian woodland (south coast live oak, central coast cottonwood-sycamore, and southern willow scrub) and non-native annual grasslands. Elevation, aspect (shade or sun), rainfall, and water availability are the primary determinants of where each community exists (District 2010d).

2.2.2 Existing Land Uses and Zoning

The Ventura River watershed supports a variety of land uses, including agricultural, commercial, light industrial, and residential. Open space and residential uses account for over 99 percent of the watershed. Development in the watershed has generally been limited to the floodplain areas (Figures 2.2-1 and 2.2-2). Most of the land in the Ventura River valley is privately held. Included in the watershed is the incorporated City of Ojai and several unincorporated population centers, including Casitas Springs, Live Oak Acres, Meiners Oaks, Mira Monte, and Oak View. Land use and land development within these incorporated cities is controlled by the policies of each City's General Plan and the regulations set forth in each City's zoning ordinance. Figures 2.2-3 through 2.2-5 show the zoning maps for Ventura County, the City of Ventura, and Ojai, respectively.

In addition to the activities to be permitted, a variety of other activities are conducted along the Ventura River and its tributaries by other agencies, commercial and industrial interests, and private parties. A brief summary of these activities is provided below.

2.2.3 Recreational Land Uses

The northern half of the Ventura River watershed is contained within the Los Padres National Forest (Forest), Ojai District. The Forest is managed for many purposes. The Los Padres National Forest Land and Resource Management Plan (Forest Plan) contains forest-wide guidelines, as well as specific "management areas," which have a set of compatible management goals and practices. In general, the Forest Plan has the following management objectives in the Ventura River watershed: recreation, visual resources, wilderness preservation, watershed, and biological resources. The Upper Matilija Creek watershed is within the Matilija Wilderness, where only foot access is allowed along established trails. In contrast, most of the remainder of the Forest in the watershed is designated as semi-primitive motorized or road-containing natural areas.

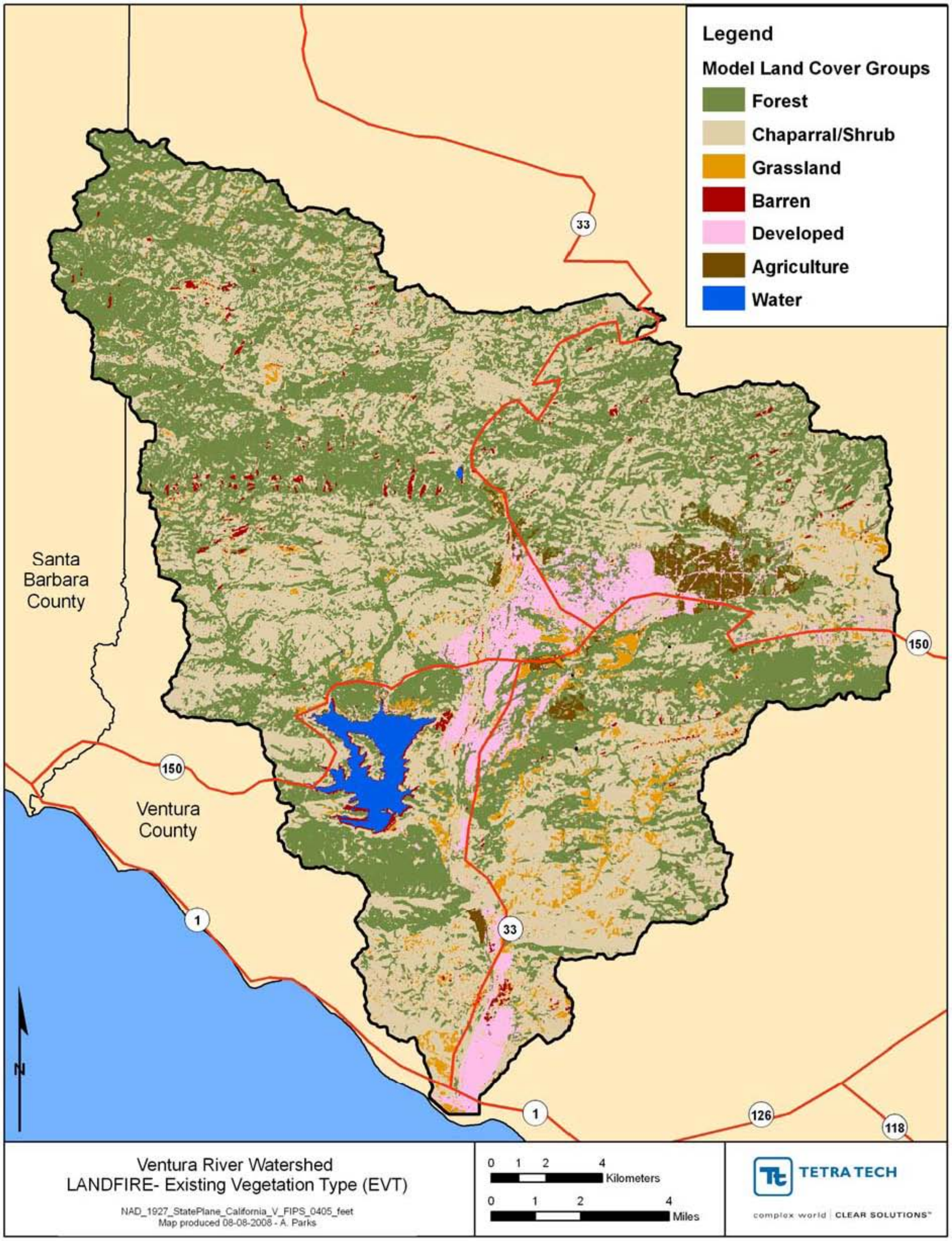


Figure 2.2-1 Undeveloped Land Cover in the Ventura River Watershed

Source: Tetra Tech 2009a

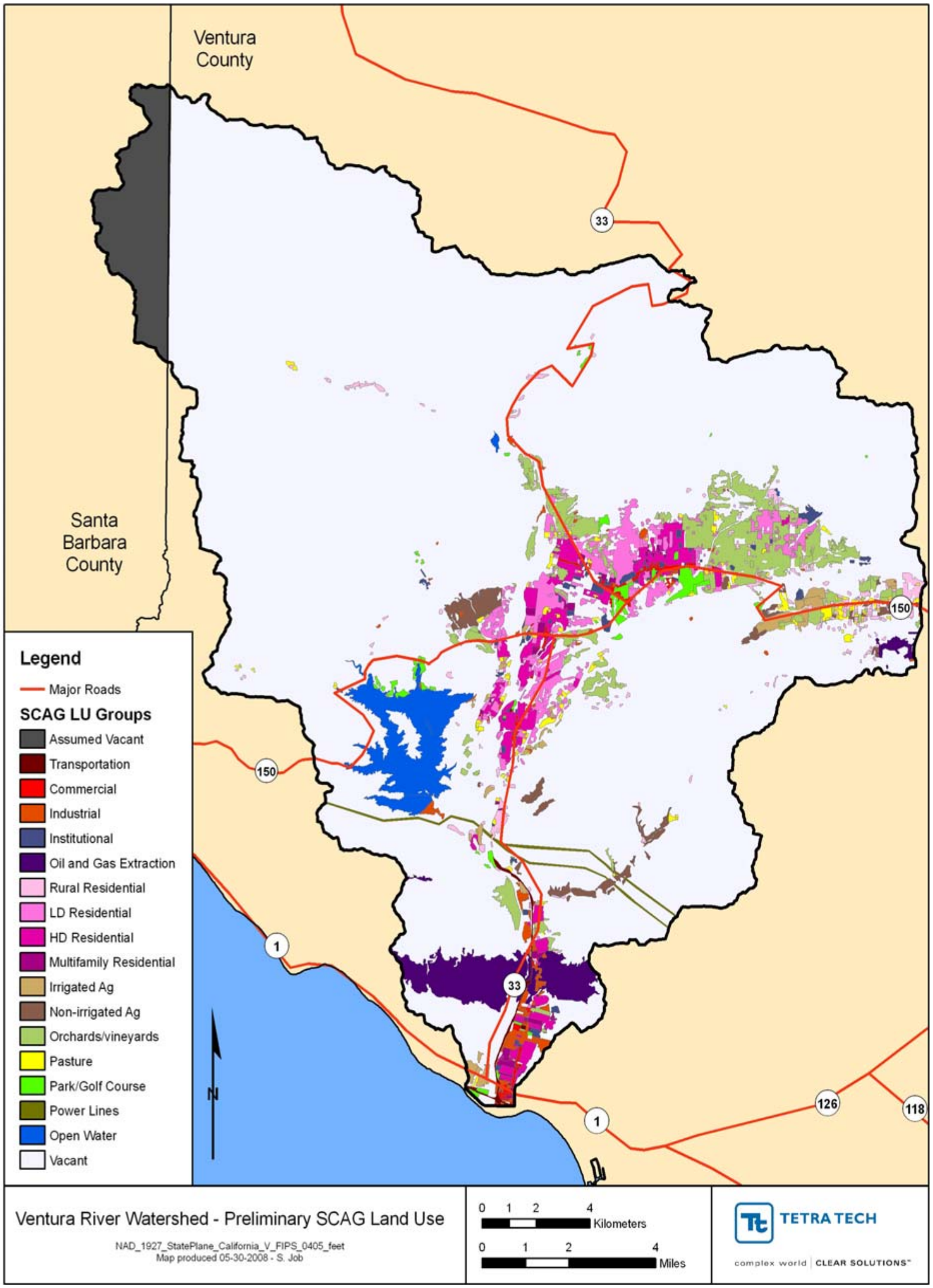


Figure 2.2-2 SCAG Land Use Groups (Year 2005) for the Ventura River Watershed

Note: This figure shows generalized land uses in the watershed, based on GIS data from the Southern California Association of Governments (SCAG). SCAG does not cover Santa Barbara County; however, this remote area of the watershed is predominately vacant.

Source: Tetra Tech 2009a

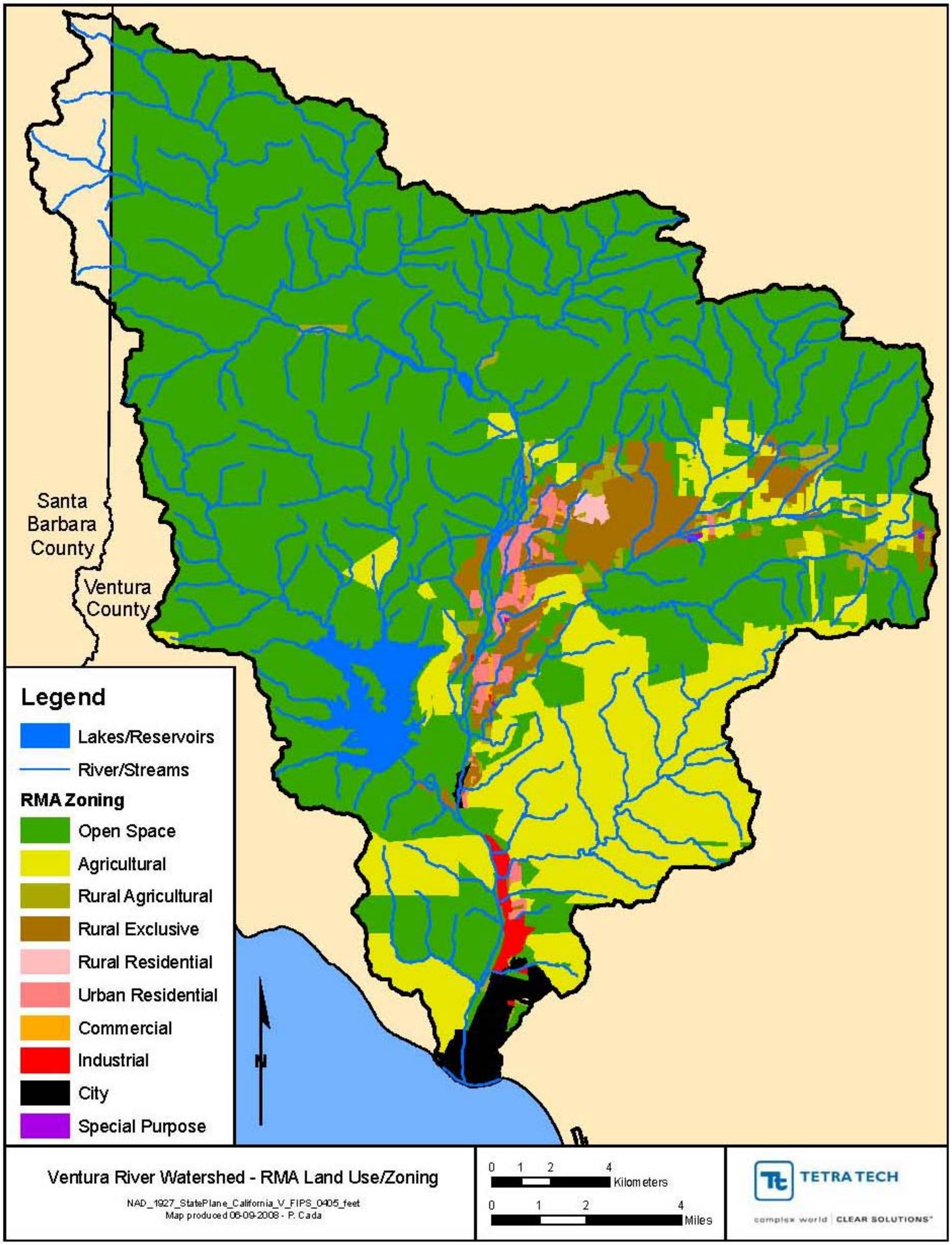


Figure 2.2-3 Ventura County Zoning in the Ventura River Watershed

Source Tetra Tech 2008a

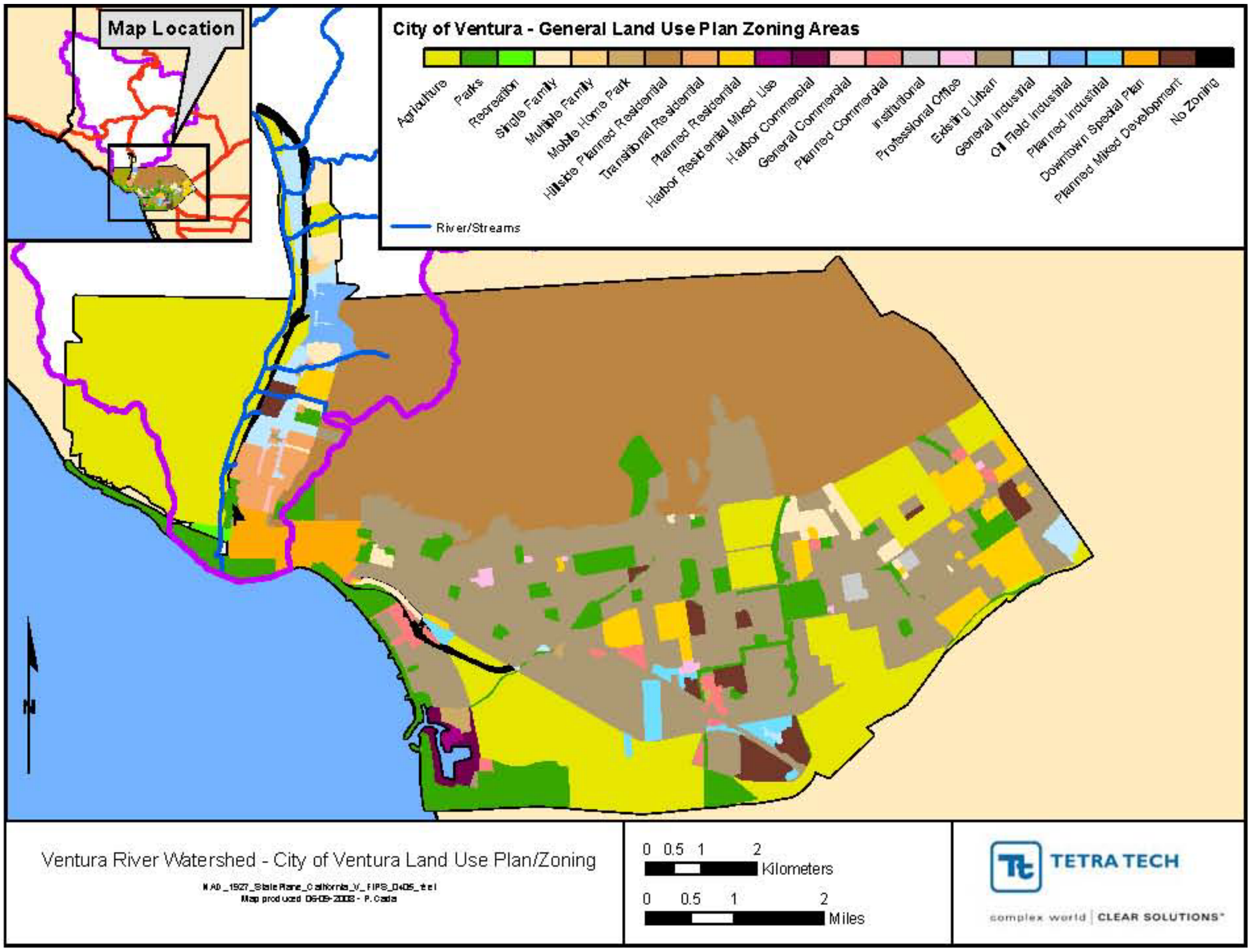


Figure 2.2-4 City of Ventura Land Use Plan/Zoning Map

Source: Tetra Tech 2008b

Numerous trails in the Forest are used for hiking, mountain biking, and horseback riding. Fire breaks and services roads are also used for the same purposes, as well as by off-road vehicles and motorcycles. Significant private land inholdings exist along the southern boundary of the Forest, and particularly along Matilija Creek, with many residences adjacent to the creek. These residences include domestic pets, small vegetable gardens, horses, and small livestock. Nearly the entire Forest in the Ventura River watershed was burned in the 1985 Wheeler Fire; hence, the vegetation age class in the watershed is very young. Erosion in the watershed has slowly decreased since Wheeler Fire.

The California Department of Parks and Recreation owns and manages the 115-acre Emma Wood State Beach, located at the mouth of the Ventura River. The western portion along the beach is used for family camping, while the eastern portion adjacent to the Ventura River Lagoon is used for group camping. The City of Ventura's Seaside Wilderness Park is located adjacent to the mouth of the Ventura River.

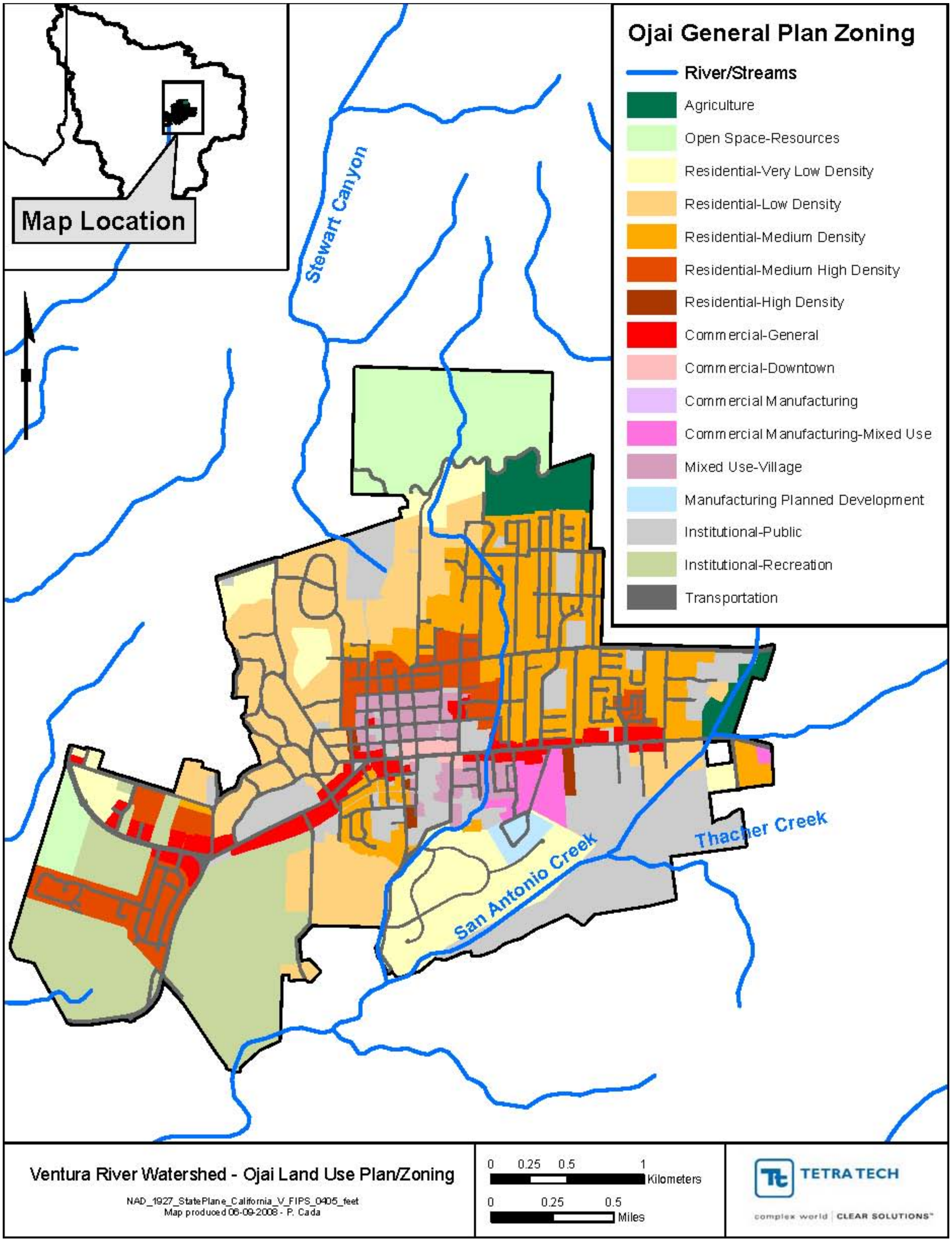
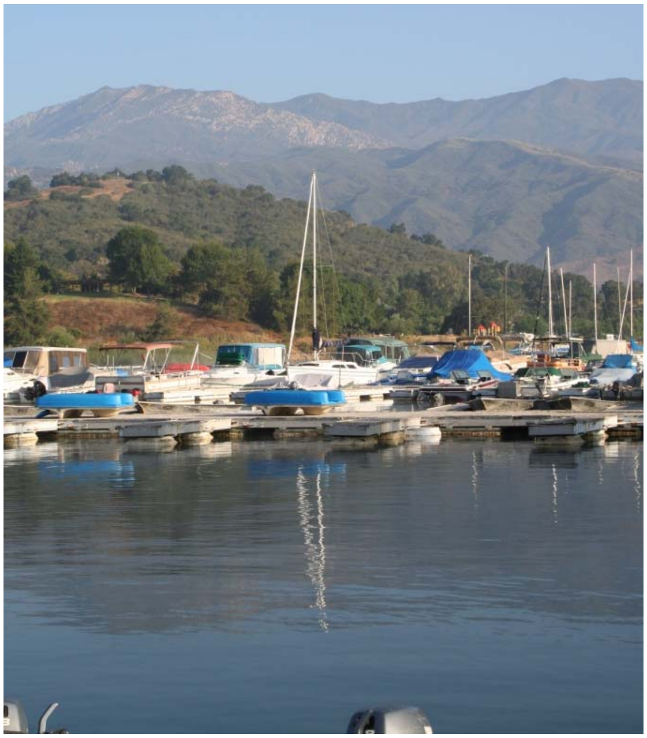


Figure 2.2-5 Ojai Zoning Map

Source: Tetra Tech 2008b

Several multiple-use trails serve bicyclists, equestrians, and pedestrians in the watershed. The Ojai Valley Trail follows the abandoned Southern Pacific Railroad right-of-way and is located along the west side of State Route 33 from Ojai to northern Foster Park. The Ventura River Trail, managed by the City of Ventura, is a multi-purpose trail that extends from Foster Park to the beach. It follows the Southern Pacific Railroad easement and connects the Ojai Valley Trail with the Omer Raines Trail (which extends along the coastline).



Lake Casitas is open to the public for non-body contact recreational activities. All recreational activities are operated by Casitas Municipal Water District (Casitas) or by concessionaries.

The Recreation Area encompasses approximately 4,097 acres and consists primarily of open space. The recreational facilities are located on approximately 400 acres scattered about the perimeter of the lake. Existing recreational facilities include camping, picnicking, motor boating, sailing, canoeing, and fishing. Lake Casitas hosted the 1984 Olympic Rowing and Canoeing Events and is currently the home of the Lake Casitas Rowing Association which provides recreational and competitive rowing training to youth and adults in the community. The lake is also used by bird watchers to view the many migratory birds that use Lake Casitas as they pass through the Pacific flyway. Facilities include stores, campgrounds, RV campgrounds, showers, restrooms, picnic areas, boat ramps, water playground, a radio-controlled airplane landing strip, and boat and trailer storage.

Lake Casitas is famous for its record fish catches. Fishing takes place from docks, boats, and shore. Lake Casitas contains a warmwater fishery that includes bass (primarily large mouth), catfish, sunfish, and crappie. These fish are non-native and were introduced when the lake was formed, but now are self-sustaining populations. Casitas stocks the lake annually with catchable size rainbow trout. Lake Casitas has also been stocked on an irregular basis with crappie and other panfish.

The Ventura County Parks Department maintains three regional parks (Camp Comfort, Soule Park, and Foster Park) located adjacent to waterways of the Ventura River. Camp Comfort Regional Park is situated adjacent to San Antonio Creek. Soule Park recreation area consists of a golf course and a public park. The confluence of San Antonio and Thacher creeks occurs within Soule Park, and the Ventura River runs through Foster Park. Activities at all parks include picnicking and playground areas and services such as public restrooms. Park users also wade in San Antonio Creek at Camp Comfort and in the Ventura River at Foster Park. Soule Park includes baseball and equestrian facilities as well as a public golf course. Water for golf course

irrigation at Soule Park comes from an on-site well operated by the golf course concessionaire and from water purchased from Casitas.

Other open spaces in the watershed near the Ventura River and its tributaries (excluding Lake Casitas Recreation Area) include:

- **Ojai Valley Land Conservancy's (OVLC) Ventura River Preserve.** In 2003, OVLC opened this preserve to the public. The preserve was formerly the 1,591-acre Rancho El Nido ranch. The property lies in the western half of the Ojai Valley and is bordered by 3 miles of the Ventura River. It is located adjacent to the Los Padres National Forest and other protected watershed lands. The preserve is a popular recreation destination for horseback riding, swimming, picnicking and hiking. As of May 2011, a new trailhead and public parking area located on Old Baldwin Road provides easy access to the Ventura River Preserve. The Old Baldwin Road Trailhead also includes a unique wheelchair-accessible paved trail leading to a scenic vista within the preserve.
- **OVLC's Ventura River-Confluence Preserve.** Established in April 2004, this thirty-acre parcel is named for the merging of the river's two major year-round streams. The preserve is located on both sides of Highway 33 just south of the San Antonio Creek Bridge at the base of the Arnaz Grade near Oak View. The Ojai Valley Bike and Bridle Path pass through the center of the Preserve. Lands within the river bottom will be open for special tours only and are still privately owned by OVLC, while the land lying between the Ojai Valley Bike Path and Highway 33 will be open for public use.
- **OVLC's San Antonio Creek Preserve.** The nine-acre San Antonio Creek Preserve is located adjacent to San Antonio Creek Road and 3/10 of a mile south of Camp Comfort County Park. For public safety and protection of sensitive habitat, this Preserve is open only for special tours and upon prior written requests.
- **Ventura Beach Resort (RV Park).** This privately owned facility is located on the west side of the river in the floodplain between Main Street and U.S. 101. The park has suffered several major floods due to its low-lying location in the floodplain. Park users can access the river directly.

In addition to the above facilities, there are many small commercial and residential equestrian facilities and stables in the watershed for boarding horses, equestrian training, and general equestrian recreation. Many of these stables are located along San Antonio Creek and along the stretch of the Ventura River north of the Robles Fish Passage Facility along Oso Road. These facilities include pastures and corrals that traverse the creek. Some horse-related facilities, grooming areas, manure or hay stockpiles, and training areas exist in or immediately adjacent to San Antonio Creek on private property. Equestrian riders routinely use informal trails in the bed and on the banks of the Ventura River and San Antonio Creek for recreation.

2.2.4 Urban Land Uses

Ojai is the most densely populated portion of the upper watershed, but it has a rural atmosphere and lifestyle. Industrial activities in Ojai are few and primarily related to agricultural support. Ojai attracts many out-of-town tourists due to the large number of cultural events, many small shops and art galleries, and various outdoor recreation and resort facilities. In 1979, the City of Ojai implemented growth management controls that remain in place today. As a result, the overall land use pattern in Ojai is well established and is not intended to substantially change over time (City of Ojai 1997). The overall goal of the Land Use Element of the General Plan is to preserve the community's "small town" character. In addition, the Land Use Element specifies that the large expanses of open lands surrounding the city be preserved as agricultural open space or very low intensity residential development (less than one unit per 10 acres). The Land Use Element also discourages traditional suburban development around the perimeter of Ojai because it is separated from the main part of Ojai and contrary to its character (City of Ojai 1997).

The Land Use Element also expresses an intention for the City to take a stewardship role in the management of natural environments in the Ojai Valley and to consider preservation of natural features such as arroyos and creeks, hillsides, and viewsheds in future development.

Outside of Ojai are many small rural residential communities, including Meiners Oaks, Oak View, Live Oak Acres, and Casitas Springs. In general, residences and commercial buildings do not encroach into the river, except along selected portions of San Antonio Creek, Coyote Creek, and Live Oak Creek. Development in these areas is under the jurisdiction of Ventura County.

2.2.5 Agricultural Land Uses

Agricultural-related activities along the river and its tributaries include:

- Orchards scattered among industrial and residential development, east of SR 33 along Ventura Avenue.
- Dryland farming and cattle grazing between Santa Ana Road and the river, on the west side of the river between Foster Park and Santa Ana Road Bridge and along lower Live Oak Creek.
- Irrigated row crop farming and minimal cattle grazing at the Gramckow Ranch, previously Rancho Matilija/Farmount property west of the river, between SR 150 and the National Forest.
- Cattle grazing in the hills south of San Antonio Creek and along Lions Creek.
- Orchards in the northern and eastern portions of Ojai Valley adjacent to upper San Antonio Creek and major tributaries to San Antonio Creek, including Thacher, Reeves, McNell, Senior, Wilsie Canyon, Steward Canyon, McDonald Canyon, Gridley, and Cozy Dell creeks.
- Orchards scattered on both sides of the river on narrow terraces between Meiners Oaks and the confluence of Matilija Creek and the North Fork.
- Orchards and row crops on the floodplain west of the river and north of Main Street.

2.2.6 Industrial Land Uses

The major industrial area along the Ventura River and its tributaries is on the lower river where oil development occurs in the hills above the river, and industrial activities occur along Ventura Avenue east of the river. The latter consists of various manufacturing, construction, processing, and industrial storage facilities mostly north of School Canyon Road. The area south of this road is primarily residential and commercial.

A large abandoned chemical facility, PetroChem, is located adjacent to the river south of the Ojai Valley Sanitary District (OVSD) Wastewater Treatment Plant. The owner of the refinery, USA

Petroleum Company, has proposed to sell the refinery so that the site can be remediated and used for residential development. Other industrial facilities adjacent to the river include the OVSD Wastewater Treatment Plant, City of Ventura's Avenue Water Treatment Plant (for potable water), Enviro-Lene, Ventura County Hazardous Materials Recycling Facility, Brooks Institute of Photography (Ventura Campus), and Ojai Rubbish.

Oil development in the hills above the lower river has created a large system of well pads and access roads in relatively steep and rugged terrain. Primary access to the Area (formerly Shell) oil fields on the west side of the river is across Shell Road Bridge. A series of oil-related paved and dirt roads are located on west side of the Ventura River floodplain and the adjacent mountains.

The Ojai Schmidt Rock Quarry, an active aggregate mine, operates on the hillsides over the North Fork of Matilija Creek near SR 33. The mine operates under a Conditional Use Permit from Ventura County. The mine has steep barren slopes that exhibit evidence of severe erosion and sediment production that could enter the creek.

An in-channel sand mine along the lower river, operated by S. P. Milling for many decades, was closed in 1992. The site has been undergoing reclamation since that time, resulting in the development of dense willow woodland on the west side of the river downstream of the Shell Road Bridge.

2.3 Watershed Topographic Characteristics

The Ventura River watershed has three distinct sections that differ in topography and geology, and as a result, surface and groundwater hydrology in these sections differ (Keller and Capelli 1992, Fugro West 1996). These topographic sections can generally be described as:

- Mountainous upland creeks above the confluence of Matilija and North Fork Matilija creeks.
- Alluvial channel and floodplain areas along the mainstem of the Ventura River.
- The lagoon or delta, which is approximately 2 miles wide at the coast and extends about 1 mile upstream, almost to the Main Street Bridge.

Elevations and slopes in the Ventura River watershed are shown in Figure 2.3-1 and 2.3-2.

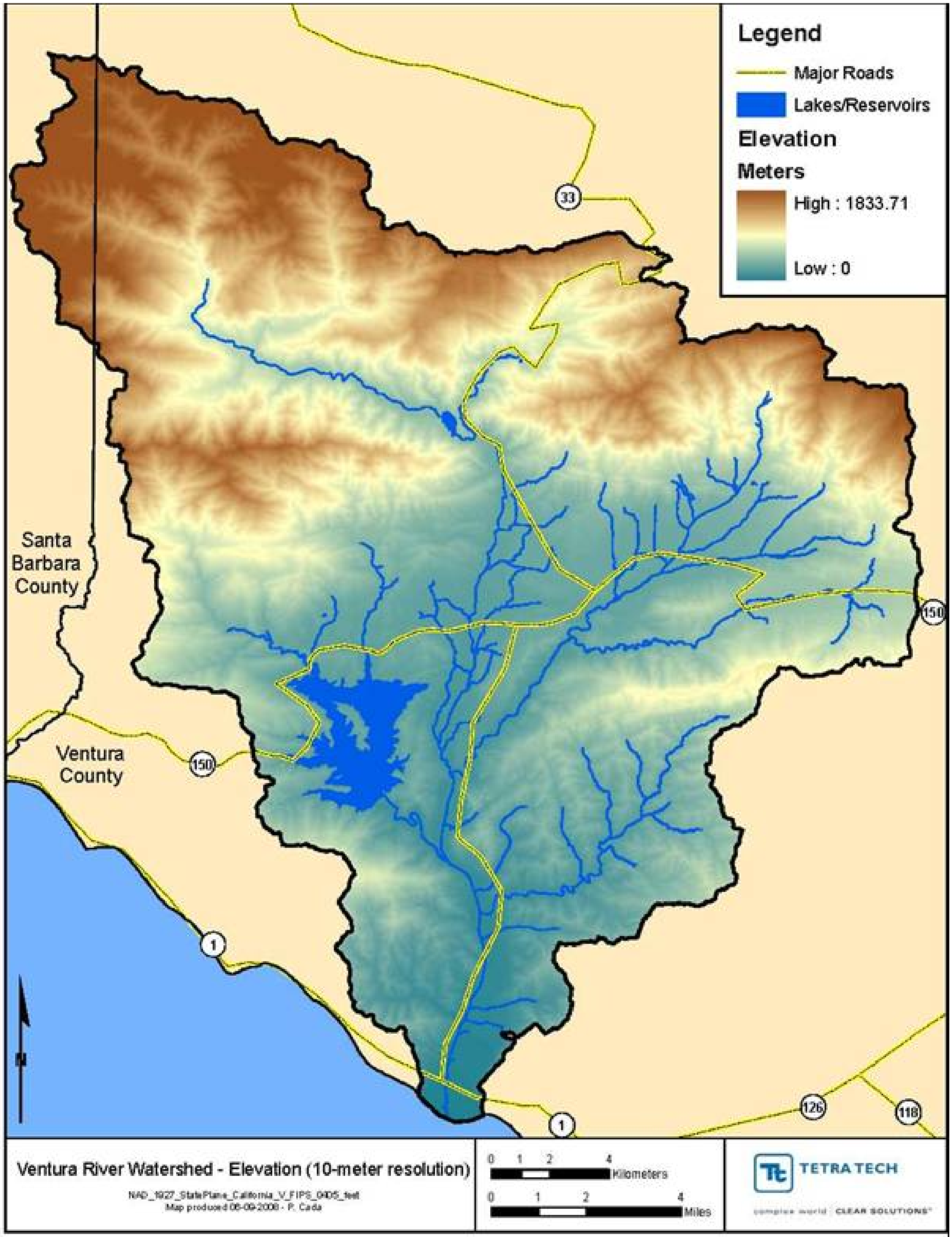


Figure 2.3-1 Ventura River Watershed Elevations

Note: Elevation Data derived from the 10-meter Digital Elevation Model for the Ventura River Watershed
Source: Tetra Tech 2008a

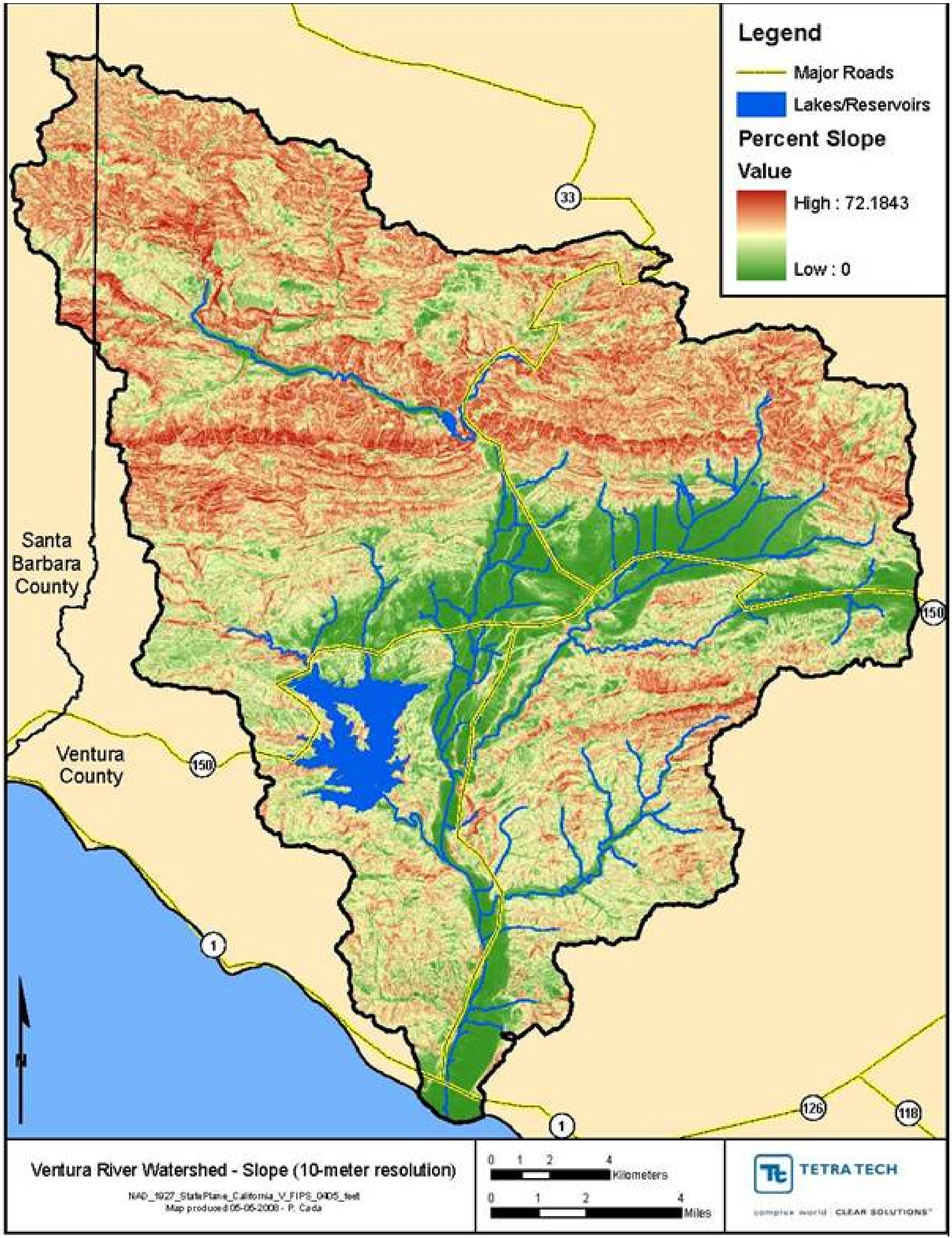


Figure 2.3-2 Ventura River Watershed Slopes

Note: Slope Data derived from the 10-meter Digital Elevation Model for the Ventura River Watershed.
Source: Tetra Tech 2008a

2.3.1.1 Mountainous Uplands

The mountainous uplands are the primary water and sediment production areas, with few or no alluvial deposits and steep streambed gradients. The major sub-basins with significant uplands include Matilija, North Fork Matilija, Coyote, Santa Ana, and San Antonio creeks (Tables 2.3-1 and 2.3-2). This is also the zone in which two major water supply and flood control facilities are located (Matilija Dam and Casitas Dam).

Table 2.3-1 Major Ventura River Watershed Sub-Basins and Water Facilities

Sub-Basin	Unit Area (sq. mi.)	Percent of Area at Foster Park (%)	Storage and Diversion Facilities	Present Capacity
Uplands: Headwaters/Tributaries				
Matilija Creek	55	29.3	Matilija Dam	500[a] acre-feet (AF)
North Fork Matilija Creek	16	8.5		
San Antonio Creek (includes Ojai Valley)	51	27.1		
Coyote and Santa Ana Creeks	41	21.8	Casitas Dam	254,000 AF
Alluvial Valleys: Mainstem				
Upper Ventura River	74[b]	39.4	Robles Dam	900 AF/day
Ventura River near Ventura at Foster Park	188	100.0	Foster Park	Surface: 21.4AF/day[c] Sub-surface: 11.1 AF/day
Ventura River below Foster Park	100			
Total	228			

a. Estimated by Reclamation (2000)
b Includes area of all upstream sub-basins
c. Average daily capacity, exclusive of Nye well field. Maximum production is effectively limited by the 13 mgd (20 cfs) capacity of the water treatment plant.

Source: ENTRIX and Woodward Clyde Consultants 1997 and Reclamation 2000

Table 2.3-2 Drainage Area of Sub-Watersheds in the Ventura River Watershed

Local Area Watershed Name	Drainage Area (mi^2)	Maximum Length of Watershed (ft)	Minimum Elevation of Watershed (ft)	Maximum Elevation of Watershed (ft)	Mean Annual Precipitation (inches)
Matilija at Matilija Dam	54.6	83,363	1,009.29	5456.77	23.5
North Fork Matilija Creek	16.2	40,554	1009.29	5006.72	22.1
Ventura River D/S of Willis Canyon	7.4	22,090	696.87	4,278.56	20.2
Ventura River at Live Oak Creek	11.6	45,685	290.61	2,310.04	17.8
San Antonio Creek	51.0	79,331	290.41	5.410.69	18.3
Santa Ana Creek at Lake Casitas	9.5	38,211	528.60	4,645.89	18.7
Coyote Creek above Lake Casitas	13.4	36,127	560.88	4,769.48	21.1
Drainage area that includes Lake Casitas	15.3	31,470	514.96	2,342.64	18.2
Ventura River Subarea to Foster Park	9.3	25,313	195.36	1,302.82	17.3
Cañada Larga Subarea to Foster Park	19.3	50,752	195.78	2,788.00	17.9

Table 2.3-2 Drainage Area of Sub-Watersheds in the Ventura River Watershed

Local Area Watershed Name	Drainage Area (mi^2)	Maximum Length of Watershed (ft)	Minimum Elevation of Watershed (ft)	Maximum Elevation of Watershed (ft)	Mean Annual Precipitation (inches)
Lower Ventura River	15.5	35,470	0.00	2,117.63	16.9
Entire Ventura River Watershed	228	—	0.0	5,456.77	19.9

Source: U.S. Army Corps of Engineers (USACE) 2004

Approximately 80 percent of the watershed is composed of uplands of hill slopes and ridges with surface geology of Tertiary sedimentary rocks (3 million to 70 million years old). The bedrock units of the Tertiary sedimentary rocks (i.e., well-cemented sandstones, siltstones, conglomerates, and shales) have been severely deformed by folding and faulting, and have low permeability relative to the unconsolidated alluvial deposits in the main valleys (Reclamation 2003).

2.3.1.2 Alluvial Valleys

The alluvial valleys are primarily a zone of storage and transfer of water and sediment and include the mainstem river, floodplain, and valley bottom downstream of the confluence of Matilija and North Fork Matilija creeks and the Ojai Valley (or the San Antonio Creek sub-basin). The upper portion of the Ventura River mainstem valley (upstream of Foster Park) is the reach of the river with the majority of groundwater production and surface diversions.

The alluvial valleys are underlain by relatively shallow deposits, ranging in age from 10,000 to 1 million years old. The Ventura River has slowly migrated to the west during the late Quaternary Period, leaving a series of terraces marking former channel and floodplain locations (Putnam 1942 and Rockwell et al. 1984, as cited in Keller and Capelli 1992).

The alluvial deposits continue to be affected by active regional tectonic forces that tilt and bend sediments and create vertical and horizontal offsets (faults), affecting subsurface water flow and water levels. The alluvial valley fills constitute the major groundwater aquifers, and the major groundwater basins of the Ventura River watershed are located in these valleys and include the Ojai Valley basin, the Upper Ventura River basin (above Foster Park), and the Lower Ventura River basin (Fugro West 1996). In addition, minor groundwater basins occur in the Upper Ojai Valley (along Lion Creek) and along lower San Antonio Creek (Turner 1971, as cited in EDAW et al. 1981).

2.3.1.3 Lagoon/Delta

The Ventura River lagoon encompasses approximately 3.7 acres between the shoreline and a few hundred yards upstream of the U.S. Highway 101 Bridge. The lagoon is separated from the Pacific Ocean by a sand/cobble bar during the dry season and opens and closes in response to storms and flow changes throughout the year. When full, the lagoon covers approximately 1.5 surface hectares and ranges in depth from 0.6 to 2.4 meters. The river lagoon includes the shifting channels and depositional environments at the mouth of the river, occurring in an arc-shaped delta that extends approximately 1 mile upstream from the ocean and is 2 miles wide at the coast. An estuary at the second mouth exists to the west of the main lagoon (CRWQCB-LA 2002).

In general, sandbar formation and breaching depends on wave action to deposit or remove sand, freshwater streamflow in the river, and tidal action. Lagoons generally open during periods of high river flow and storm-generated waves in the winter storm season. Low streamflow during drought years can prevent sandbar breaching; some California streams may be closed for multiple years under such conditions.

For most years, the lagoon is dominated by freshwater during most of the year (CRWQCB-LA 1993, Moore 1980). When the lagoon is open to the ocean, tidal water level changes are observed to about 150 meters upstream of the railroad bridge (Casitas and City of Ventura 1984). The sandbar breaches readily under natural conditions and has never been artificially breached. The lagoon opens in winter after the first few major storms and usually remains open until early spring. With the sandbar open, water levels in the lagoon depend on tide levels and the height of the sandbar, and reach a maximum depth of approximately 4 feet (City of Ventura 1990). Tidal influence can extend to just above the U.S. Highway 101 Bridge (Ferren et al. 1990). During the summer, the lagoon will open periodically, usually two to six times for brief periods (2 to 7 days).

2.4 Seismicity, Soils, and Geomorphology

2.4.1 Faults and Seismicity

Potential for earthquake damage exists throughout Ventura County, as with most of Southern and coastal California due to the number of active faults within and near the county. These faults are described below (URS 2005).

- San Andreas Fault. The San Andreas is the longest and most significant fault in California. Due to clearly established historical earthquake activity, this fault has been designated as active by the State of California. The last major earthquake on this fault near Ventura County was the Fort Tejon earthquake of 1857, which is estimated to have had a magnitude of 8.0 (Richter Scale) and would have caused considerable damage had there been structures in the southern county area. The occurrence of another such earthquake along this fault is considered possible within the near future.
- Malibu Coast Fault system. The Malibu Coast Fault system includes the Malibu Coast, Santa Monica and Hollywood faults. The system begins in the Hollywood area, extends along the southern base of the Santa Monica Mountains, and passes offshore a few miles west of Point Dume. The 1973 Point Mugu earthquake, described in the following section, is believed to have originated on this fault system.
- San Cayetano-Red Mountain-Santa Susana Fault system. This fault system consists of a major series of north-dipping reverse faults that extend over 150 miles from Santa Barbara County into Los Angeles County. The San Cayetano Fault is a major, north-dipping reverse fault that extends for 25 miles along the northern portion of the Ventura Basin. The San Fernando earthquake of 1971, described in the following section, was caused by activity along this fault.
- Oak Ridge Fault system. The Oak Ridge Fault system is a steep (65 degrees) southerly-dipping reverse fault that extends from the Santa Susana Mountains westward along the southerly side of the Santa Clara River Valley and into the Oxnard Plain. The system is over 50 miles long on the mainland and may extend an equal or greater distance offshore. Several

recorded earthquake epicenters on land and offshore may have been associated with the Oak Ridge Fault system. Portions of the system are zoned by the state as active.

- Simi-Santa Rosa Fault System. This fault system extends from the Santa Susana Mountains westward along the northern margin of the Simi and Tierra Rejada Valleys and along the south slope and crest of the Las Posas Hills to their westerly termination.
- Pine Mountain Thrust Fault and Big Pine Fault. These two large faults occur in the mountainous portion of the county north of the Santa Ynez Fault; the faults are located 9 and 16 miles north of the City of Ojai, respectively. The Pine Mountain Thrust Fault is reported to have ruptured the ground surface for a distance of 30 miles along its length during the northern Ventura County earthquakes of November 1852.

The Ventura River basin is underlain by Tertiary-age marine and continental deposits, primarily sandstone, clay/siltstone, and shale (Dibblee 1988). These deposits have been deformed by tectonism, resulting in east-west trending fold and fault structures and geologic units inclined toward the north and south (Jennings 1994). The Santa Ana/Arroyo Parida fault is an east-west trending structure that runs from the south-central portion of the Ojai Valley across the Ventura River near the SR 150 Bridge. The relative displacement along this fault is such that the northerly fault block has been lowered relative to the southerly fault block. The other fault is the San Cayetano fault, a steep, north-dipping thrust fault that runs over a distance of 30 miles from the Ojai Valley to northeast of Piru.

Additionally, several flexural-slip faults in the vicinity of Oak View have produced tilted terrace surfaces south of the Santa Ana fault within the Ayers Creek syncline (Rockwell et al. 1984). The Red Mountain anticline and thrust fault dominates the reach from Oak View to Foster Park.

Ongoing field and laboratory studies suggest the following maximum likely magnitudes and recurrence intervals for the major local faults: San Andreas (M8.0, recurrence interval of 300 years), Malibu Coast Fault system (M6.7, recurrence interval 2,908 years), San Cayetano Fault system (M6.8, recurrence interval 150 years), Red Mountain Fault system (M7.0, recurrence interval 507 years), Santa Susana Fault system (M6.6, recurrence interval 138 years), Oak Ridge Fault system (M6.9, recurrence interval 299 years), and the Simi-Santa Rosa Fault system (M6.7, recurrence interval 933 years) (URS 2005, and Reclamation 2010).

The strength of an earthquake's ground movement can be measured by peak ground acceleration (PGA). PGA measures the rate in change of motion relative to the established rate of acceleration due to gravity 980 centimeters per second. PGA is used to project the risk of damage from future earthquakes by showing earthquake ground motions that have a specified probability (10 percent, 5 percent, or 2 percent) of being exceeded in 50 years. These ground motion values are used for reference in construction design for earthquake resistance. The ground motion values can also be used to assess relative hazard between sites when making economic and safety decisions (URS 2005).

The Ventura County Resource Management Agency derived probabilistic PGA data based on seismic data from the California Geological Survey. The county data were used to assess exposure to moderate and high-risk areas for earthquake hazards. Moderate earthquake hazard areas were defined by ground accelerations of 0.65, 0.75, and 0.85; and high earthquake hazard areas were defined by ground accelerations of 0.95 and 1.05 (URS 2005).

Ventura County falls within the middle to top ranges of the scale. Regions at the upper end of this scale are often near major active faults. These regions will, on average, experience stronger earthquake shaking more frequently, with intense shaking that can damage even strong modern buildings (URS 2005).

2.4.2 Soils

Soils in the United State are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. Based on the infiltration rate, soils are assigned to four groups (A, B, C, and D) or may be assigned to one of three dual classes (A/D, B/D, and C/D). The groups are defined as follows (Natural Resources Conservation Service 2011):

- Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a clay pan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission. Soils in this group may also be assigned to a dual hydrologic group (A/D, B/D, or C/D), with the first letter for drained areas and the second for undrained areas.

Hydrologic soil groups in the Ventura River watershed are shown in Figure 2.4-1.

2.4.3 Channel Geomorphology and Sediment Transport

2.4.3.1 Historical Context

Based on a review of the historical ecology of the Ventura River (SFEI, 2011), the form of the river valley has not changed substantively since the arrival of European settlers. The upper reach of the river, in Matilija Canyon, was relatively narrow, confined by the canyon walls, the river bed contained many large boulders, and flows were perennial. Once the river exited the canyon, the channel broadened into multiple braided channels, separated by large islands that supported mature vegetation, flows were intermittent, and the channel bed was comprised of gravel and sands. Below Casitas Springs and the confluence with San Antonio Creek, the channel narrowed, and flows became perennial and the river bed contained large cobbles. Below Foster Park, the river was contained in multiple braided channels, flows were perennial, and cobbles predominate. At the mouth of the river, the channel broadened into a broad willow forest, with remnant lagoons and wetlands formed from the shifting of the river channel.

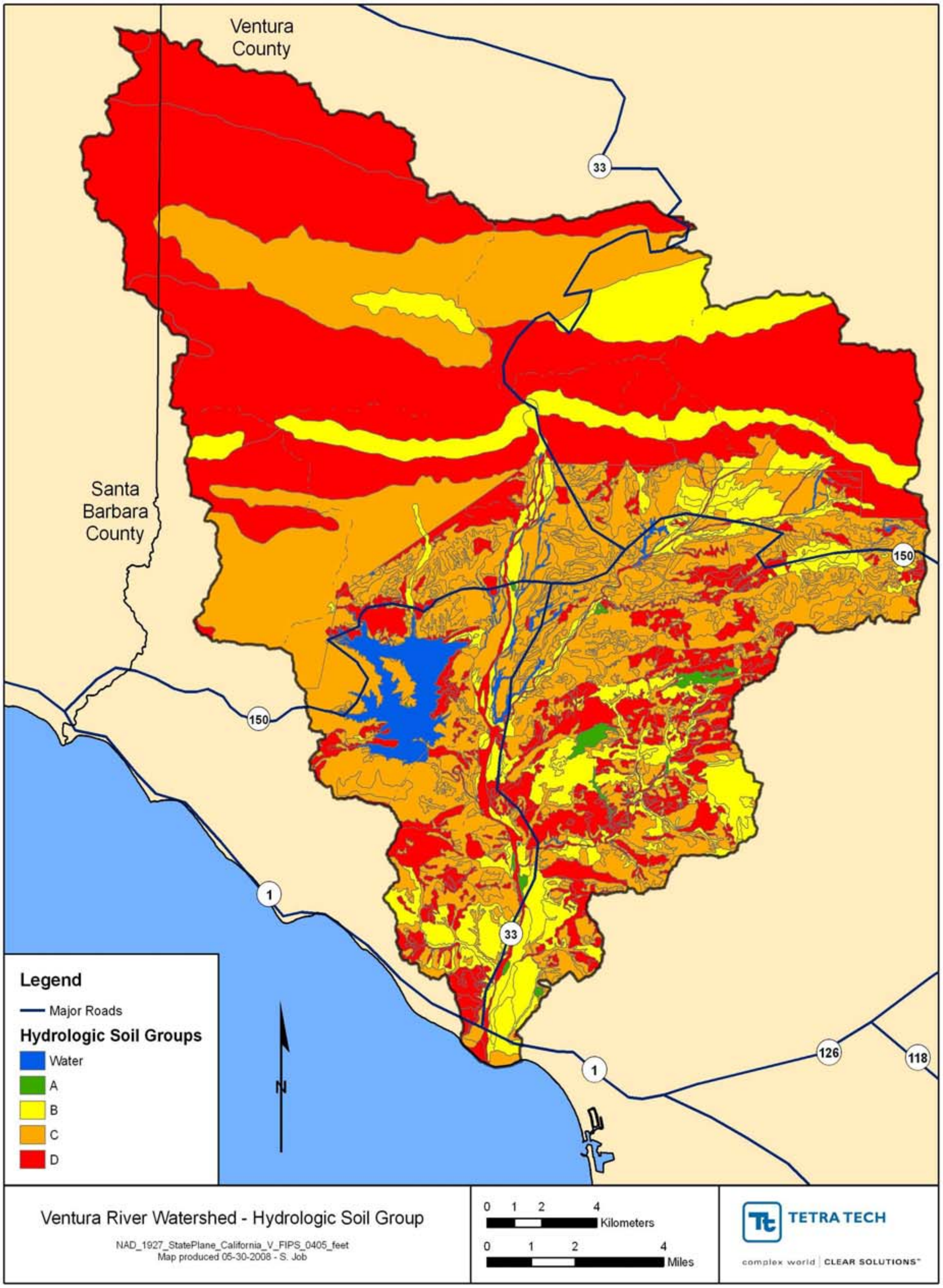


Figure 2.4-1 Hydrologic Soil Groups in the Ventura River Watershed

Source: Tetra Tech 2009a

In historic times, changes in the river channel have resulted from the installation of Matilija Dam, the placement of levees along the river in several locations, and the installation of bridges at the mouth of the river. The construction of Matilija Dam (in 1949) has altered flows and sediment transport in the river channel. Before the dam, historical evidence suggests a cycle of sediment build-up (during dry and average years) and transport (during flood events) which may have changed the elevation of the river bed (SFEI 2011). The placement of levees along several stretches of the river has constrained the lateral movement of the channel during high flow events. At the mouth of the river, the placement of levees and the installation of three bridges (for the Union Pacific railroad, Main Street, and US Highway101) have constrained the lateral movement of the river bed and reduced the size of the lagoon.

2.4.3.2 General River Description

Upstream of the Matilija Dam, Matilija Creek is a steep, cobble bed stream confined between canyon walls. Matilija Creek gradually becomes less steep and experiences active channel migration as it cuts through the delta to reach Matilija Reservoir. Downstream of the dam, Matilija Creek joins the North Fork of Matilija Creek to form the Ventura River. The 1.5 miles immediately downstream of the dam is an extremely steep reach composed primarily of boulders. As the Ventura River exits this steep canyon, it enters a wide depositional plain for approximately 1 mile until it reaches the Robles Diversion Dam. From the Robles Diversion Dam to the confluence with San Antonio Creek, the Ventura River is a slightly sinuous braided stream that experiences active channel migration. From San Antonio Creek until the lagoon, the river is relatively more confined and has fewer channels (Reclamation 2003).

The morphologic parameters of the Ventura River can be classified as a “D” type stream based on the Level 1 Classification system developed by Rosgen, which integrates information on basin relief, landform, and valley morphology. D-type streams are distinctive: multiple channel systems exhibiting a braided pattern with longitudinal, transverse and mid-channel bar formations. Historically, the cross-sectional shape of the river channel has been typically wide and relatively shallow, tending to increase in width more than in depth as discharge increases. However, recent cross-section surveys suggest the channel has incised between 1971 and 2001 and is becoming more entrenched, which could decrease the width/depth ratio (Reclamation 2003).

The morphology of the Ventura River reflects the changes in topography that occur from the headwaters to the lagoon at the ocean. Channel slopes are generally greater than 0.05 ft/ft on the tributary streams, but decrease to approximately 0.02 ft/ft between Matilija Dam and Robles Diversion. Slopes decrease further to between 0.015 ft/ft and 0.01 ft/ft from the Robles Diversion Dam to the confluence with San Antonio Creek. Below San Antonio Creek, the channel gradient generally decreases to 0.005 ft/ft to the mouth (ENTRIX 2001b).

The significant change in channel gradient reduces the capacity of the river to transport bed and suspended sediment loads derived from the upper watershed. In addition to the downstream reduction in channel slope, the more highly entrenched and narrow tributary streams give way to a wide alluvial valley that has comparatively much less energy to transport sediments. The multiple channel morphology of the mainstem is a result of the high sediment yields and reduced sediment transport capacity relative to tributary streams that creates a series of various bar types and unvegetated islands that are subject to shifting positions during high-flow events (ENTRIX 2001b).

The D-type channels indicative of the Ventura River are associated with unstable bar features and frequent lateral channel adjustments. Based on the historic aerial photography, the low- and high-flow channels may change position within a dynamic floodplain, but the floodplain width and terrace features have remained relatively stable. Over geologic time periods, there has been an approximate balance between rate of uplift due to faulting and the rate of river down-cutting (Reclamation 2000). There is considerable evidence that fault displacement and landform deformation in the central Ventura Basin and the western Transverse Ranges is causing local uplift. The Arroyo Parida-Santa Ana fault, Oak View faults, and other faults have demonstrated to cause local uplift since the late Pleistocene age. In response to this uplift, the Ventura River has been adjusting by down-cutting at an approximately equal rate as to uplift, from about 0.5 to 1.3 millimeters (mm) per year (Rockwell et al. 1984). Cross-section data from Reclamation (2003) suggests that channel down-cutting has accelerated in recent decades. Channel down-cutting could result in disconnecting the floodplain from the channel, depending upon the relative magnitude of incision.

Interpretation of the time-series aerial photography indicates that the Ventura River between Foster Park and Robles Diversion has likely always possessed the morphological characteristics and functionality of a D-type channel. However, recent decades of channel incision is an indicator that sections of the Ventura River are evolving into a different stream type that is associated with the loss of multiple high- and low-flow channels and is more characteristic of a single-thread channel, which is becoming disconnected from its former floodplain. As such, the river is not vertically stable, although the extent to which continued vertical incision may occur is not known.

2.4.3.3 Sediment Supply and Characteristics

The Ventura River is considered to produce some of the highest suspended and bedload yields per unit watershed area in Southern California (Brownlie and Taylor 1981, as cited in Keller and Capelli 1992), with steep headwater slopes in the watershed producing most of the sediment supplied to the river through mass wasting processes (Reclamation 2000). Forest fires are also believed to have a significant impact on sediment production in the watershed by increasing the erodibility of hillslopes.

Previous studies have estimated sediment yields for the Matilija sub-basin upstream of the dam at 1.92 AF per square mile per year and at 2.10 AF per square mile per year for the entire Ventura basin without the influence of Casitas and Matilija dams to 2.78 AF per square mile per year with Matilija and Casitas dams in place (Reclamation 2000). Estimated sediment yields ranged from 1.6 to 6.8 AF per square mile per year for headwater sub-basins of the Ventura River; 2.5 AF per square mile per year is an accurate estimate for solely the Matilija sub-basin (Reclamation 2000). This compares with 0.7 AF per square mile per year average sediment yield and 3.0 AF per square mile per year (considered a high sediment yield), compiled from various drainage basins of 100 square miles or less in California (Leopold 1994). However, construction of dams in the upper watershed has reduced suspended and bedload sediment transport into the mainstem of the river since the late 1940s.

Over 98 percent of the total sediment load in the Ventura River and San Antonio Creek is suspended (Reclamation 2003), which is typical of coastal California streams. Approximately 96 percent of the coarse sand load (0.062 mm to 2 mm in diameter) is suspended (Reclamation 2003). While larger particles are moved during large floods, these grain sizes comprise a relatively small portion of the load (approximately 2 percent of the total sediment load). The relative amount of coarse material being transported increases with increasing flow rate. However, these large particle sizes dominate the bed material and exert a much greater influence on channel form (Reclamation 2003). Most of the mainstem Ventura River is dominated by large gravel-size material, with smaller-sized gravels and larger-sized boulders as sub-dominant materials.

Total sediment load is transported during only a few days each year with relatively infrequent storm events. For example between October 1976 and September 1978, 92 percent of the sediment load in the Ventura River was transported during five storm events each averaging 10 days (Reclamation 2000). It has been estimated that, over the long-term, the largest proportion of the total sediment load (i.e., suspended sediment plus bedload sediment) is transported by flows of approximately 6,000 cfs, which is equivalent to the mean annual flood, with a 2.33 year return interval.

2.5 Fire Regime

Wildfires are a common occurrence in the hills and mountainous regions of Ventura County. They generally occur in the late summer and fall when vegetation is dry and weather conditions are favorable for the occurrence and spread of fires. Moderate fires associated with floods have occurred every 10 years, while extreme fires and major floods have occurred every 20 years (Chubb 1997). The Matilija and North Fork Matilija sub-basins have experienced the most widespread, repeated fire damage, with major fires in 1932, 1949, and 1985 (the Wheeler Fire, or Wheeler #2). Wheeler #2 covered 54 percent of the watershed and the southeastern portion of the watershed also was heavily impacted by a single fire in September 1979 that covered 15 percent of the watershed, known as the Creek Road Fire (Tetra Tech 2009a). The area affected by these two fires is shown in Figure 2.5-1, and the cumulative area burned between 1965 and 2007 is shown in Figure 2.5-2.

Several other fires burned at least 5 square miles of land within the watershed and are thus considered to be potentially significant for impacts on basin hydrology (Table 2.5-1). These include the two major fires occurring in 1979 and 1985, mentioned above, as well as major fires in 1983 and 1993.

Table 2.5-1 Fires Covering more than 5 Square Miles in Ventura River Watershed, 1965-2008

	Date of Fire	Square Miles in Watershed	Percentage of Watershed Area Burned	UIDENT
Wheeler #2	07/01/1985	122.10	54%	LPNF19850027
Creek Road	09/18/1979	33.85	15%	47VENT_CO
Matilija	07/07/1983	7.35	3%	LPNF19830019
Ferndale	10/14/1985	5.65	3%	197VENT_CO
Steckel	10/27/1993	5.54	2%	187VENT_CO

Source: Tetra Tech 2009a

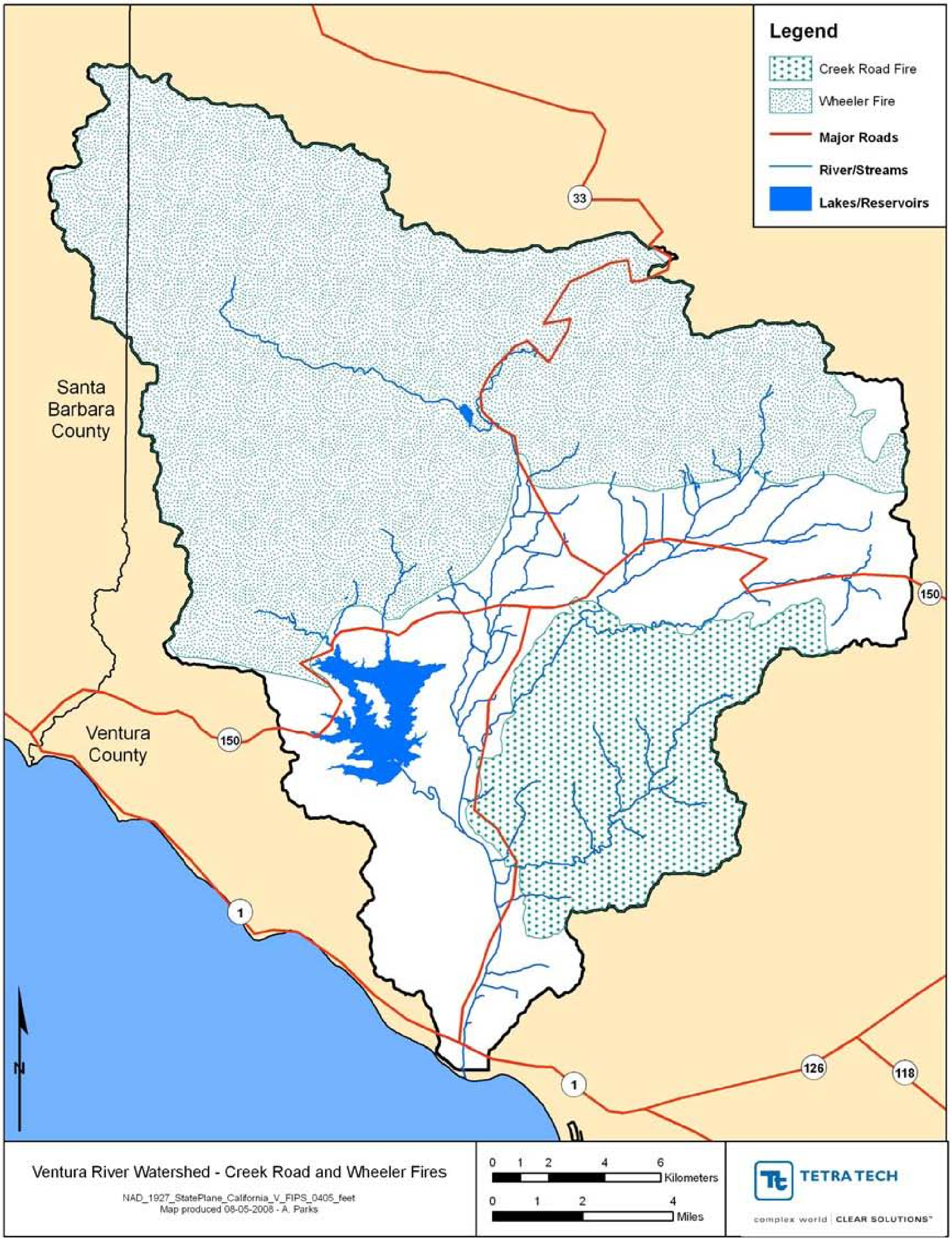


Figure 2.5-1 The Creek Road (1979) and Wheeler #2 (1985) Fire Areas

Source: Tetra Tech 2009a

Figure 2.5-2 Cumulative Burned Area within the Ventura River Watershed, 1985-2007

Source: Tetra Tech 2009a

Some areas of the watershed have not burned for many years, such as the area around Lake Casitas and parts of the San Antonio Creek basin. These locations may be susceptible to intense damage from future fires due to accumulated fuel loads (Chubb 1997). By reducing or destroying vegetative cover and altering soil characteristics, fires may result in conditions that can significantly increase runoff and erosion when winter rains begin to fall. These conditions may result in a debris flow (also referred to as mud flow) – a slurry of water, sediment, and rock that converges in a stream channel (URS 2005).

2.6 Hydrology

2.6.1 Historical Context

Although few records exist prior to the 20th century, a review of historical maps and documents suggests that the historical hydrology of the Ventura River was a result of the form of the river channel and the associated geology. In the reach of the river within Matilija Canyon, flows were perennial. As the river entered the Ojai Valley and the channel broadened, surface flows became intermittent. At the confluence with San Antonio Creek, and from Foster Park to the mouth of the river, flows were perennial (SFEI 2011).

2.6.2 Surface Water

Flow conditions in the mainstem of the Ventura River and tributary watersheds are naturally variable depending upon precipitation (rainfall and snowmelt). About 80 percent of the time, there is no significant surface flow in the Ventura River above the confluence with San Antonio Creek. However, there is generally year-round flow in the lower reaches of San Antonio Creek. During the wet season, the surface flows are "flashy," with sudden rises in discharge immediately following the onset of precipitation, and relatively rapid declines in streamflow after precipitation decreases (USACE 2004).

Under summer low-flow conditions, surface streamflow at various locations in the watershed is governed by a number of factors, including precipitation input, spring discharge, groundwater levels, the effects of water diversions, water storage and water supply releases, treated wastewater discharge, and groundwater extraction. Some reaches of the mainstem Ventura River tend to go dry on a yearly basis. This typically includes the Ventura River reach between Robles Fish Passage Facility and the upstream end of the Casitas Springs/Foster Park reach between the confluence of San Antonio Creek and Foster Park. The Casitas Springs/Foster Park reach and Ventura River downstream from the OVSD Wastewater Treatment Plant to the lagoon typically retains flows year round. This section of the Ventura River has perennial flows, except during some drought years, due to a natural bedrock barrier that forces subsurface flow to the surface. The river channel occurs as a wide floodplain and during high flows is "characterized by a typical pool riffle continuum found in low gradient streams." Vegetation such as watercress and water veronica is consistent with the spring-fed nature of this reach (Moore 1980).

San Antonio Creek typically goes dry upstream from Soule Park across the Ojai Valley, but is typically perennial downstream to the confluence with the Ventura River. North Fork Matilija Creek retains perennial surface flows except during long periods of severe drought (ENTRIX 2003). Along the mainstem, surface flows dry up in locations between the Robles Fish Passage Facility and the confluence of San Antonio Creek. However, small summer flows are maintained upstream of the Robles Fish Passage Facility; in the Casitas Springs/Foster Park reach, between Foster Park and the confluence of San Antonio Creek; and downstream of the OVSD Wastewater

Treatment Plant (ENTRIX and Woodward Clyde Consultants 1997). The following background information summarizes the general hydrology of the Ventura River watershed.

From the Matilija Creek headwaters to Camino Cielo, the Ventura River is perennial, supported in part from releases from Matilija Dam. The flow is intermittent from Camino Cielo to the confluence with San Antonio Creek with the reach below the Robles Fish Passage Facility typically going subsurface during the summer months (ENTRIX 2001). Historically, there has been little or no surface flow in the river in the summer from Hollingsworth Ranch (8 miles above the lagoon) to the former Soper's Ranch (14 miles inland). There is a geologic discontinuity at Casitas Springs that causes groundwater to rise and feed a perennial stretch of the surface flow below San Antonio Creek (CRWQCB-LA 2002). Surface flows in this reach come from San Antonio Creek, Live Oaks Acres Creek, and small springs and rising groundwater. Between the confluence with San Antonio Creek and Foster Park, flow is perennial, with some disruption at Foster Park by the groundwater extraction. The river has a perennial flow to the lagoon due to rising groundwater and water treatment plant discharges.

2.6.2.1 Surface Flow Conditions

The factors controlling surface streamflow differ considerably during the high-flow season or wet years from those that occur during low-flow seasons or dry years. The following summary of historical conditions presents separate discussions of high and low flows to help clarify the relationship between streamflow conditions and various water resource developments and operations. Several stream gages are located in the Ventura River watershed, and some have a record extending as far back as 1927 (Table 2.6-1). Originally, the U.S. Geological Survey (USGS) operated them all, but starting in the 1980s, the District and Casitas have operated several gages. The operation of some gages has been discontinued for various reasons; for example, the gage above Matilija Dam (11114500) was destroyed in the 1969 flood. The gage locations are shown in Figure 2.6-1 along with their periods of record.

Table 2.6-1 Stream Gages in the Ventura River Watershed

Description	USGS Gage Number	Drainage Area (mi^2)	Period of Record	Data Source
Matilija Creek U/S Reservoir near Matilija Hot Springs	11114500	50.7	1948-1969 (destroyed)	USGS
Matilija Creek at Matilija Hot Springs	11115500	54.7	1927-present	USGS and Casitas
North Fork Matilija Creek at Matilija Hot Springs	11116000	15.6	1928-present	USGS and District
Ventura River near Ojai	11116500	70.7	1911-1984 (not maintained)	USGS
Ventura River near Meiners Oaks	11116550	76.4	1959-present	USGS and Casitas
San Antonio Creek near Ojai	11117000	33.7	1927-1932	USGS
San Antonio Creek at Casitas Springs	11117500	51.2	1949-present	USGS and District
Coyote Creek near Oak View	11117800	9.11	1958-present	USGS and Casitas
Coyote Creek near Ventura	11118000	41.2	1927-1982	USGS and Casitas
Ventura River Diversion near Ventura	11118400	--	1969-present	USGS
Ventura River near Ventura	11118500/ 11118501	188	1929-present, 1932-present, respectively	USGS
Ventura River at Santa Ana Blvd.	Flood warning gage	--	2002-present	District

Table 2.6-1 Stream Gages in the Ventura River Watershed

Description	USGS Gage Number	Drainage Area (mi²)	Period of Record	Data Source
Thacher Creek at Boardman	Flood warning gage	--	2002-present	District
Matilija Creek upstream of Reservoir	11114495	47.8	2002-present	USGS

Source: District 2007; USGS 2007; Casitas, no date

2.6.2.2 River and Tributary Runoff Production

The production of runoff in various tributaries is generally related to sub-basin area, peak elevations, and variations in vegetation and soil conditions, as well as local storm patterns. Runoff volumes, hydrograph timing, and sediment yield over the period of record has been greatly affected by interaction of fires and floods (refer to Section 2.5, Fire Regime).

Long-Term Averages

The long-term average runoff production for the gauged tributaries and the Ventura River is presented in Table 2.6-2. Matilija and San Antonio creek sub-basins have the largest average annual runoff volumes, with Matilija Creek being the single most important sub-basin for total volume. North Fork Matilija Creek and Matilija Creek are the major water production areas, with long-term average runoff of approximately 500 AF per square mile of watershed area. San Antonio Creek has the lowest runoff production per unit area, but has a larger watershed than either Coyote or Santa Ana creeks. Therefore, the average annual runoff produced from the San Antonio Creek basin is approximately equal in volume to that from both the Coyote and Santa Ana sub-basins upstream of Lake Casitas.

Water Year Types

Annual unimpaired runoff for the Ventura River watershed between 1930 and 2005 varies greatly, with several extremely high years of runoff much higher than the mean value (Table 2.6-3; Figure 2.6-2). The totals range from a low of 1,602 AF in water year (WY) 1961 to a maximum of 277,300 AF in WY 1995. The median annual unimpaired runoff, 18,116 AF, is much lower than the mean due to the statistical effect of a few extremely large runoff years.

The wide range of streamflows from year to year is not unusual for a semi-arid setting, but has important implications as a natural limitation to both the native fisheries resources and water supply management. Over typical planning timeframes (20 to 50 years), such variability creates limitations to water supply management and native fisheries resources. However, when viewed from longer time spans, the conditions are less of a limiting factor than an evolutionary pressure affecting the traits of native fishes. The entire historical record has been analyzed and categorized into WY types. Standard hydrologic methods were used to rank the years and analyze the percent of years with certain ranges of values creating three classes: wet (more than 23 inches of rainfall), normal (16 to 23 inches of rainfall), and dry (less than 16 inches of rainfall. The WY type was determined using the unimpaired runoff for the Ventura River, near Ventura gage (combined record, USGS #8501) (Table 2.6-3).

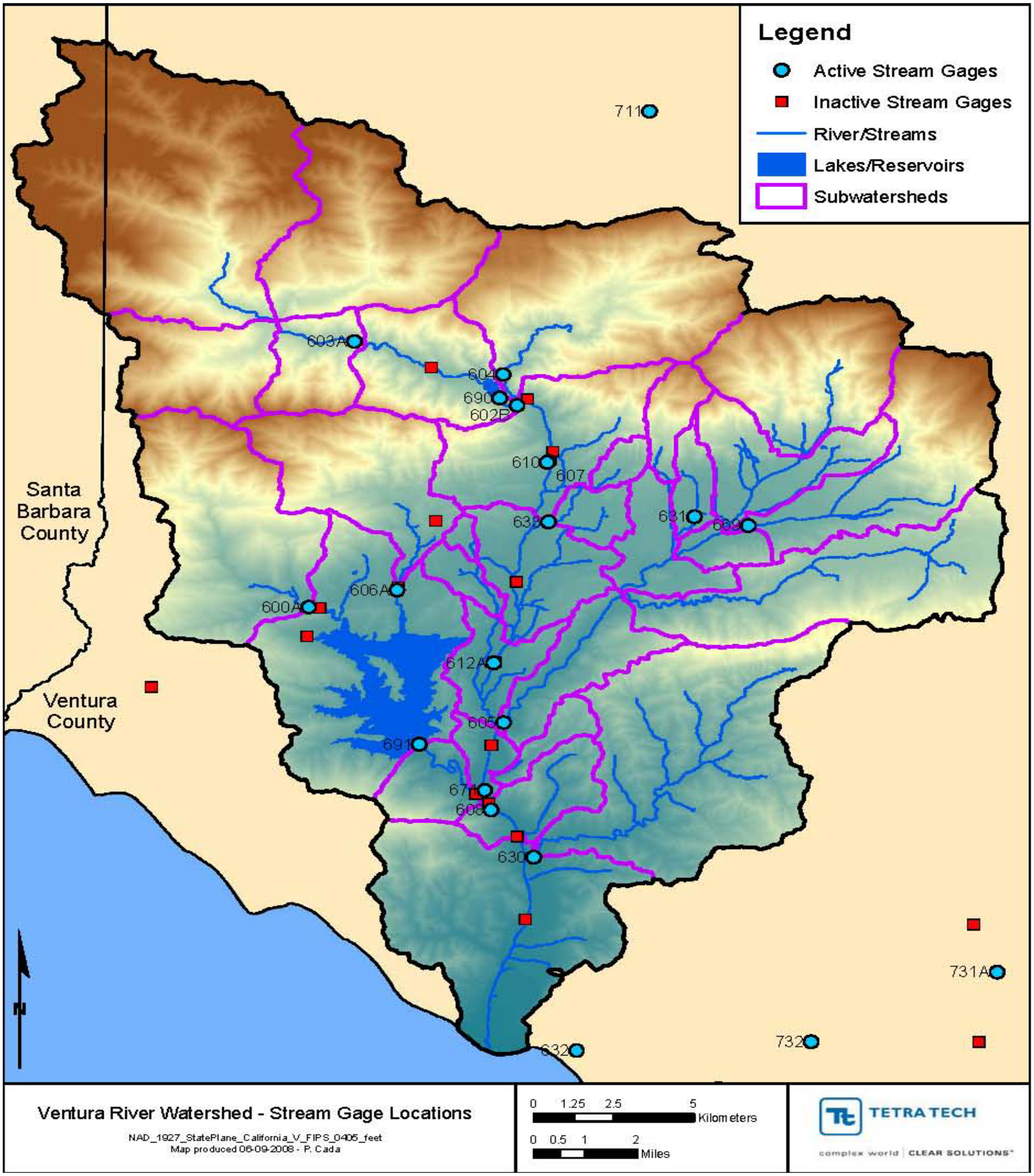


Figure 2.6-1 Ventura River Watershed Stream Gage Locations

Source: Tetra Tech 2008a

Table 2.6-2 Long-Term Average Runoff of the Ventura River Mainstem and Tributaries

Gauging Station	Period of Record	Unit Area (sq. mi.)	Average (mean) Annual Runoff (AF)	Unit Area Production (AF/sq. mi)	Percent of "Ventura River, Combined"
Matilija Creek	1927-present	55	26,442	480.8	55.6
North Fork Matilija Creek	1928-1931 1933-present	16	8,477	529.8	17.8
San Antonio Creek	1949-present	51	11,206	219.7	23.5
Coyote and Santa Ana Creeks	1958-1990	41	9,318	227.3	9.5
Ventura River near Ventura	1912-1913 1930-present	188[a]	42,385	--	89.1
Ventura River near Ventura, combined (unimpaired)	1930-present	188[b]	47,596	253.2	100

Source: USGS gage records; Reclamation 1954; and City of Ventura and Casitas 1991

a. Tributary runoff as a proportion of the unimpaired runoff at Foster Park
b. Includes area of all upstream sub-basins

Although the base number of years differs for the pre-Matilija (1930 to 1947), Matilija-only (1948 to 1958), and post-Casitas/Robles (1959 to 2005) periods, the proportion of water year types in each period can be fairly compared (Table 2.6-3). The post-Casitas period includes 47 years of the total record, and has evenly distributed water year types (approximately 19 percent in each of four classes and 26 percent in the below-normal class). In contrast, over half of the Matilija-only period was below normal or dry. The 18 years of record prior to Matilija had proportionally more wet and above normal years (67 percent) than either of the more recent periods.

High Flows and Flooding

Surface flows in streams of the Ventura River watershed during the wet season are derived almost entirely from rainfall, and generally exhibit variability of flow that parallels the precipitation inputs. The streams have "flashy" storm hydrographs, with sudden rises in discharge immediately following the onset of precipitation, and relatively rapid declines in streamflow after the rainfall ends. On the mainstem, flows can surge from near zero to thousands of cfs within a few hours during major storms (Reclamation 1954).

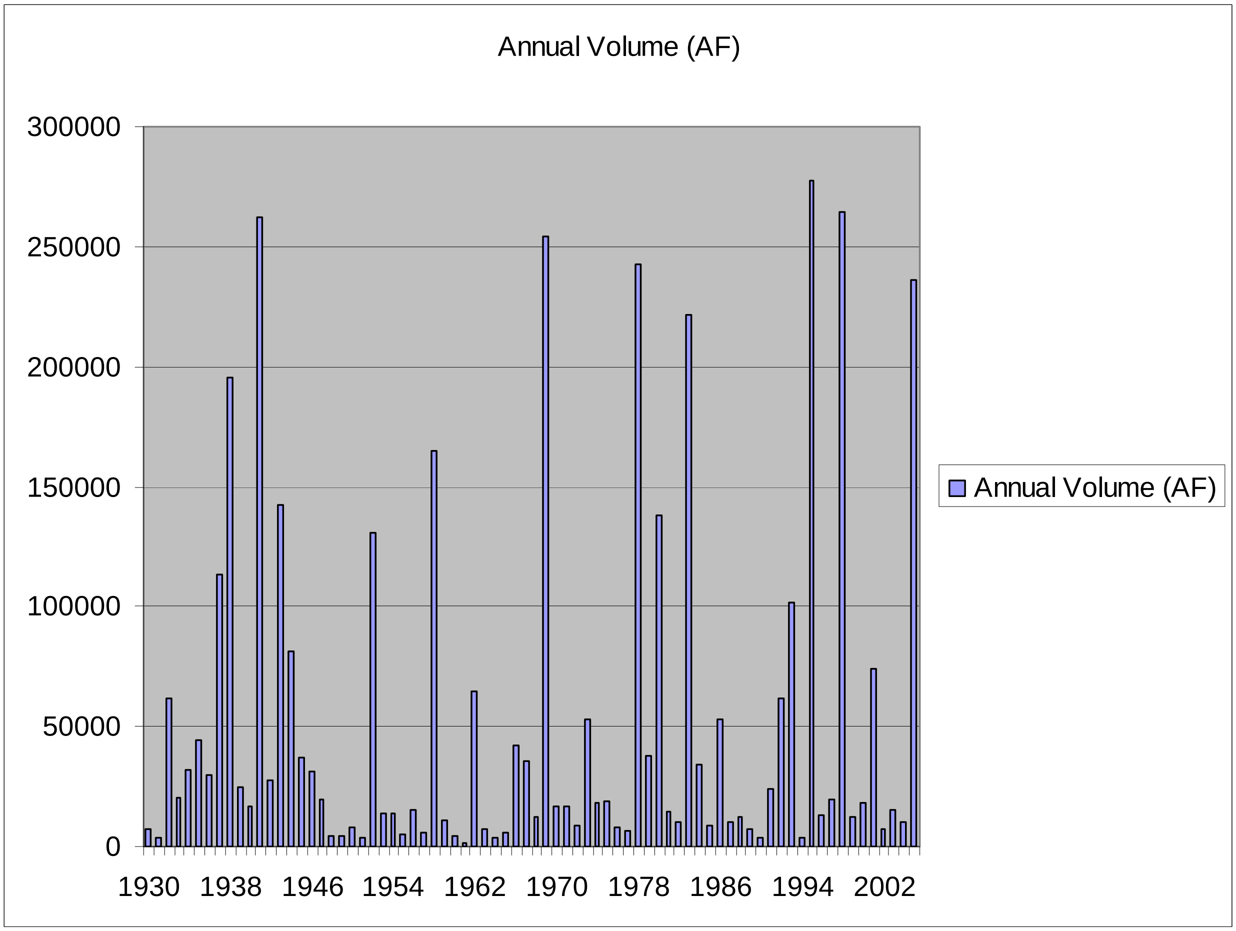


Figure 2.6-2 Annual Unimpaired Runoff 1930-2005

Source: USGS Gage #8501

Table 2.6-3 Water Year Types for the Ventura River Basin Based on Unimpaired Runoff

Water Year	Ventura River Runoff*		Water Year	Ventura River Runoff*	
	Annual Volume (AF)	Water Year Type**		Annual Volume (AF)	Water Year Type**
1930	7,419	Below Normal	1967	35,642	Above Normal
1931	3,322	Dry	1968	12,266	Below Normal
1932	61,808	Above Normal	1969	254,100	Wet
1933	20,141	Normal	1970	16,394	Normal
1934	32,316	Above Normal	1971	16,488	Normal
1935	44,554	Above Normal	1972	8,669	Below Normal
1936	29,550	Above Normal	1973	52,739	Above Normal
1937	113,311	Wet	1974	18,165	Normal
1938	195,303	Wet	1975	18,998	Normal
1939	24,773	Normal	1976	7,731	Below Normal

Table 2.6-3 Water Year Types for the Ventura River Basin Based on Unimpaired Runoff

Water Year	Ventura River Runoff*		Water Year	Ventura River Runoff*	
	Annual Volume (AF)	Water Year Type**		Annual Volume (AF)	Water Year Type**
1940	16,807	Normal	1977	6,558	Dry
1941	262,031	Wet	1978	242,412	Wet
1942	27,751	Above Normal	1979	37,661	Above Normal
1943	142,573	Wet	1980	137,703	Wet
1944	81,338	Wet	1981	14,888	Normal
1945	37,087	Above Normal	1982	10,121	Below Normal
1946	30,919	Above Normal	1983	221,222	Wet
1947	19,268	Normal	1984	34,373	Above Normal
Matilija Dam began storing water in water year 1948			1985	8,820	Below Normal
1948	4,473	Dry	1986	52,680	Above Normal
1949	4,308	Dry	1987	10,523	Below Normal
1950	7,863	Below Normal	1988	12,087	Below Normal
1951	3,574	Dry	1989	7,011	Dry
1952	130,918	Wet	1990	3,672	Dry
1953	14,112	Normal	1991	23,967	Normal
1954	14,102	Below Normal	1992	61,637	Above Normal
1955	4,909	Dry	1993	101,855	Wet
1956	14,972	Normal	1994	3,683	Dry
1957	5,804	Dry	1995	277,300	Wet
1958	165,177	Wet	1996	13,009	Below Normal
Casitas Dam, Robles Diversion began functioning in water year 1959			1997	19,513	Normal
1959	10,847	Below Normal	1998	264,364	Wet
1960	4,238	Dry	1999	12,141	Below Normal
1961	1,602	Dry	2000	18,068	Normal
1962	64,884	Above Normal	2001	73,788	Wet
1963	7,087	Dry	2002	7,299	Below Normal
1964	3,960	Dry	2003	15,466	Normal
1965	6,155	Dry	2004	9,901	Below Normal
1966	42,424	Above Normal	2005	235,817	Wet

* The Water Year Type was determined using the unimpaired runoff for the Ventura River, near Ventura gage (combined record, USGS #8501).

** Water Year Type is defined as the surface-water supply for the 12-month period October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1990, is called "water year 1990."

Floods on the Ventura River occur relatively frequently, with 13 major floods between WY 1938 and WY 2005 (Table 2.6-4). The largest flood occurred in February 1978, with a peak discharge of 63,600 cfs at the Ventura River, near Ventura gage. The storage available at Matilija and Casitas reservoirs to regulate peak flows from major storms has varied over the years. Matilija Dam was capable of appreciably lowering (by 50 percent) flood flows in the river for the first decade or two after construction. The original design included a probable maximum flood peak inflow of 60,000 cfs. However, it presently has little effect on reducing the peak of major flood flows. The available capacity at Casitas Reservoir and the rate of flow above the Robles Fish Passage Facility have become more important factors during major storms, even though they are not designed as flood control facilities. The 500 cfs diversion at Robles Fish Passage Facility has little effect on large peak flows. However, the 500-cfs diversion likely reduces the "moderate" peak events (flows at or near the capacity of the diversion). From the 1970s until the present, floods have occurred relatively frequently and several have been quite large (Reclamation 2003). The 2005 water year was officially one of the wettest years in the century and high flows significantly altered the streambed morphology and vegetation in the mainstem and tributaries (Leydecker and Grabowsky 2006).

Table 2.6-4 Major Floods and Flow Regulations on the Ventura River

Year	Flood Month	Ventura River Peak Discharge (cfs)	Matilija Reservoir Storage Capacity[a] (AF)	Casitas Reservoir Available Storage[b] (AF)
1938	March	39,200	None	None
1943	January	35,000	None	None
1952	January	29,500	7,020	None
1969	January	58,000	2,500	137,000
1969	February	40,000	2,500	37,000
1978	February	63,600	2,500	76,000
1980	February	37,900	2,000	17,000
1983	March	27,000	1,400	40,000
1992	February	46,700	1,000	110,000
1993	January	12,500	990	42,000
1995	January	43,700	990	30,000
1998	February	38,800	990	26,000
2005	January	41,000	990	86,000

a. Maximum storage capacity, based on historic reports; storage available would be less than the maximum.
b. Available storage, based on the difference between the 254,000 acre-feet capacity and reported "first of year" storage (data received from Casitas Municipal Water District 2006).

Low Flows

Under summer low flow or drought conditions, surface streamflow at various locations in the watershed are governed by a complex interaction of precipitation input; discharge from springs; groundwater levels; the effects of water diversions, water storage, water supply releases, and treated wastewater discharge and groundwater extraction.

It is not unusual for streams in Southern California that are rainfed, and lack groundwater support, to dry up in summer months, in both average and below average precipitation years. In the Ventura River watershed, however, several of the smaller tributaries, and even the mainstem, have short perennial reaches that are fed by springs and/or the perched groundwater over shallow bedrock. Perennial flows are present in San Antonio Creek, and in the Casitas Springs/Foster Park reach, defined as the portion upstream of, and including, Foster Park and including lower San Antonio Creek from SR 33 to its confluence with the Ventura River. The presence of year-round flow in this reach of the river is due to high groundwater levels in the shallow alluvium over bedrock, which is artificially raised at Foster Park by the City's subsurface dam (URS Corporation 2003).

Small summer streamflows maintained by springs were documented by both Reclamation (1954) and EDAW et al. (1981) in the upper reaches of the larger sub-basins. EDAW reported typical summer base flows of 1 to 2 cfs in North Fork Matilija Creek, 1 to 3 cfs in Matilija Creek, and less than 0.5 cfs in San Antonio Creek and Coyote Creek below Casitas Dam. Since the 1960s, effluent discharge from the OVSD Wastewater Treatment Plant provides summer flows of approximately 1.9 cfs (2002 data) from the OVSD Wastewater Treatment Plant downstream to the lagoon.

2.6.3 Groundwater

Groundwater has been an important water source for irrigation, domestic, and municipal supplies in the Ventura River watershed for many decades. In general, groundwater in the Ventura River system occurs under unconfined conditions. However, in some localized areas (where fine-grained overbank deposits form a relatively low permeability cap over old channel deposits with higher permeability), semi-confined conditions may exist, especially during periods of high water levels (Fugro 2002). The primary source of recharge to the alluvial aquifer system is direct infiltration of precipitation. Two other sources of recharge include direct infiltration of surface flows, and downvalley underflow through alluvial sediments.

The Ventura River system is composed of five major groundwater basins: the Upper Ojai basin; the Ojai basin; the Upper Ventura River basin; the Lower Ventura River basin; and the San Antonio Creek basin (ENTRIX 2001c). Of primary importance to this report are the Upper Ventura River, Ojai, and San Antonio Creek basins because local agencies operate and maintain water supply facilities in these areas (Figure 2.6-6). A description of the major groundwater basins is provided below.

2.6.3.1 Groundwater Basins

Upper Ventura River Basin

The Upper Ventura River Basin has a partial downslope along the Arroyo Parida fault to the north (ENTRIX 2001b). The upper basin extends from the confluence of Matilija Creek and North Fork Matilija Creek (RM 16.2) to the City's subsurface dam at Foster Park (RM 5.9), which delineates the boundary between the Upper and Lower Ventura River groundwater basins. The basin is believed to have a capacity of approximately 14,000 AF when full (USACE 2004). The boundary between the Ojai Basin and the Upper Ventura River Basin is situated between Camp Comfort to the south and Arbolada to the north. The depth to bedrock decreases in the vicinity of this boundary resulting in a decrease in thickness of the aquifer materials.

The Upper Ventura River is underlain by alluvial deposits with a maximum thickness of approximately 200 feet and an average thickness of 60 to 100 feet. A natural subsurface obstruction blocks subsurface flow below the Ventura River just above San Antonio Creek causing groundwater to rise as springs. Therefore, the groundwater beneath the Ventura River is divided into an upper cell and a lower cell (Reclamation 2003).

The thickness of aquifer materials is generally shallow, but varies along the river due to the geologic structure of the basin (variations in the depth to bedrock and faulting). Along the Upper Ventura River, the water-bearing units increase in thickness downstream of the confluence of Matilija and North Fork Matilija creeks, attaining a maximum thickness of approximately 200 feet on the north (down dropped) side of the Arroyo Parida-Santa Ana fault (Figure 2.6-7). Downstream of the Santa Ana fault, in the Mira Monte area, the alluvium thickness is controlled by the folded bedrock surfaces and is approximately 65 feet thick. In the Foster Park area, north of the subsurface dam and in the vicinity of the City's Nye Wells, the aquifer materials are 45 to 60 feet thick, providing a saturated thickness ranging from 35 to 45 feet (Fugro West 2002). The total storage capacity of about 14,000 AF typically empties during a 1 to 3-year critical dry period. The dominant source of recharge is direct infiltration or precipitation and percolation from local streambeds (ENTRIX and Woodward Clyde Consultants 1997).

Ojai Groundwater Basin

The Ojai Groundwater Basin (Ojai Basin) is located within the Ventura River watershed, within the western portion of Ventura County, California. The Basin is bordered by the Topa Topa Mountains and Santa Ynez Mountain Range on the north and east, Black Mountains on the south, and the Upper Ventura River Groundwater Basin to the west. Ground surface elevations across the alluvial surface of the Basin range from over 1,300 feet above mean sea level (amsl) at the northeastern portion of the Basin, to approximately 700 feet amsl. The drainage area for the basin comprises 36 square miles and rises to elevations over 4,500 feet amsl. The alluvial groundwater Basin is 10.7 square miles (Kear 2005, as cited in Daniel B. Stephens & Associates [DBS&A 2010b]). A large fraction of land within the basin is dedicated to orchards, with the remaining area composed of residential, pasture, commercial and vacant land uses. Municipal and agricultural water requirements of the basin have historically been supplied by both surface water and groundwater sources.

The Ojai Basin is composed of alluvium deposits within a structural depression, and the lateral boundaries of the basin are defined by the contact between the alluvial deposits and the underlying sedimentary rocks (SGD 1992, as cited in DBS&A 2010b). The alluvial aquifer consists of undifferentiated and poorly consolidated deposits of clay, sand, gravel, and boulders. Confining clay units exist within the alluvium, and Kear (2005, as cited in DBS&A 2010b) reported that the units are thickest in the southern portion of the basin.

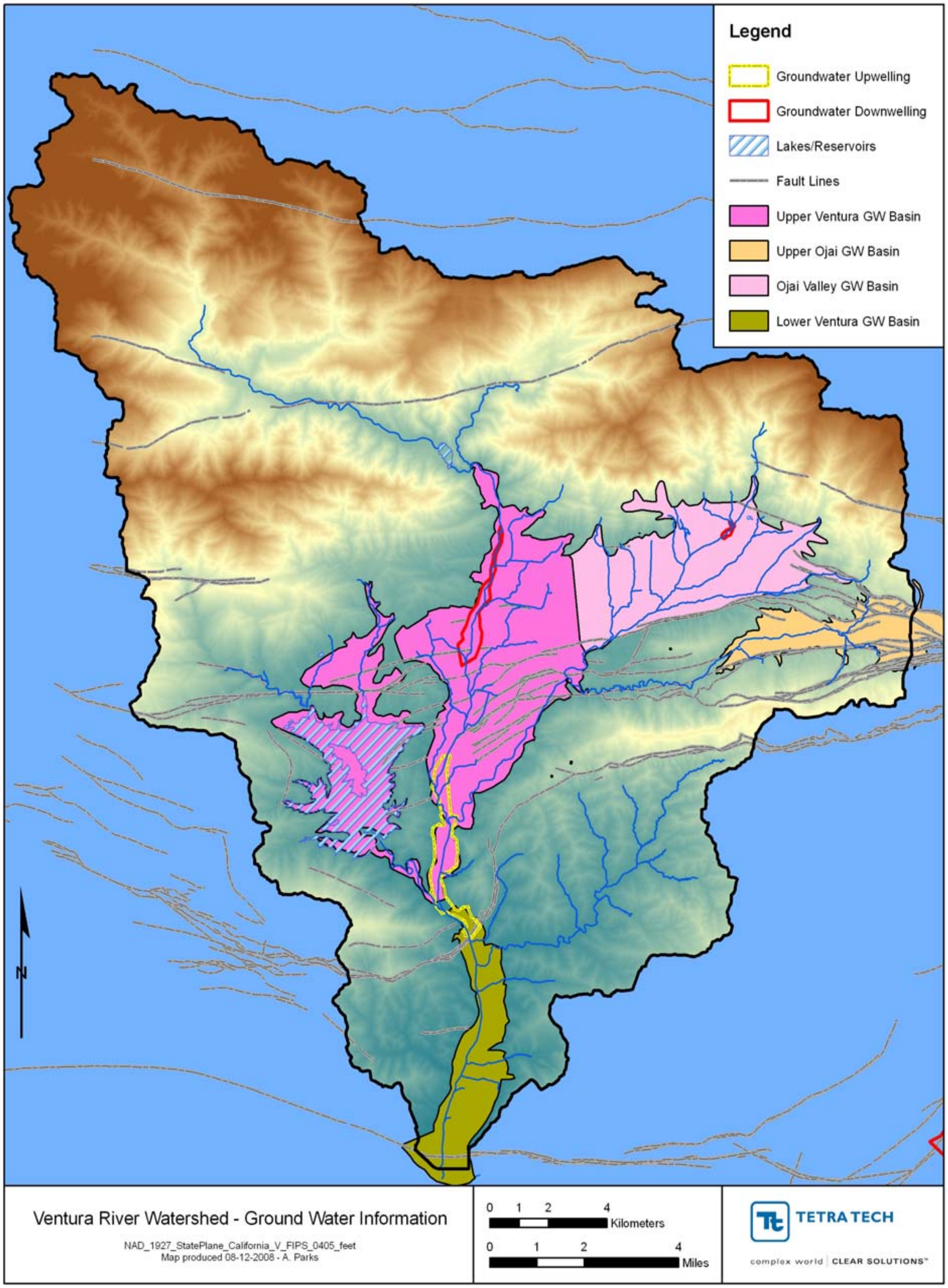


Figure 2.6-6 Groundwater Basins, Upwelling and Downwelling Areas, and Fault Lines

Source: Tetra Tech 2009a

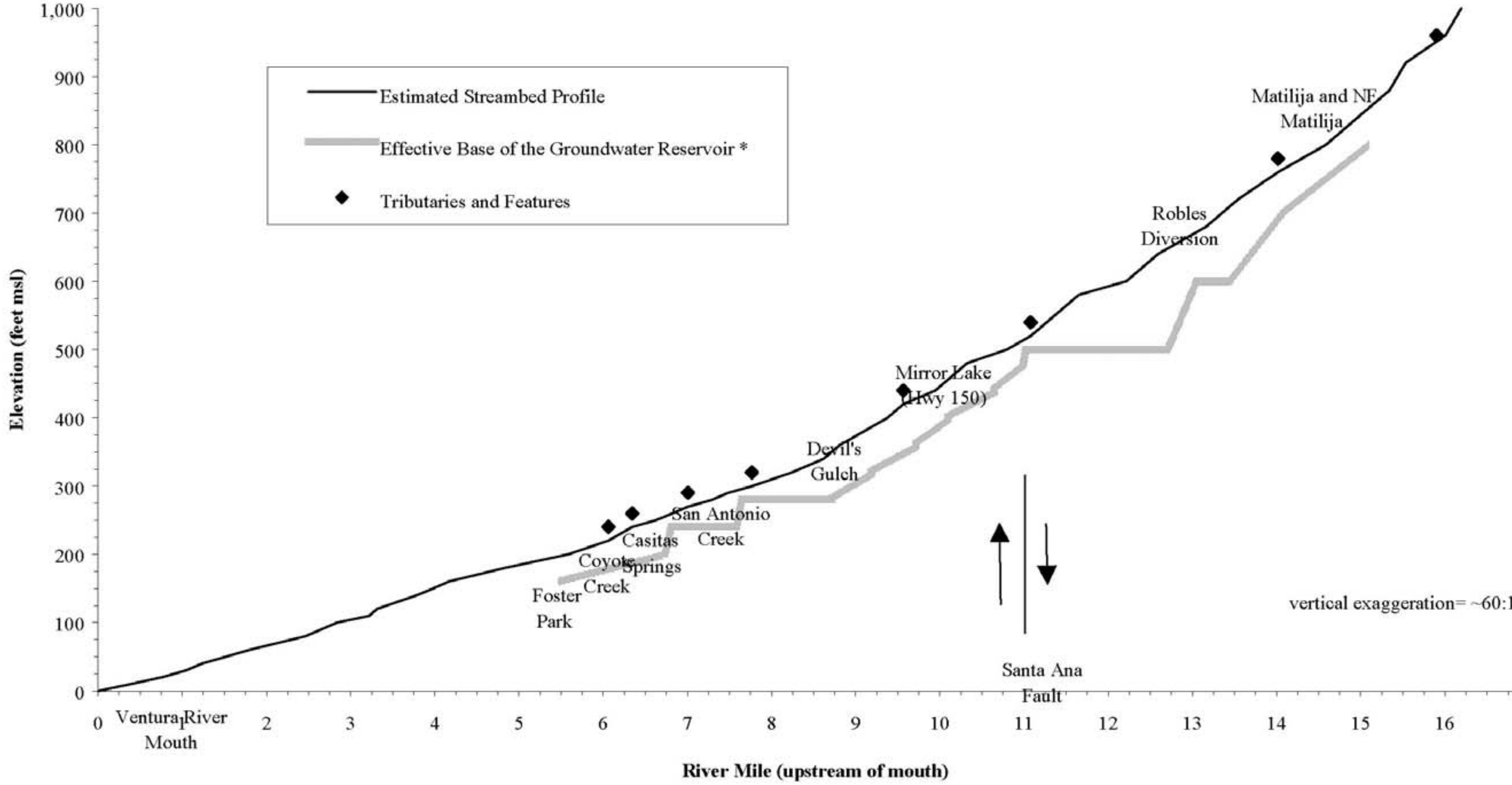


Figure 2.6-7 Ventura River and Effective Base of Groundwater Profiles

Source: ENTRIX 2001c

Depth to groundwater varies spatially and temporally within the basin. Near the alluvial fan heads, depths to water can be on the order of 300 feet below grade with seasonal variations between 50 and 90 feet. In the southern and western portions of the basin, however, the typical depths to water are less than 50 feet and show seasonal fluctuations on the order of 15 feet. Artesian conditions are common in the Ojai Basin in the winter and spring months of years with significant local precipitation. Recent water level monitoring has also indicated that significant static water level differences exist between the stratified aquifers of the Ojai Basin.

Historically, groundwater levels have declined following relatively dry periods (e.g., late 1940s, mid 1960s, late 1980s), and have been restored in subsequent years with relatively heavy rains. SGD (1992, as cited in DBS&A 2010b) reported that, since the early 1970s, decreases in groundwater demand and increases in recharge (through infiltration of excess applied irrigation water) have generally resulted in higher water levels within the basin. In 1971, Turner (1971, as cited in DBS&A 2010b) reported that, spatially, groundwater flow directions generally follow topographic trends, with groundwater flowing from alluvial fan heads in the northern and eastern portions of the basin towards the southwestern portion of the basin. Similarly, surface waters within the basin drain to the southwest towards the Ventura River, exiting the Basin via San Antonio Creek.

San Antonio Creek Basin

The water-bearing materials underlying San Antonio Creek consist of alluvial sediments of Recent Age. The average thickness of the sediment ranges from approximately 20 to 30 feet. The aquifer is generally unconfined and has a limited storage capacity and is used primarily for agricultural and domestic purposes (ENTRIX 2001c). As is typical for alluvial deposits, the aquifer is composed of sand, gravel, cobbles, boulders, silt, and clay, often with interstratified, lenticular, and discontinuous sediment units. Sedimentary structures include channel fill deposits, point bars, and overbank deposits. As a result of these complex depositional features, the aquifer parameters can vary greatly over short distances.

2.6.3.2 Groundwater Trends

Groundwater levels in the Upper Ventura River Basin, the Ojai Basin, and the Lower San Antonio Creek Basin fluctuate annually and seasonally, with the highest water levels occurring in the winter and early spring and the lowest levels occurring in the late summer and early fall. In general, groundwater levels in these basins recover rapidly following periods of precipitation and decline slowly under natural conditions, which is characteristic of unconfined groundwater basins. In the Upper Ventura River basin, groundwater levels in the vicinity of Meiners Oaks appear to fluctuate less than groundwater levels in the vicinity of Casitas Springs, which may be related to differences in groundwater extraction (District 1971).

Water levels in the two major groundwater basins, Ojai and Upper Ventura River, experienced dramatic drops during periods of dry years with low recharge and high extraction, such as the period from 1944 to 1951 (Reclamation 1954), and more recently from 1986 to 1990 (Casitas 1993). A study in 1978 conducted by EDAW, Inc. reviewed groundwater production in the Upper Ventura Basin from 1947 to 1973. In 1961, a particularly dry year, water in the basin was nearly depleted and some wells in the basin went dry (CRWQCB-LA 2002). The water level in the key District well 04N22W05L08S in the Ojai Basin was reported to have declined 31.1 feet in 2009 after increasing 26.5 feet in 2008, and declining a total of 75.5 feet in 2006 and 2007 (District 2009, as cited in DBS&A 2010b).

A rapid rise of the groundwater levels occurred immediately following drought-breaking wet seasons in both 1952 (Reclamation 1954) and 1992 (Casitas 1993). This response illustrates the high degree of interaction between groundwater and surface water hydrology, and suggests that groundwater extraction use during droughts has not exceeded recharge capability. The provision of supplemental surface water supplies from Casitas has contributed to the stability of the groundwater storage and water levels in the Ojai Basin over the last 25 years.

2.6.3.3 Surface-Groundwater Interaction

A surface water-groundwater interaction evaluation study based on available empirical data was conducted to develop an improved understanding of the hydrologic system dynamics, and determine the likelihood of groundwater pumping impacts on surface flows (ENTRIX 2001b). This effort involved collecting and evaluating available surface flow and groundwater data and prior analyses of the surface and groundwater system. The data reviewed as part of the evaluation included seasonal changes in groundwater levels and groundwater storage, groundwater flow relationships, and estimated contributions from groundwater to surface water.

The findings of this study can be summarized as follows:

- The Santa Ana/Arroyo Parida fault is likely a major influence on downvalley movement of groundwater. Improved knowledge of physical properties and flow processes of the groundwater aquifer in this critical area should provide the basis for developing groundwater management of upstream nodes that considers resultant water table impacts, not simply extraction volumes.
- The rate and ability of the groundwater system to recharge from surface water infiltration/percolation under water year types other than wet years should be evaluated as part of a “safe-yield” assessment, due to the climatic cycles in the region.
- The surface flow in the vicinity of Foster Park reflects augmentation from downvalley contribution of groundwater, over a wide range of water year types.
- Further quantification of groundwater pumping impacts on surface flows would require two critical datasets: (1) site-specific observations of the extent, duration, and magnitude of surface flows in the Casitas Springs/Foster Park reach and other locations of concern; and (2) concurrent information on groundwater pumping rates or volumes.
- An improved understanding of the historical water budget data, even without detailed historical observations of surface flows in the Casitas Springs/Foster Park reach could be developed if groundwater pumping data for some of the dry and wet years in the water-budget study period (WY 1970 to 1982) were obtained.

2.7 Surface Water Quality

In recent years, the RWQCB has taken on the task of reviewing and interpreting data by watershed and subwatershed that were collected by different agencies and programs to establish a general baseline of the water quality in the Ventura River watershed. Most of the available data is in the form of water column chemistry. There are also a limited amount of sediment chemistry, sediment toxicity, and bioaccumulation data available.

In January 2001, the Santa Barbara Channelkeeper, along with the Ventura section of the Surfrider Foundation launched the Ventura Stream Team water quality monitoring program. Over the past five years, more than 350 local volunteers have collected valuable water quality data including dissolved oxygen (DO), DO percent (%) saturation, pH, total dissolved solids (TDS), temperature, turbidity, conductivity, flow, nitrate (N-NO3 and NH3), phosphate, and dichloro-diphenyl-trichloroethane (DDT) at 15 sites on the Ventura River and its major tributaries including San Antonio, Stewart, Thacher, Cañada Larga, and Matilija creeks (Table 2.7-1). There are four Lower Ventura River sites, two Cañada Larga sites, four San Antonio Creek sites, and four Upper Ventura River sites.

Results of the first 5 years of studies are posted on the Channelkeeper website (www.channelkeeper.org) and a summary was reported in the Ventura River Stream Team Report – 2001-2005 (Leydecker and Grabowsky 2006). The report notes elevated average nitrate and phosphate levels at a number of sites, particularly in the Lower Ventura River (below the OVSD Treatment Plant) and along San Antonio Creek downstream of two golf courses and a number of equestrian stables. Although these sites have somewhat elevated levels, recorded measures for these sites are far below Public Health limits and the limits set in OVSD's Nationwide Pollutant Discharge Elimination (NPDES) discharge permit.

Table 2.7-1 Ventura Stream Team Water Quality Sampling Sites

Station Name	Location	Description
VRW001	Main Bridge	Ventura River (VR) just below the Main Street Bridge
VRW002	Stanley Drain	VR just at the confluence with the Stanley Drain
VRW003	Shell Road	VR at the Shell Road Bridge
VRW004	Lower Cañada Larga	Off of Ventura Ave, just south of the Cañada Larga Bridge
VRW005	Upper Cañada Larga	3.5 miles up Cañada Larga Road, at a small bridge over the creek
VRW006	Foster Park	Along the VR, just downstream from Foster Park at the Casitas Vista Drive Bridge
VRW007	San Antonio Creek	On Old Creek Rd, just off of Highway 33
VRW008	Lion Canyon	On Lion Canyon, just above the confluence with San Antonio Creek
VRW009	Stewart/Fox	Adjacent to site 10, where the Stewart and Fox drainages combine
VRW010	Thacher/San Antonio	Adjacent to site 9, where the upper San Antonio and Thacher drainages combines
VRW011	Santa Ana	VR at the Santa Ana Rd bridge
VRW012	Highway 150	VR at Highway 150 bridge
VRW013	Matilija	Approximately 1 km downstream of the Matilija Dam
VR014	North Fork Matilija	Along the North Fork Matilija
VR015	Upper Matilija	Approximately 1.5 miles above the Matilija Dam in Matilija Canyon

Source: Leydecker and Grabowsky 2006

Additionally, the City of Ventura collects water quality samples at 11 sites located throughout the watershed. Since 2002, the City has monitored water quality along the Ventura River and San Antonio Creek at these sites for *Cyptosporidium*, *Giardia*, bacteria, nutrients, bromide, total organic carbons, chloride, and conductivity.

The Ventura River and San Antonio Creek Watershed Sanitary Survey 20010 Update (Kennedy/Jenks 2011b) confirmed the previous sanitary survey findings that horse manure, sewer overflows, septic tanks near Casitas Springs, illegal dumping, oil wells, and tanks were the primary sources of surface water contaminants. The survey cited the 2009 Ventura County Storm Water Monitoring Mid-Year Sampling report, which indicated that sample events in November 2008 – February 2009 showed exceedances of bacteriological water quality objectives. These wintertime bacteriological increases are consistent with winter storms in surface waters. Giardia and Cryptosporidium were below detection limits in the City of Ventura's water sampling program during the 2005 to 2010 period. Monitoring of general mineral, general physical, radionuclide, and inorganic chemicals stayed within the historical range found in previous surveys (Kennedy/Jenks 2011b).

The Sanitary Survey Update also notes actions since 2000 that have reduced the risk of contamination including:

- New OVSD siphons that reduce the risk of spilling untreated wastewater.
- Horse manure public awareness program.
- Successful operation of the permanent Household Hazardous Waste Collection Facility.
- Improvements to the City's Avenue Water Treatment Plant.

Casitas also prepared a 2011 Watershed Sanitary Survey Update (Casitas 2011c), which concluded:

- The Lake Casitas water supply has not been adversely affected by activities or conditions in the watershed within the last 5 years.
- Casitas' water supply continues to meet the current state and federal Drinking Water Standards.
- The watershed receives many protections through Casitas' ordinances, as well as federal, state, and county policies, plans, and regulations.

2.7.1 Summary of Water Quality Conditions in the Subwatersheds

Above Foster Park, surface water quality in the Ventura River is controlled in large part by the tributary water quality. In the upper tributaries, boron is contributed by hot springs in the Santa Ynez Mountains. Boron can be as high as 6.5 ppm in Matilija Creek above the reservoir during low flow conditions. The high boron is diluted in the reservoir so that water downstream is of higher quality. Turbidity in the watershed can rise as high as 600 turbidity units following storms (Casitas and City of Ventura, 1984).

Uncontrolled stockpiling and storage of horse manure has been observed at some locations within the watershed which could lead to nutrient loading and coliform problems (URS 2002).

Organic chemical analysis of raw water by the City of Ventura in 1997 and 1999 did not find organic chemicals at detectable levels (URS 2002). The excessive growth of vascular plants, particularly the non-native water primrose, is prevalent in the lower Ventura River. Below the discharge point from the Ojai Valley Wastewater Treatment Plant, DO generally remains above 7.0 mg/l, but seasonally in the late summer and early fall DO levels fall. With the first major winter or spring storms and corresponding increased flows in the Ventura River, the DO levels tend to return to desirable levels. Actually, DO levels in the river have improved dramatically to about 11 mg/l. Nitrate levels continue to be considerable in San Antonio Creek, which drains much of the Ojai area. According to the Ventura Stream Team, slightly elevated levels of nitrate are also seen in the lower river.

2.7.2 Impaired Water Bodies in the Ventura River Watershed

The Clean Water Act requires each state to assess the status of water quality in the state (Section 305(b)) and provide a list of impaired water bodies (Section 303(d)) to the U.S. Environmental Protection Agency (USEPA) every 2 years. Impaired water bodies are those that have been determined to not achieve designated beneficial uses. A finding of impairment is made through use of decision rules specified in the State Board Listing Policy, which considers data on chemical-specific water quality standards; bacterial water quality standards; health advisories; bioaccumulation of chemicals in aquatic life tissues; nuisances such as trash, odor, and foam; nutrients; water and sediment toxicity; adverse biological response; and degradation of aquatic life populations and communities. For water quality limited segments included on the 303(d) list, the state is required to develop a Total Maximum Daily Load (TMDL) or take other action to address the impairment. The 2008 update to the Section 303(d) list (CRWQCB-LA 2009, Appendix F) identifies a number of waterbody segments in the Ventura River watershed as water quality limited and requiring a TMDL. These listings are shown in Table 2.7-2. A TMDL for trash has already been developed for the Ventura River Estuary (Tetra Tech 2009b).

Table 2.7-2 2010 Section 303(d) List of Water Quality Limited Sections in the Ventura River Watershed Requiring Development of a TMDL

Waterbody Name	CALWATER Watershed	Estimated Size Affected	Impairment
Cañada Larga (Ventura River watershed)	40210010	8.01 miles	Fecal coliform Low DO TDS
Casitas Lake	40220032	2,069 acres	Mercury
Matilija Creek, Reach 1 / Reach 2	40220010 / 40220012	15.6 miles (combined)	Fish passage
Matilija Reservoir	40220012	121 acres	Fish Passage
San Antonio Creek (tributary to Ventura River Reach 4)	40220023	9.79 miles	Indicator bacteria Nitrogen TDS
Ventura River Estuary	40210011	0.2 miles	Algae Eutrophic Total coliform
Ventura River Reach 1 and 2 (Estuary to Weldon Canyon)	40210011	4.49 miles	Algae
Ventura River Reach 3 (Weldon Canyon to	40210011	2.82 miles	Indicator bacteria

Table 2.7-2 2010 Section 303(d) List of Water Quality Limited Sections in the Ventura River Watershed Requiring Development of a TMDL

Waterbody Name	CALWATER Watershed	Estimated Size Affected	Impairment
Confl. w/ Coyote Cr.)			Pumping Water diversion
Ventura River Reach 4 (Coyote Cr. to Camino Cielo Rd.)	40220021	19.22 miles	Pumping Water diversion

Source: Tetra Tech 2009b and CRWQCB – LA 2011

2.8 Groundwater Quality

Historically, the Upper Ventura River and Lower Ventura River sub-basins both have had generally good water quality, with the exception of concentrations of TDS that are elevated above the USEPA's secondary maximum contaminant level (MCL) of 500 milligrams per liter (mg/L) and nitrate concentrations in excess of the state MCL of 45 mg/L (as nitrate). TDS concentrations within the Upper Sub-Basin are reported to range from 500 to 1,240 mg/L (California Department of Water Resources [DWR] 2004 and District 2009, as cited in DBS&A 2010b). For the Lower Sub-Basin, TDS concentrations are reported to typically range from 760 to 784 mg/L, but become elevated to as high as 3,000 mg/L during extended dry periods when there is less recharge of lower-TDS surface waters. Nitrate concentrations reach a maximum approaching 70 mg/L in the central portion of the Upper Sub-Basin. The Lower Sub-Basin also has exhibited elevated levels of hydrogen sulfide, hydrocarbons associated with oil seepage, sulfate, iron, and nitrate (DWR 2004 and District 2009, as cited in DBS&A 2010b). In sampling conducted by District in 2009, no samples from either of the sub-basins exhibited levels of metals (i.e., Title 22 metals) above the USEPA or state MCLs (District 2009, as cited in DBS&A 2010b).

The District has historically collected groundwater level and groundwater quality data within the Ojai Basin. Summaries of monitoring data collected by District, the Ojai Basin Groundwater Management Agency (OBGMA), and several state agencies, are found in various reports (e.g., DWR 1933, DWR 1953, Turner 1971, and SGD 1992, as cited in DBS&A 2010b). Annual reports prepared by the District also summarize groundwater quality data collected within the basin (e.g., District 2008, District 2009, as cited in DBS&A 2010b). Average TDS was 888 mg/L and ranged from 631 to 1,680 mg/L. Chloride has been a major anion of concern in the basin and has been observed to be significantly elevated in the deeper stratified aquifers of the Ojai Basin (Kear 2010, as cited in DBS&A 2010b). In production well blends, however, chloride concentrations exceeded the USEPA secondary MCL of 250 mg/L in one well (DBS&A 2010b).

2.9 Water Management

2.9.1 Debris and Detention Basins

The steep headwaters of the Ventura River watershed present a risk of flooding and debris flows. To address these risks, five debris basins have been constructed that collect sediment from drainages before they enter the mainstem Ventura River. Live Oak, McDonald, and Dent Canyon basins are on direct tributaries of the Ventura River. One is located in Stewart Canyon, a tributary to San Antonio Creek, and the other basin is on upper San Antonio Creek (Table 2.9-1 and Figure 2.9-1) (District 2011b).

Table 2.9-1 Debris Basins in the Ventura River Watershed

	Watershed Area Acres	Maximum Debris Storage Capacity (cy)	Annual Sediment Production (cy)	Expected Debris Production for 100-Year Storm (cy)
Dent Debris Basin	27	4,100	263	1,624
Live Oak Basin	794	28,700	NA	NA
McDonald Detention Basin	565	23,400	NA	NA
San Antonio Creek Debris Basin	6,280	30,000	4,586	455,700
Stewart Canyon Creek Debris Basin	1,266	328,300	2,781	209,000

Source: URS 2005

The San Antonio Debris Basin was constructed in 1986 as an emergency structure in response to the Wheeler Fire, which had burned the watershed the previous year. The basin was constructed entirely of earth and rock with a maximum capacity of 30,000 cubic yards and accumulated 26,600 cubic yards of debris the first year of operation. The basin was cleaned and subsequently refilled over the next few years and was cleaned out again in 1992 (Hawks & Associates 2005). The San Antonio Creek Spreading Grounds Rehabilitation Project would rebuild an abandoned diversion works, rehabilitate existing infiltration basins, and construct passive percolation recharge wells adjacent to San Antonio Creek. The proposed project received grant funding Proposition 50 Integrated Regional Water Management Grant, which was awarded to the Watersheds Coalition of Ventura County. The project will capture 25 cfs of surface flow (when available) from San Antonio Creek and enhance groundwater storage and recharge in the Ojai Valley Groundwater Basin (District 2011c).

In terms of the flow of water, the basins function as dry detention basins (Tetra Tech 2008a) (Figure 2.9-2). The major dams also function to intercept storm peak and debris flow, and some of the diversion structures are used for this purpose as well.

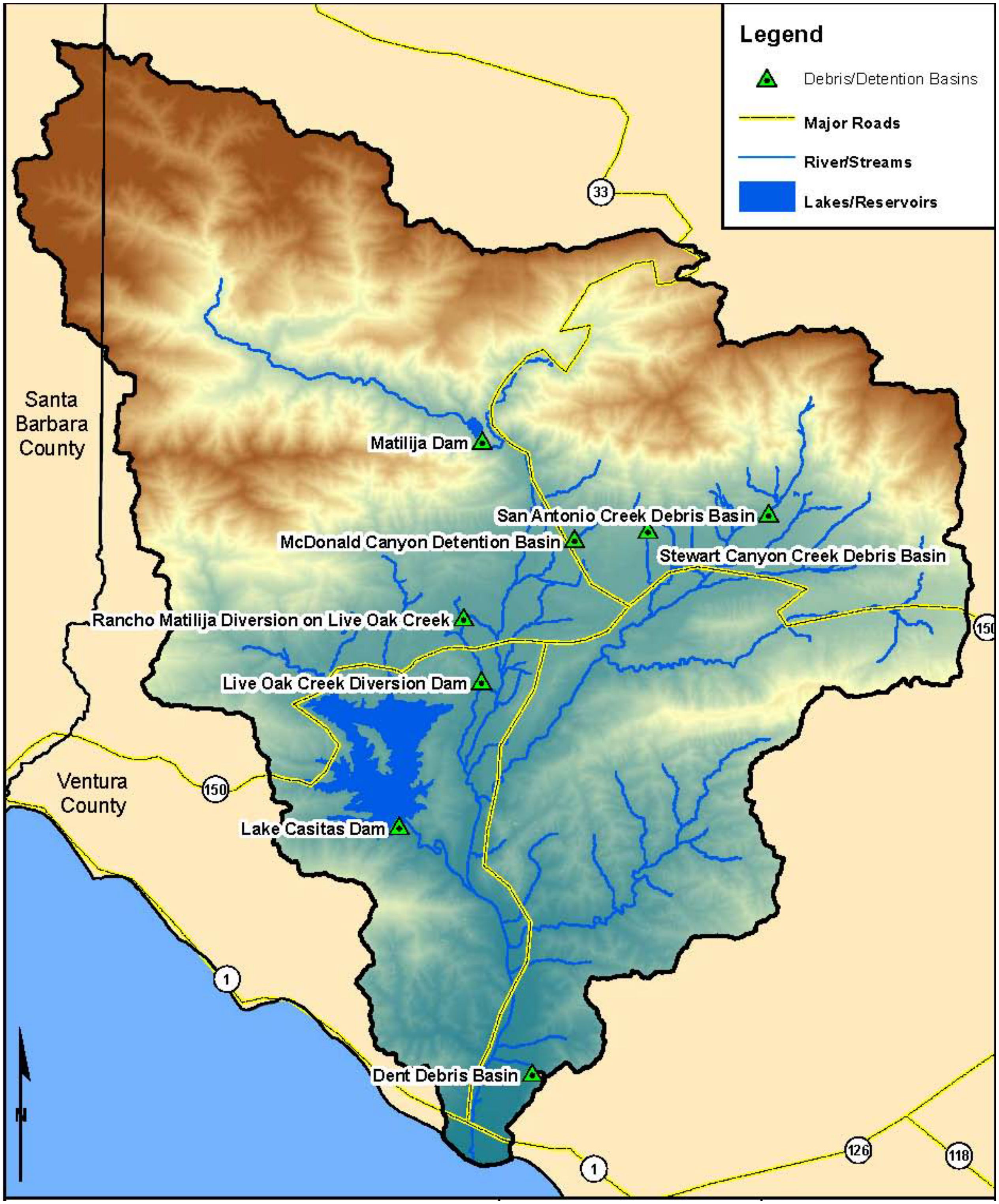


Figure 2.9-1 Dams and Debris and Detention Basins in the Ventura River Watershed

Source: Tetra Tech 2008a

Figure 2.9-2 Stormwater Detention Basin in the Ventura River Watershed

Source: Tetra Tech 2008a

2.9.2 Diversion Structures

Four major on-stream diversion structures and conveyances have been identified in the Ventura River watershed (Figure 2.9-3). Three canals are represented spatially in the GIS; the fourth (Foster Park) is shown only as a point. Water stored in Casitas Reservoir is in large part derived from the Ventura River via the Robles Diversion Dam and the Casitas-Robles Canal (Tetra Tech 2008a).

Surface water from the Ventura River is collected via surface diversion, subsurface collector, and shallow wells and delivered to the Avenue Treatment Plant through the City's Foster Park facilities. Currently, the surface intake structure at Foster Park is unused due to the natural channeling of the active river channel bypassing the structure. Each year the flows can change the position of the active river channel in relation to the intake structure. The Foster Park facilities produce groundwater throughout the year. However, due to storm flows, the wells are subject to inundation and erosion. The early 2005 winter storms destroyed or damaged, some of which were repaired between 2006 and 2009 (RBF 2011).

2.9.3 Flood Protection Levees

There are three major levees along the Ventura River. The most downstream levee, the Ventura Levee (District ID VR-1) is located along the east bank and protects the City of Ventura. The Casitas Springs Levee (VR-2) is located along the east bank and protects the town of Casitas Springs. The most upstream levee (VR-3) is near the Santa Ana Boulevard Bridge. It protects the Live Oak community along the west bank of the river (USACE 2004b).

The Ventura River (VR-1) Levee (VCWPD ID No: VR-1) is located in the city of San Buenaventura and extends from the Pacific Ocean inland to Canada de San Joaquin. The VR-1 levee system is located along the left side of the Ventura River. The levee system consists of embankment levees, side drainage penetrations, and a stop-log structure in the levee at a bike trail crossing. The length of the levee along the Ventura River is approximately 2.65 miles, with an embankment height up to 10 feet above natural ground on the landward side. The levee's earthen berm is protected by loose riprap and grouted riprap with an access road that runs along the top which is approximately 18 to 26 feet wide (Tetra Tech and AMEC 2009a).

The Casitas Springs (VR-2) was improved in 2007 to raise the existing levee by 4 to 6 feet to provide 100-year flood protection to the community of Casitas Springs (ENTRIX and Woodward Clyde 1997, Ventura County Star 2007).

The Live Oaks Levee and Floodwall (VR-3) is located in the community of Oak View, at Live Oaks along the right side of the Ventura River. The levee system consists of embankment levees, floodwalls, high ground and side drainage penetrations. The levee system begins at the Santa Ana Boulevard Bridge in Ventura County, continues upstream to the confluence with the Live Oaks Creek Diversion, and ends along the Live Oaks Creek Diversion at Burnham Road. The length of the levee is approximately 1.28 miles. The levee's earthen berm is protected throughout by riprap that is grouted along certain portions. An access road runs along the top which is approximately 10 feet wide (Tetra Tech and AMEC 2009b).

2.9.4 Water Supply and Use

Surface water and groundwater diversions have been developed for use along the Ventura River for over 200 years. As of 1981, approximately 45 known entities withdrew water from the Ventura River system (EDAW et al. 1981). These entities include irrigators, domestic users, industrial users, and water purveyors or suppliers.

2.9.4.1 Matilija Dam

Matilija Dam was constructed in 1946 to 1947 by the USACE –Los Angeles District to provide water storage for agricultural needs and for limited flood control. The structure is a concrete arch dam with an average height of 190 feet and a crest length of 616 feet, located approximately 0.6 miles upstream of the confluence of Matilija Creek and North Fork Matilija Creek. The original storage capacity of the dam and reservoir was 7,020 AF, but structural modifications to address concrete deterioration and siltation since 1947 have reduced the water storage capacity to less than 500 AF at present. Matilija's current operations are primarily for optimizing diversions at the Robles Diversion Dam, using a release valve with a maximum capacity of 250 cfs (Reclamation 2000).

In July 2004, the District and the USACE – Los Angeles District completed the public draft of The Matilija Dam Ecosystem Restoration Feasibility Study, a study of the feasibility of removing Matilija Dam and restoring the ecosystem above and below the dam location. The report presents the findings of the alternatives analysis and the selection of a recommended preferred alternative. The study focuses on ecosystem restoration in the Ventura River watershed to benefit native fish and wildlife (including the federally listed endangered southern steelhead trout) of the Ventura River and Matilija Creek in the vicinity of Matilija Dam, and improvement to the natural hydrologic and sediment transport regime to support coastal beach sand replenishment from the Ventura River. In September 2004, the Final Environmental Impact Report/Environmental Impact Statement for this project was completed (USACE 2004).

In 2005, the Project Management Plan was developed specifically for the Matilija Dam Ecosystem Restoration Project, Preconstruction Engineering and Design Phase for the purpose of setting forth the management strategy to be employed by both the USACE – Los Angeles District and the District (Sponsor/Partner/Non-Federal Interest). Currently, grant applications and congressional funding is being sought to fund project components outlined in the feasibility study.

2.9.4.2 Casitas Dam

Casitas Dam was constructed in 1959 and is located approximately 2.5 miles upstream of the Ventura River on Coyote and Santa Ana creeks (near RM 6.2). Lake Casitas has a maximum storage capacity of 254,000 AF and is supplied by inflow from the Robles Diversion via the Robles-Casitas canal in addition to watershed runoff from the Coyote and Santa Ana basins.

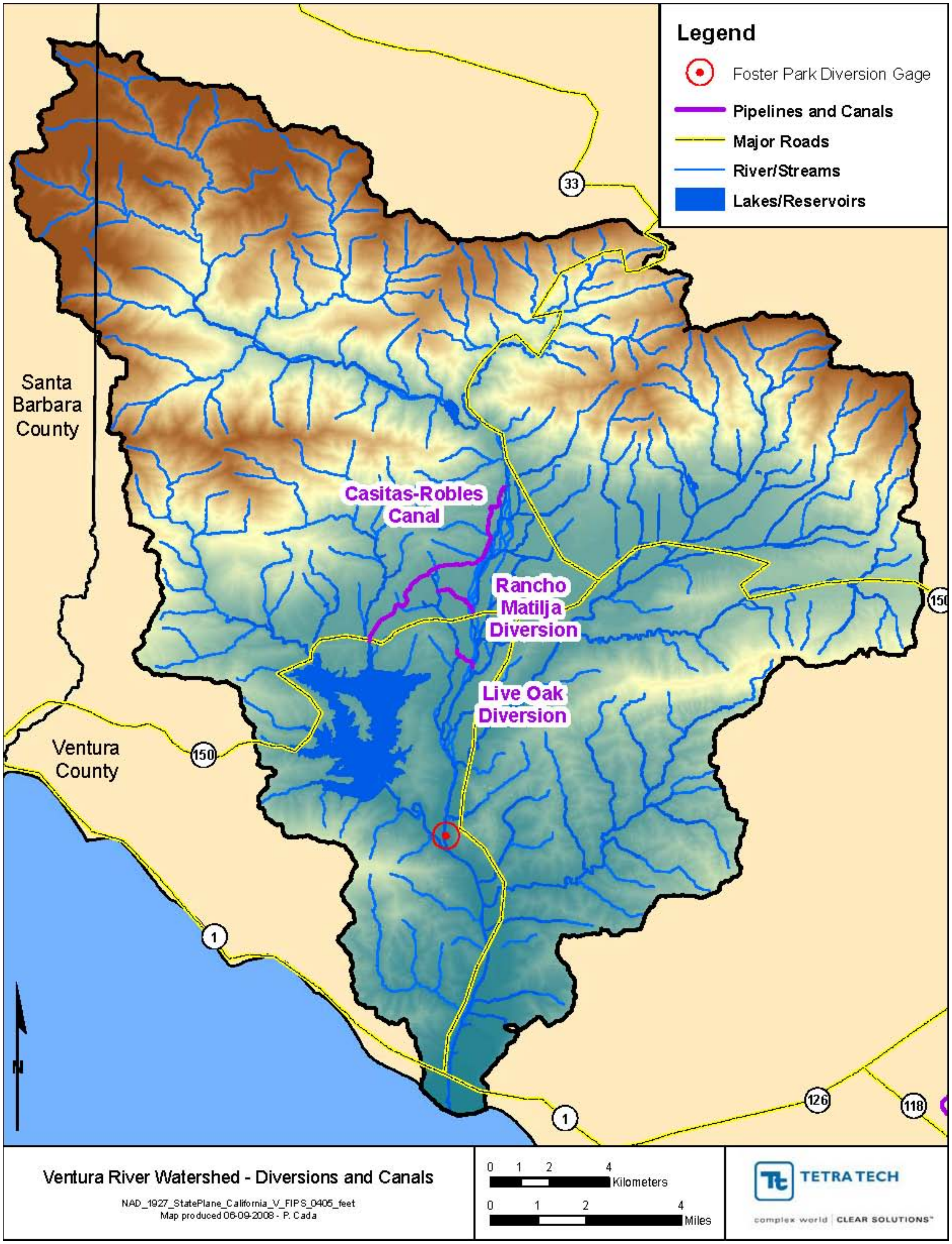


Figure 2.9-3 Diversions and Pipelines in the Ventura River Watershed

Source: Tetra Tech 2008a

2.9.4.3 Robles Fish Passage Facility

The Robles Diversion Dam was first built in 1958 and is located approximately 1.5 miles downstream of the confluence of Matilija Creek and North Fork Matilija Creek (RM 14). Since 1960, the diversion has been used to transfer water to Lake Casitas via a canal. The surface water diversions primarily occur in January, February, and March, and the mean monthly diversions during these months range from 2,183 to 3,489 AF (Reclamation 2003). The annual total diversion volume varies with available runoff and storage capacity remaining in Casitas Reservoir, averaging 13,095 acre-feet per year (AFY), with a median diversion volume of 6,335 AFY (Reclamation 2003). In dry years, there are often almost no diversions.

Since 2003, the Diversion Dam has been referred to as the Robles Fish Passage Facility due to the construction of a fish ladder at the facility. Prior to construction, The National Oceanic and Atmospheric Administration Marine Fisheries Service (NOAA Fisheries) issued a Biological Opinion on southern steelhead for the construction, operations and maintenance of the Robles facility (NOAA Fisheries 2003).

2.9.4.4 Foster Park Surface Diversion and Subsurface Dam

The City of Ventura's water supply facilities at Foster Park consist of a surface and subsurface water collection system. These facilities operate in conjunction with an underground dam (a weir that is 973 feet long and maximum of 65 feet deep and stops short by 300 feet from extending the full breadth of both streams) that was constructed between 1906 and 1908 at the confluence of Coyote Creek and the Ventura River. The underground dam and confining bedrock surfaces increase groundwater levels in the vicinity of Foster Park to produce enhanced surface flows. These flows are captured by a surface diversion (which is currently awaiting repair) and a subsurface collector system consisting of two perforated concrete pipes situated on the upstream side of the dam (Kennedy/Jenks 2006).

2.9.4.5 Groundwater Wells

Several public and private groundwater supply wells are located within the Upper Ventura River basin in the vicinity of the mainstem of the river. The largest groundwater extraction entities are Meiners Oaks County Water District (CWD), Casitas Springs Mutual Water Company, the Ventura River CWD, and the City of Ventura. Meiners Oaks CWD operates two wells located approximately 1 mile downstream of Matilija Dam and two wells in the vicinity of Meiners Oaks, one of which is adjacent to Rice Road. Meiners Oaks CWD produces approximately 1,150 AF of water per year from these wells. The Ventura River CWD operates three wells located between Meiners Oaks and the SR 150 crossing. The Ventura River CWD produces approximately 1,320 AF of water per year from these wells. Casitas Springs Mutual Water Company operates at least one water supply well north of the City's property at Foster Park. The location and annual production from that well is unknown (URS Corporation 2003). The City of Ventura operates four wells located in the Foster Park area. The City of Ventura produces approximately 4,000 AFY from these wells (ENTRIX and Woodward Clyde Consultants 1997; Ventura County Water Purveyors' database 2000; updated by City of Ventura 2006). Production from the City's Foster Park facilities varies greatly from year to year due to effects of weather, local hydrology, the storage capacity of the Ventura River alluvium, and upstream diversions (URS Corporation 2003). The City's wells and pipelines are subject to damage by erosion from heavy storm flows.

More than 300 wells have been installed along the Ventura River and its tributaries, extracting groundwater from the Ventura River Alluvial Basin, outside of the Ojai Basin. Records of groundwater wells were examined at the Ventura County Public Works Agency, Water and Environmental (W&E) Division. A summary of the wells recorded and mapped is provided in Table 2.9-2. Data are unavailable for most wells. However, based on the limited data, it appears that most of the wells are shallow (less than 200 feet), drilled for domestic use, and potentially intact. The available data do not indicate how many wells are still in operation. A large number of the wells appear to have been installed during the 1986 to 1991 drought period. Because the vast majority of the wells are private, there is no monitoring of extractions and, therefore, no estimate of annual private pumping from the alluvial basin.

Table 2.9-2 Summary of Wells Adjacent to the Ventura River Mainstem and Tributaries

	No. of Wells				Type of Well			
Area	Active	Inactive or Abandoned	Unknown	Total	Domestic or Municipal	Irrigation	Unknown	Total
A. Estuary area, including Seaside and Emma Wood Parks	?	?	7	7	?	?	7	7
B. Lower river, between Main Street bridge and Foster Park	2	1	7	10	5	?	5	10
C. Foster Park area	7?	1	22	23	3	?	20	23
D. Coyote Creek below the dam	?	?	6	6	1	?	5	6
E. Casitas Springs area	?	?	9	9	1	1	7	9
F. San Antonio Creek, below Soule Park	?	1	49	50	4	1	45	50
G. Santa Ana Creek watershed above Lake Casitas	?	?	18	18	10	?	8	18
H. Oak View, Live Oak Acres, and western Mira Monte	?	1	139	140	10	2	128	140
I. Mira Monte (western Ojai Valley)	?	?	25	25	4	2	19	25
J. Upper River, between Meiners Oaks and Matilija Ck.	?	?	24	24	4	2	18	24
K. N. F. Matilija Creek	?	?	12	12	10	?	2	12
L. Matilija Creek	?	?	1	1	1	0	0	1
Total				325				325

Source: Ventura County Public Works Agency, Water Resources Division and RBF 2011

? = Current Status Unknown.

The greatest concentration of wells is in the Oak View, Live Oak Acres, and western Mira Monte area where there is significant residential development. A high number of wells are also located along San Antonio Creek in the Ojai Basin. Golden State Water Company has five wells on San Antonio Creek in the City of Ojai. The OBGMA was formed in 1991 to manage the groundwater within the Ojai Basin for the protection and common benefit of agricultural, municipal and industrial water users within the Ojai Basin. Approximately 150 wells have been monitored by the OBGMA, but the agency recently adopted a requirement for metering of all wells in the Ojai Basin and reporting of extractions to the OBGMA.

2.9.5 Reservoir Management

Dams and reservoirs directly alter the natural flow of streams, allowing water to be stored rather than transferred downstream. Two significant on-stream reservoirs are in the Ventura River watershed: Casitas and Matilija (Figure 2.9-1) (Tetra Tech 2008a).

Casitas Reservoir, completed in 1959, is part of Reclamation's Ventura River Project and supplies the majority of water for human use in the watershed. Casitas Dam impounds Coyote Creek; however, the major source of water for the reservoir is a diversion from the Ventura River mainstem via the Robles Diversion. Lake Casitas has an active capacity of 251,000 AF and a storage capacity of 254,000 AF. Lake Casitas provides irrigation, municipal, and industrial water to urban and suburban areas with the Casitas Municipal Water District (Tetra Tech 2008a).

The outlet works of Lake Casitas have a maximum capacity of 570 cfs. There is an uncontrolled spillway with a 50-foot crest at elevation 567 feet. Six off-stream balancing reservoirs, Oak View, Villanova, Ojai East, Upper Ojai, Rincon Control, and Rincon Balancing, are filled from the Casitas main conduit during the off-peak hours and are used to help supply the full requirement of water during peak hours and as a carryover supply in case of an emergency.

The water balance in Lake Casitas is closely monitored, and record keeping of the water balance for Lake Casitas is available from the date of the first impoundment of water behind the dam in 1959.

Matilija Dam was constructed in 1947 by the USACE, Los Angeles District as both a flood control and water supply facility. The dam originally provided 7,018 AF of storage. The available storage volume was, however, rapidly depleted by sedimentation. The concrete in the dam also experienced corrosion, and the dam was lowered by cutting a notch in 1965, followed by another notch in 1977 (Tetra Tech 2008a).

Records for Matilija are more problematic than Casitas. Daily records of elevation and percent opening of the outlet works are available (but electronically only from 2001 on). A stage-storage curve was supplied for 1994, but this has likely changed over time due to sedimentation. A USGS gage has been operated below Matilija Dam at Hot Springs (11115500) with daily flows from 1927. It is likely that this record can be used to create an approximate discharge record and stage-discharge curve for Matilija Dam (Tetra Tech 2008a).

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Chapter 3

Summary of V-1 Projects

This chapter summarizes the studies funded by the Proposition 50 grant (V-1 projects), which are intended to help meet the objectives of the Ventura River Watershed Protection Project (i.e., to address water supply, water quality, and habitat issues in the Ventura River watershed).

3.1 Ventura River Watershed Hydrology Model

As part of the funded V-1 projects, the District guided the development of a watershed simulation model for the Ventura River. The simulation model provides a mathematical representation of the physical characteristics of the watershed, including the land area and characteristics (e.g., slope and vegetative cover), land management, the length and character of stream reaches, the location of reservoirs and detention basins, and water diversion structures. The simulation model uses precipitation and other weather inputs to generate predictions of streamflow and water quality throughout the watershed in 15-minute increments. This "continuous" model provides the ability to produce real-time estimates of flow during storm events and thereby identify locations that could be subject to flooding; evaluate the effects of development or changes in land use practices on water supply or runoff volumes; and evaluate the effects of BMPs on surface water quality in the watershed.

The Ventura River watershed model was developed using the Hydrological Simulation Program–FORTRAN (HSPF)—a comprehensive flow and water quality simulation model supported by the USEPA and the USGS. The model represents 228 square miles of land area and 94 individual stream reaches, covering the entire area of the Ventura River watershed. The model also represents various land uses within the watershed. The HSPF model incorporates both the effects of surface and groundwater; and, therefore, can be used to evaluate water supply reliability and basin yield in water supply studies. The HSPF model has been calibrated and validated for the Ventura River Basin.

The following sections describe the reports prepared to date that led to the development and testing of the hydrologic model.

3.1.1 Data Summary Report

The Data Summary Report (Tetra Tech 2008a), summarizes existing data and reports relevant to model development, providing an initial summary of background reports, spatial coverages, and data to support model development and calibration. In addition, data gaps and potential data quality issues were identified where appropriate. This data report summarizes the background information and data that were used to develop a Simulation Plan, which described the detailed approach for applying the HSPF model to the Ventura River watershed.

3.1.2 Simulation Plan

The Simulation Plan (Tetra Tech 2008b) served as the draft modeling Work Plan and Quality Assurance Project Plan (QAPP) for model calibration and validation and describes the proposed approach to applying the HSPF model to the Ventura River watershed. The major sections of the report discuss (1) meteorological representation, (2) hydrologic response representation, (3) hydraulic routing network development, and (4) a summary of special modeling considerations made in preparation for water quality modeling.

3.1.3 Calibration and Validation Baseline Report

The Calibration and Validation Baseline Report (Tetra Tech 2009a) is the third in the series and covers model calibration and validation. This report was designed as a standalone document that incorporates relevant material contained in the two earlier reports, with relevant changes as necessary. This report provided the following conclusions and recommendations.

The performance of a model is judged by a weight of evidence approach, recognizing that some discrepancies are likely to be unavoidable at specific locations and times. The Ventura River Watershed Model performs well across a variety of measures and is judged ready for use, despite certain caveats: During the calibration period, it was evident that there are problems with the flow gage records for Coyote Creek and Santa Ana Creek, neither of which appear to have been measured and calibrated during the last decade. Excluding these gages, 92 percent of the pre-specified performance criteria for the various components of the water balance are met. In addition, the coefficient of determination (R2) between observed and predicted daily flows are high, ranging from 86.4 to 93.5 percent.

Performance during the validation period is also good, although some degradation in fit is noted (and is expected due to less precise information on high-elevation precipitation, diversions, and withdrawals). On the other hand, discrepancies are not present relative to the Coyote and Santa Ana Creek gage records during most of this period when the gage rating tables originally developed by USGS were likely a closer representation of actual conditions. The R2 values between observed and predicted daily flows range from 84.4 to 91.4 percent during the validation period.

Model prediction of storm event peaks is also generally good. Some individual events are not well predicted, presumably because the available point rainfall measurements do not accurately reflect the total rainfall across the upstream watershed. Tetra Tech's conclusion is that the model is fully usable; however, it will be important to consider the range of uncertainty revealed in the model validation relative to specific uses of the model.

Areas where the model might be further improved are discussed in Chapter 6, Data Gaps.

3.1.4 Natural Conditions Report

The Natural Conditions Report (Tetra Tech 2009b) addresses the question of natural flows in the Ventura River system. Natural flows are those flows that would be present without human intervention. Both high and low flow regimes are of interest. To evaluate natural condition flows, the calibrated model is rerun with all developed land use converted to natural land use and all dams, diversions, irrigation, water withdrawals, and discharges removed. The natural condition scenario is run over the same meteorological input (October 1967 through September 2007) as was used for the calibrated existing conditions model, enabling a direct comparison of results.

Because much of the Ventura River watershed remains undeveloped, substituting natural land use has a relatively small effect on flows. On the other hand, the dams, diversions, and water withdrawals currently in place have a large effect, and tend to reduce flows under existing conditions. However, irrigation of agricultural land does serve to increase instream flows somewhat under dry conditions.

3.1.4.1 Water Balance Results

Detailed water balance summaries were constructed for WY 1997 through 2007 (the model calibration period). Inputs are predominantly precipitation, although some water is also added by irrigation under existing conditions, and by depletion of soil and shallow groundwater storage. Differences in the upland water balance between existing and natural conditions are small, but include the elimination of irrigation input (4 percent of the total) and changes in evapotranspiration and storage due to different land cover. Total precipitation to the uplands is a little higher under natural conditions because of the additional land area present due to the removal of Lake Casitas and Matilija Reservoir. Under both existing and natural conditions, about 60 percent of this input is returned to the atmosphere via evapotranspiration, and one-third becomes runoff, while the residual enters deep groundwater. This deep groundwater is a source of irrigation water and also interacts with the stream; however, a complete water balance of the groundwater component is not possible because a groundwater model has not been completed.

The waterbody balance has a number of inputs, beginning with runoff from the land surface, but also including upwelling groundwater, point sources, and direct precipitation (the tables show net precipitation, the difference between precipitation and evaporation, which is an input for some reaches and an output for others). Output from the stream reaches and reservoirs includes downstream flow, diversions for consumptive use from Lake Casitas (existing conditions only), evaporation, and losses to groundwater. Under existing conditions, downstream flow to the Pacific Ocean constitutes 69 percent of the water entering stream reaches or about 25 percent of precipitation on the watershed. About 16 percent of the surface water flow is diverted for consumption, while the remainder is lost to groundwater or evaporation. Under natural conditions, there are no diversions to consumptive use, nor are there reservoir evaporation losses. As a result, the outflow from the Ventura River to the Pacific Ocean increases from 933,677 to 1,199,780 AF over the simulation period, or about 33 percent of the precipitation that falls on the watershed.

3.1.4.2 Flow Duration-Frequency Analysis

The complete distribution of flows was analyzed for WY 1968 to 2007. As a first step, the average flows over the simulation period were compared for each of the gage locations, plus the mouth of the Ventura River. Little difference is estimated in results for those stations that gage predominantly undeveloped land (Matilija Creek, North Fork Matilija Creek, Coyote Creek, and Santa Ana Creek), although average flows under natural conditions are slightly higher. For San Antonio Creek, the average flow under natural conditions is slightly lower as this watershed contains significant amounts of irrigated lands. The most dramatic changes are seen in the Ventura River mainstem; average flows in the river near Meiners Oaks are almost 50 percent higher, due to removal of both Matilija Dam and the Robles Diversion to Casitas. They are also about 50 percent higher under natural conditions for Ventura River near Ventura, reflecting the influence of Casitas Dam. The difference is slightly smaller at the mouth of the Ventura River, as existing conditions add in the flow from the Ojai wastewater treatment plant (approximately 3 cfs).

For those watersheds that are predominantly undeveloped under existing conditions, the flow-duration curves for existing baseline and natural conditions are very similar. Low flows of a given frequency are slightly lower under natural conditions, reflecting the shift from forest to chaparral without fire suppression, as discussed above.

San Antonio Creek drains an area with substantial amounts of developed land and irrigated agriculture. Groundwater pumping, with associated losses from stream reaches, is removed under the natural conditions scenario; however, irrigation is also removed, resulting in a net reduction in low flow magnitude under natural conditions. Flows above the median value are also higher under existing baseline conditions because of the presence of impervious surfaces that promote runoff rather than infiltration.

The mainstem stations are strongly affected by the removal of dams and diversions. Below the site of Matilija Dam, median and lower frequency flows are higher under natural conditions due to the removal of storage and evaporation losses from the dam. Flows are dramatically different for Ventura River near Meiners Oaks because existing baseline conditions include both diversions to Casitas above this location and significant alluvial pumping that causes the channel to frequently go dry.

Natural condition flows are much higher at Ventura River near Ventura. This gage location is downstream of the confluence with Coyote Creek and Lake Casitas, so the absence of Casitas Dam under natural conditions is the major factor here. Finally, at the mouth of the Ventura River, natural condition flows are generally higher than under existing conditions, except at the lowest flows. Under existing conditions, low flows are maintained at a higher level by the Ojai wastewater treatment plant discharge.

3.1.4.3 Storm Event Peaks

Human influences impact peak runoff in the watershed in a number of ways. Impervious surfaces associated with development cause increased runoff, although the amount of impervious area in the watershed is relatively small. On the other hand, the storage capacity provided by Lake Casitas, Matilija Reservoir, and several smaller detention basins significantly reduces peak flows. A variety of other modifications to the natural drainage pattern have also been made.

The USGS PeakFQ program provides flood-frequency analyses according to Bulletin 17-B methodology (USGS 1982, as cited in Tetra Tech 2009b). This analysis was applied to both existing and natural condition simulated annual peak series for water years 1968 to 2007. For consistency with the model calibration report, the Bulletin 17-B procedure was applied to the complete annual peak series without any corrections for low outliers.

In general, the differences in estimated peaks between existing and natural conditions are small for watersheds without significant flow modification. Peaks under existing conditions are higher for Fox Canyon Drain and Happy Valley Drain as routing modifications have diverted additional area to these drains. On the other hand, peak flows are predicted to be much higher under natural conditions for the Ventura River mainstem, reflecting the removal of the Casitas and Matilija dams. In general, the presence or absence of reservoirs is the dominant factor differentiating between peak flow estimates for existing and natural conditions.

3.2 Surface Water Quality Monitoring Program

The Surface Water Quality Monitoring Program is designed to help fill gaps in the data required to achieve the water quality objective of the Ventura River Watershed Protection Project. The information collected will be used in watershed modeling efforts, to characterize pollutant loading, and to evaluate the effectiveness of projects implemented in the Ventura River watershed.

The collected data will be incorporated into a hydrologic and water quality model that can simulate historic conditions on a continuous basis. The continuous hydrologic model can then be used to evaluate the effects of land use in the watershed on runoff, as well as the effects of BMPs on improving water quality in the basin. HSPF will be the framework for the hydrologic model.

The V-1 Surface Water Quality Monitoring Program can be used to assess the water quality effects of projects implemented in the Ventura River watershed and will be coordinated with other monitoring efforts to create a more sophisticated and accurate picture of surface water quality throughout the watershed. Long-term goals include using the data resulting from this monitoring program to identify priority water quality issues and develop additional implementation projects to enhance and protect water quality within the watershed.

3.2.1 Water Quality Modeling Plan (Draft), Ventura River Watershed Model

This discussion is drawn from the Water Quality Modeling Plan (Draft), Ventura River Watershed Model, prepared by Tetra Tech (2009b).

The waterbody segments of the Ventura River that are listed as impaired, requiring the development of a TMDL, are discussed in Section 2.7.3 above. As discussed in Section 3.1, a simulation model of the Ventura River watershed (HSPF) has recently been completed, calibrated, and validated for hydrology (Tetra Tech 2009a). In addition to hydrology, HSPF can simulate a full suite of water quality responses, and is frequently used to develop TMDLs.

The Draft Water Quality Modeling Plan discusses options for water quality simulation to address impairments associated with nitrates and algae within the Ventura River (excluding the estuary). Specifically, it addresses the impairment of Ventura River Reaches 1 and 2 for algae and the impairment of San Antonio Creek for nitrogen.

3.2.1.1 Critical Conditions

Impairment due to algae in the Ventura River is associated with dense growths of attached algae (Figure 3.2-1). In addition to creating unsightly conditions and poor habitat, dense algal growths lead to large diurnal swings in stream pH and DO concentration (with supersaturation during daytime photosynthesis and depletion at night). Like other plants, algae require light, warm temperatures, and a supply of nutrients to maximize growth. Excess algal growth is a common problem in the warm, shallow, and relatively unshaded streams of coastal southern California. However, the problem is exacerbated by human activities that increase nutrient loads. Algae require both nitrogen and phosphorus for growth, and a shortage of either constituent can limit growth; however, nitrogen is often a key factor in determining density of attached algae in flowing streams in Southern California (Tetra Tech 2009b).

Figure 3.2-1 Algae in Ventura River at USGS Gage 11118500, April 29, 2008

Source: Tetra Tech 2009b

The 303(d) listings for algae in the Ventura River are based on older determinations for which detailed factsheets are not available. The Santa Barbara Channelkeeper (2007) provides additional information in their comment letter on 303(d) listings in the Ventura River:

> "Ventura River Reach 1: Historical photographic evidence submitted. 24 of 70 dissolved oxygen samples exceed 120% saturation. 19 of 52 observations indicate the presence of greater than 30% algae coverage. Ventura River Reach 1 has elevated levels of nitrate and phosphate." Ventura River Reach 2: "Historical photographic evidence submitted. 45 of 138 dissolved oxygen samples exceed 120% saturation. 36 of 103 observations indicate the presence of greater than 30% algae coverage. Ventura River Reach 2 has elevated levels of nitrate and phosphate."

Although the Regional Board has not yet done so, the Channelkeeper also suggested that Ventura River Reaches 3 and 4, San Antonio Creek, and Matilija Creek be listed as impaired for algae, based on visual observations showing 51, 43, 34, and 51 percent of observations, respectively, showing greater than 30 percent coverage of the bottom by algae.

While excess nitrogen may be a contributor to excess algal growth, the 303(d) listing for nitrogen in San Antonio Creek is based on comparison to a target of 5 mg/L nitrate in the CRWQCB-LA Basin Plan, which in turn is based on human health standards. Considerably lower concentrations of nitrogen (in the presence of adequate phosphorus) would likely be needed to control algal growth to acceptable levels. The Channelkeeper (2007) compared observed nitrate and phosphorus concentrations to target values of 1 mg/L and 0.01 mg/L established in the Malibu TMDL (CRWQCB-LA 2004, as cited in Tetra Tech 2009b), and recommended that Ventura River Reaches 1 to 3, Cañada Larga, and San Antonio Creek be listed for nitrate, and that Ventura River Reaches 1 to 4, Cañada Larga, San Antonio Creek, Matilija Creek, and North Fork Matilija Creek be listed for phosphate.

For similar studies in Southern California, nutrient and algae impacts and resulting water quality impairments are often assumed to be most critical during dry conditions when flows are reduced. These conditions lead to greater light availability and higher summer temperatures. Nitrogen availability also tends to be higher during dry conditions, when stream flow is dominated by groundwater discharges (as inorganic nitrogen is highly soluble and dominantly transported via groundwater) and dilution of point source loads is at a minimum. Wet weather flows are generally accompanied by lower light availability (due to turbidity in the water column) and can lead to scour and sloughing of attached algae.

A significant body of water quality data has been collected since 2000 by USGS, Ventura County, and the Ventura River Watershed Monitoring Program (Stream Team, a joint project of Santa Barbara Channelkeeper and Surfrider, Ventura Chapter). The counts for these data are summarized in Table 3.2-1, while the results of these efforts are available on the Stream Team's website (http://www.stream-team.org/venturaalgae.html). Data collection has focused primarily on nutrients, and should provide a good basis for calibrating a model of these components. Data on suspended solids are very limited, while quantitative results are not available for algal density.

Field data collected with the Stream Team sampling include DO and pH measurements. Sample locations are shown in Figure 3.2-2. Both DO and pH respond to algal density, but point-in-time grabs are difficult to interpret in that context. While no quantitative measures of algal density are available therein, these data do include visual estimates of percent algal cover.

The percent cover estimates are plotted against model simulated flow for stations in the lower Ventura (the impaired reaches) in Figure 3.2-3. There is not a strong relationship to flow, and indeed the percent cover tends to increase with increasing flow, regardless of whether samples are examined for one or multiple stations or for summer or whole-year conditions. However, samples are not reported for flows greater than 180 cfs, likely too low for scour. Within this small range, increasing flow may aid algal growth by providing greater mixing into the algal mats and preventing desiccation. In any case, it does not appear that lowest flow conditions clearly lead to greater algal growth. There is also no clear relationship to air temperature. Thus, use of a single critical condition may not be appropriate.

Table 3.2-1 County of Ventura River Laboratory Water Quality Samples (mg/L), 2000-2007

Sampling Location	Ammonia As N	Dissolved Organic N	Nitrate + Nitrite as N	Nitrate as N	Nitrite as N	Ortho-phosphate	Soluble Reactive P	Total Dissolved N	Total Dissolved P	Total Kjeldahl N	Total Dissolved Solids	Total Suspended Solids	Total P	Turbidity
Canada Larga @ Ventura Ave	38	33	38				38	34	34					
Lion Creek	65	61		65			65	62	62					
Lower Matilija Creek	8		8	8	8	8			7	8	7	8	8	
Matilija above dam	73	66		73			73	68	68					
Matilija Cr. below dam	74	67		74			74	69	69					
N. Fork Matilija @ gauge	77	65		77			77	72	72					
San Antonio @ Lion Creek	49	42		49			49	47	47					
San Antonio @ Old Creek Rd.	74	65		74			74	70	70					
Stewart/Fox	68	61		68			68	65	65					
Upper Canada Larga	24	22	24				24	22	22					
Upper Matilija Creek	8		8	8	8	8			7	8	7	8	8	
Upper San Antonio	75	56		75			75	71	71					
Ventura @ Foster Park	125	111	125				125	120	120					
Ventura River at Ojai Valley Sanitation	20			20	20				10	19	20	20	10	20

Source: Tetra Tech 2009b

Quantitative measures of benthic algal biomass (as chlorophyll a density) were collected in 2008 by researchers from the University of California, Santa Barbara (Klose et al., 2009, as cited in Tetra Tech 2009b).These data established a strong relationship between algal density and total N concentration. Unfortunately, the samples were collected after the end of the model simulation period (September 2007), so they were not used to calibrate the model.

The water quality impairments addressed in this study are overgrowth of algae (eutrophication) and elevated levels of nitrates, which contribute to excess algal growth. Completing a TMDL requires a linkage that connects sources of nutrient loading (land sources, atmospheric deposition, point sources) to instream concentrations of nutrients and thence to predictions of

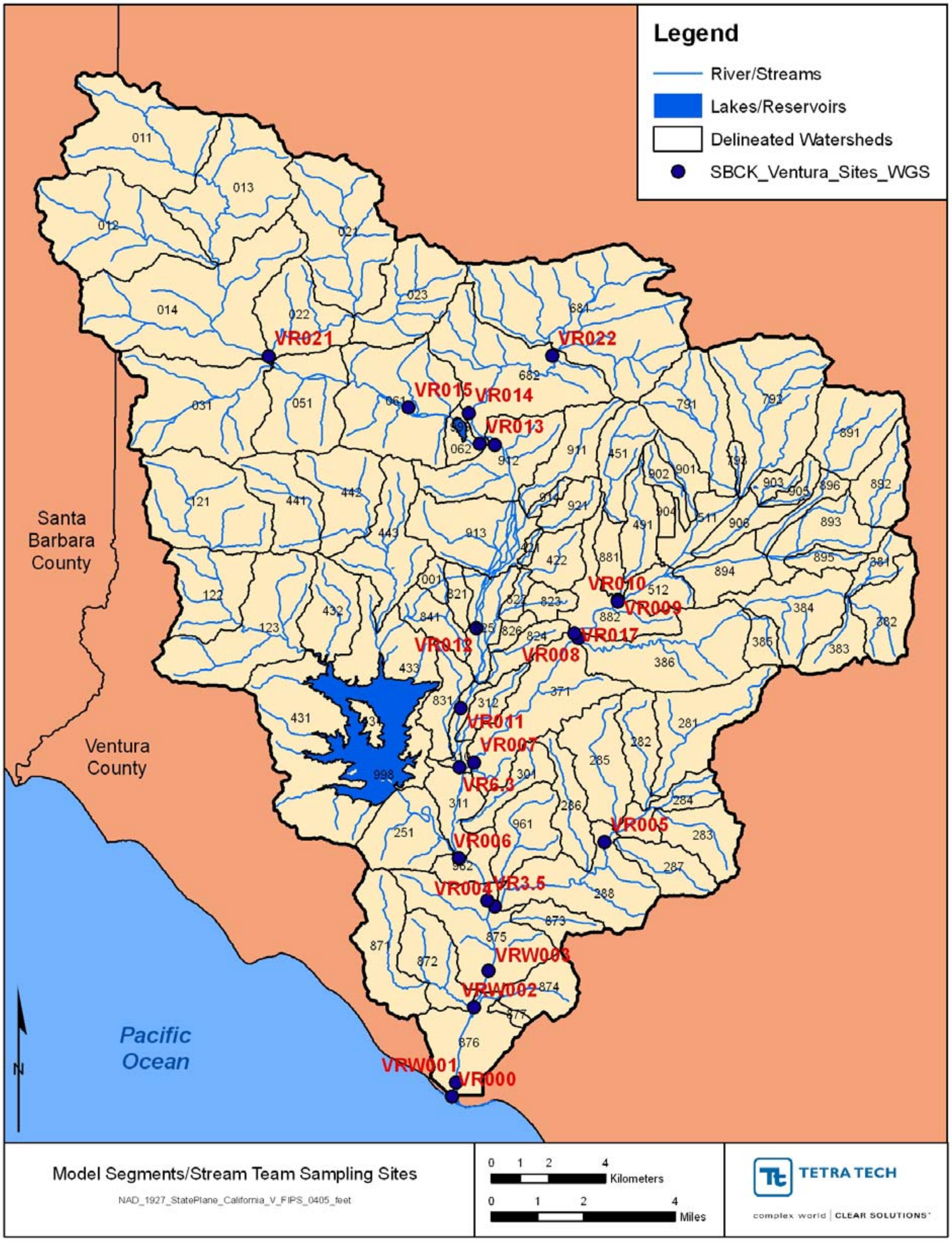
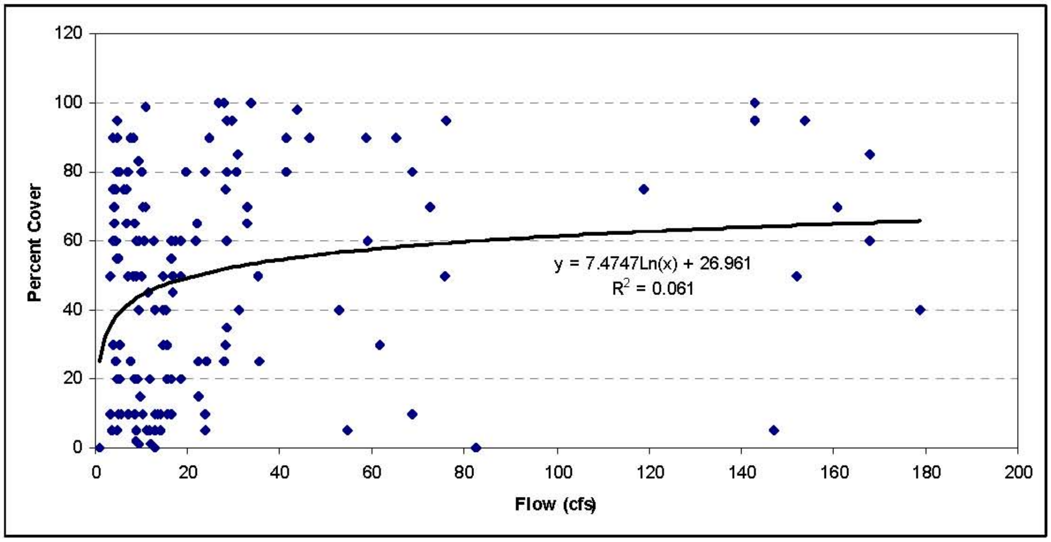
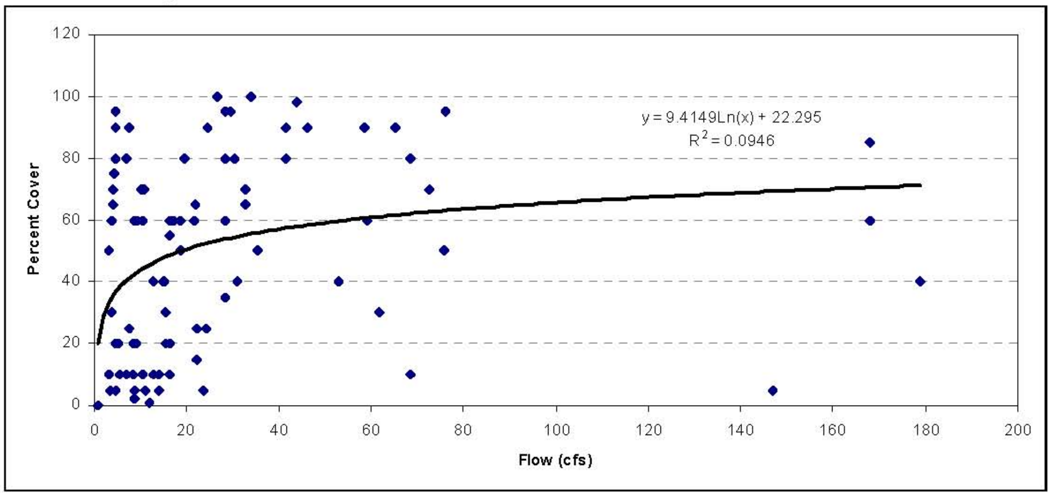


Figure 3.2-2 Location of Ventura Stream Team Sampling Sites

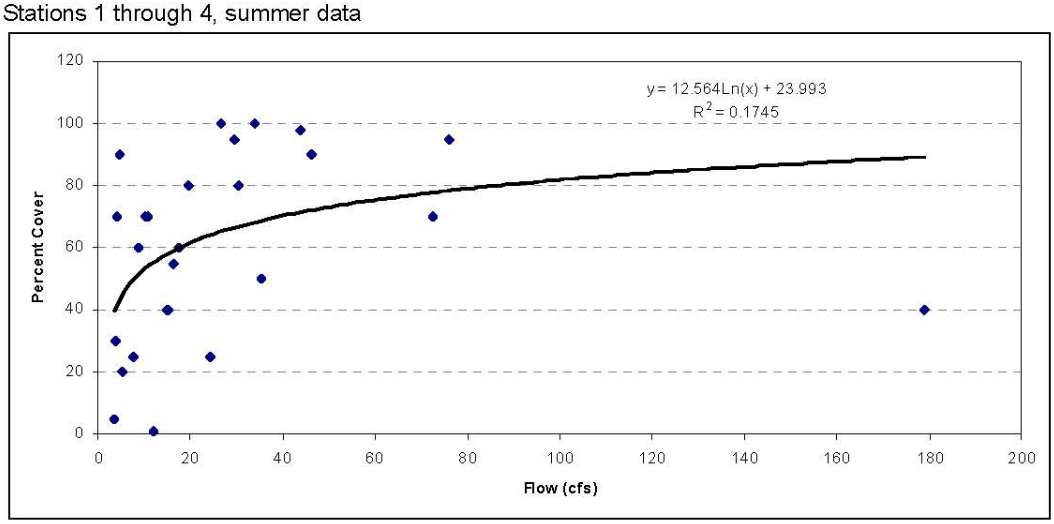
Source: Tetra Tech 2009b



Stations 1 through 4, all data



Stations 1 through 4, summer data



Station 1, summer data

Figure 3.2-3 Algal Percent Cover versus Flow, Stream Team Data 2001-2007

Source: Tetra Tech 2009b

algal biomass. This is often accomplished entirely through simulation models, implemented in either a dynamic (time-varying) or steady-state mode. Dynamic models simulate the time series of responses, while steady-state models would be implemented to address critical conditions.

The HSPF model itself is capable of addressing all necessary aspects of the simulation, from nutrient load generation to algal response. A primary limitation is that it treats stream reaches in one-dimensional, linear form, and is not applicable to situations in which flows reverse or in which the lateral and vertical distribution of algae need to be addressed. For multi-dimensional situations, dynamic models like the Environmental Fluid Dynamics Code hydrodynamic model or the Water Quality Analysis Simulation Program can be employed. These types of models simulation waterbody response only, and would thus need to be linked to a watershed loading model (e.g., HSPF). Steady-state response models are also often employed to address responses under critical conditions of dry-weather flows and nutrient loads.

Regardless of the model that may be chosen, accurate prediction of benthic algal biomass will be difficult because it depends on a large number of factors, including some, such as grazing and sloughing, which are not well represented in any of the available models. Further, such models typically require intensive site-specific calibration – but quantitative data on algal densities in the Ventura River are largely lacking.

For practical implementation, the following approach can be used:

- Modify the upland hydrologic response unit (HRU) models to provide additional time series of generic pollutant surface and subsurface loads.
- Separate the process of "integrating" the unit flows for input to the reaches into a new, intermediate integrator model. This would take the HRU output and rewrite it as a function of the current land use table. The same process can be used for the pollutant loads, with conversion from generic to specific form (i.e., by multiplying times the appropriate buildup rates and subsurface concentrations). Load reduction factors applicable to individual land uses can also be inserted at this point to represent management scenarios. Several sequential runs can be used to account for land use changes over time, as is done in the current reach model.
- Run the reach model using input from the integrator model. As the land use change function has been segregated to the integrator model, the reach model can now be run as a single, continuous simulation. The reach model would also add time series of point source loads and atmospheric deposition.

Within the reach model Tetra Tech recommends that nitrogen and phosphorus be simulated as general quality constituents subject to first-order decay, rather than undertaking a detailed representation of uptake, transformation, and sediment sorption. This is recommended because sufficient data are not available to calibrate the reach model for sediment or algae at this time.

While these modifications involve some complexities, they can be accomplished in an efficient manner using the existing model user input code, which sets up the transfer for flows. Once set up, model calibration for nutrients would proceed in two areas: (1) pollutant-specific accumulation rates on the land surface and associated groundwater concentrations (at the integrator model step), and (2) first-order decay rates in the reach model.

This calibration approach is well suited to the available data, which is strong on nutrients. The resulting framework is sensitive to land use, land management (which can be assumed to alter either buildup rates or pollutant delivery at the integrator level), and changes in flow, and can thus be used to investigate the sensitivity of nutrient concentrations in the river to a variety of scenarios.

3.2.2 Surface Water Quality Monitoring Plan 2010 and Quality Assurance Project Plan

3.2.2.1 Overview

As part of the V-1 grant-funded project, water quality and quantity data were collected from two surface water monitoring stations, laboratory analyses of the field measurements, and automated measurements. Collected data were assembled in a database and then evaluated using the water quality standards established in the California Toxics Rule and Los Angeles Water Quality Control Plan (or Basin Plan); they were then summarized in report that gives an overall view of the surface water quality in the Ventura River watershed.

The data collected from this effort can be integrated with data from a previously established monitoring station on the Ventura River and incorporated into the hydrologic simulation model developed for the Ventura River watershed (discussed above).

Water quality sampling included coordinating monitoring events to take place during various weather conditions; documenting all aspects of the water quality monitoring events including calibration of monitoring equipment; assembling hydrologic information including rainfall and flow; taking field measurements for DO, conductivity, specific conductance, salinity, temperature, and pH; and collecting grab and composite water quality samples during monitoring events and submitting them to the appropriate certified laboratory to be analyzed for the requested parameters. Monitoring events occurred four times per year − three times during wet weather and once during dry weather − to provide water quality information during various weather conditions. Laboratory analyses were conducted using approved EPA or Standard Methods and tests were conducted at California and/or National Environmental Laboratory Accreditation Program certified laboratories.

DO, conductivity, specific conductance, salinity, temperature, and pH were measured in the field using calibrated measuring equipment. Stream flow was measured using Bubbler Flow Meters programmed with appropriate rating tables. Grab samples were collected for total coliform, fecal coliform, E. coli, oil and grease, total petroleum hydrocarbons, cyanide, volatiles, and mercury (for one year). Composite samples were collected using automated samplers. All constituents are important to the project with a particular emphasis on nutrients and metals.

The project schedule and deliverables are shown in Table 3.2-2.

Table 3.2-2 Project Schedule and Deliverables

Activity	Anticipated Date of Initiation	Anticipated Date of Completion	Deliverable	Due Date
Determine monitoring locations	December 2005	January 2009	None	N/A
Design monitoring stations	December 2008	August 2009	None	N/A
Order and install equipment	June 2009	October 2009	None	N/A
Start sample collection	October 2009	August 2011	None	N/A
Enter data into database	November 2009	November 2011	None	N/A
Produce annual water quality report	November 2010	January 2011	Annual Report	N/A
Produce annual water quality report	November 2011	January 2012	Annual Report	N/A
Produce final water quality report	January 2012	March 2012	Final Report	N/A

Source: District 2010d

3.2.2.2 Monitoring Sites

The monitoring sites were selected to be representative of urban runoff in the Ojai Valley. Urban runoff rates are unpredictable during dry weather because they are dependent on usage upstream. Minimal amounts of urban runoff are desirable for the objective of pollution reduction. Public Outreach has been conducted in the Ojai Valley to encourage residents and business operators to reduce their contributions to urban runoff. These factors all contribute to the difficulties in sampling storm drains during the dry season. The Project has opted to overcome this obstacle by predominantly monitoring during rain events, which are more representative of the overall contributions of urban runoff to the watershed because accumulated material is washed into the storm drain system where it can be sampled and quantified. The locations of the monitoring sites are shown in Figure 3.2-4.

Meiners Oaks – Happy Valley Drain

The Meiners Oaks monitoring site (MO-MEI) is located on the southeast side of Rice Road, southwest of the intersection of Rice Road and W. Lomita Avenue, on the Happy Valley Drain. The Meiners Oaks monitoring site is positioned low in the watershed and receives runoff from an estimated 1.6 square mile drainage area of mixed land use (open space, residential, and agricultural).

Ojai – Fox Canyon Barranca

The Ojai monitoring site (MO-OJA) is located on the Fox Canyon Barranca, east of Fox Street, south of Highway 150 (E. Ojai Avenue), near the Ojai Valley Athletic Club. The Ojai monitoring site is positioned low in the watershed and receives runoff from an estimated 1.2 square mile drainage area of mixed land use (open space, residential, and agricultural).

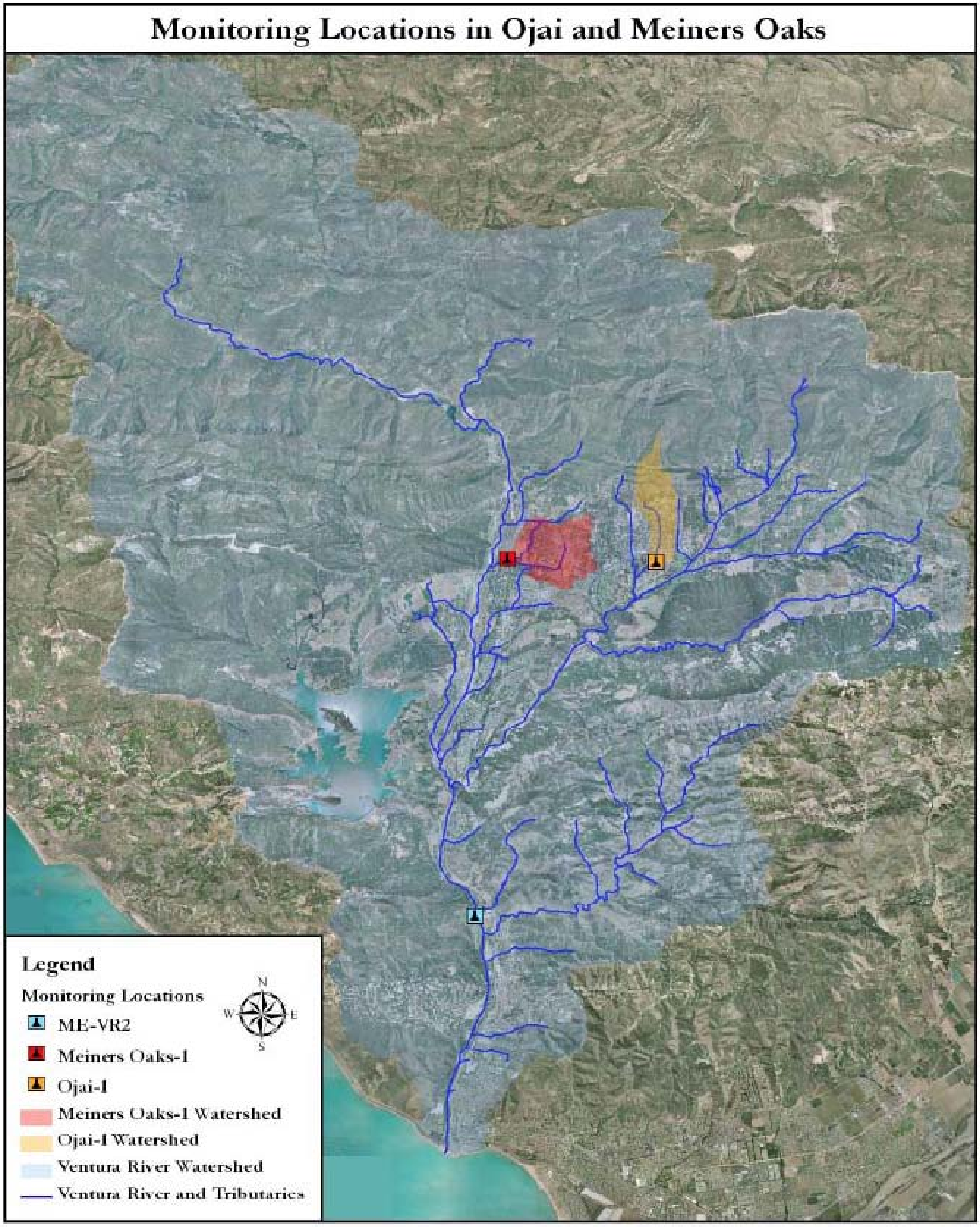


Figure 3.2-4 Monitoring Site Locations

Source: District 2010b

3.2.3 Ventura River Watershed Model – Aluminum

To demonstrate the viability of the hydrologic model (described above) to simulate water quality conditions, the District requested a pilot demonstration for the presence of aluminum in surface water. This effort included the identification of sources of aluminum (which are primarily natural), estimation of the contribution (or loading) of aluminum from those sources and the use of the model to estimate the resulting concentrations in surface waters. In addition, water quality sampling and analysis was conducted to allow a comparison of model predictions to observed concentrations in the water quality samples. A technical memorandum was prepared to describe the setup, calibration, and results of the water quality modeling for aluminum (Tetra Tech 2011).

3.2.3.1 Aluminum

Sources of Aluminum

Aluminum (Al) is ubiquitous in the environment and is the most abundant metal in the earth's crust. The primary source of aluminum in the Ventura River watershed is from natural geology and soils. Many clay minerals (kaolinite, montmorillonite, illite, and chlorite) contain a certain percentage of aluminum silicate (Al2SiO5) as a natural component of the chemical matrix (~ 5 to 15 percent). Other potential sources of elevated aluminum load include mining, accidental discharge from oil and gas exploration, certain agricultural chemicals, and point source discharge.

Mine drainage is a possible source of aluminum load, particularly acid mine drainage. There has been historic gold mining in Ventura County, but little documented activity within the Ventura River watershed. There are only two known mining operations in the Ventura River watershed. One is an inactive sand and gravel operation a few hundred yards north of Hwy 101 above the estuary, and the other is an active rip-rap operation near the confluence of Matilija Creek. Neither of these sites is known to have had any aluminum discharges or runoff.

The watershed does include an area of oil and gas exploration. The wells themselves are not expected to be sources of aluminum, but drilling muds can be a source. Drilling mud/additive manufacturers use a typical Bentonite clay for well drilling (for both oil and water wells) that contains a relatively consistent 18 percent Al2SiO2. Significant amounts of drilling muds would have to be spilled or leached and reach surface water to be a significant source of aluminum within the Ventura River. It is believed that such spills have occurred very infrequently.

Agricultural uses of aluminum sulfate can be another potential source of aluminum (e.g., used for crops that require a low pH like blueberries). However, excess soil aluminum is deleterious to many crops and this is not a typical amendment in the Ventura River watershed.

The Ojai Valley Sanitary District discharges treated wastewater to the Ventura River. This point source discharge is considered a minor source of aluminum load. The facility monitors aluminum infrequently.

In sum, anthropogenic sources of aluminum load appear to be of limited importance. The most widespread and likely source for aluminum is the natural soil and parent geology, especially the Eocene-age rock types in the upper portion of the Ventura River watershed. The Cozy Dell Shale formation exists in an east-west band that crosses the upper watershed. Rock types here are classified as argillaceous and contain aluminosilicates as a major chemical component along with a host of possible clay minerals. The adjacent Coldwater Sandstones and Matilija Sandstones also contain such clay minerals.

Monitoring Data

Only limited amounts of ambient monitoring data for aluminum are available from the Ventura River watershed. Ventura County has collected aluminum data at four sites within the Ventura River watershed (Figure 3.2-5). Data are available from two sites – Ventura River at Foster Park and Ventura River at Ojai Valley Sanitation – since 2004 to 2005 (Table 3.2-3). Monitoring occurred at two additional sites – Fox Canyon Drain and Happy Valley Drain more recently.

Table 3.2-3 Ventura River Watershed Sites with Aluminum Data

Site	Site ID	Samples	Sample Dates
Fox Canyon Drain	MO-OJA	6	10/14/09 -11/21/10
Happy Valley Drain	MO-MEI	6	10/14/09 -11/21/10
Ventura River at Foster Park	ME-VR	10	2/3/04 -1/11/05
Ventura River at Ojai Valley Sanitation	ME-VR2	32	5/4/05 -10/30/10

Source: Tetra Tech 2011

Concentrations are elevated during wet periods dominated by stormwater runoff relative to dry, baseflow conditions (Table 3.2-4). The overall average of all the wet condition data was 3012 µg/L (median equal to 878 µg/L). During dry conditions the average was 103 µg/L (median of 11 µg/L).

Table 3.2-4 Summary of Total Aluminum Data (Storm and Non-Storm)

	Dry (Non-Storm)		Wet (Storm)	
Site	Average (µg/L)	Samples	Average (µg/L)	Samples
Fox Canyon Drain	3.2	1	3,060	5
Happy Valley Drain	22.0	1	3,120	5
Ventura River at Foster Park	7.6	3	5,560	7
Ventura River at Ojai Valley Sanitation	141.5	12	2,081	20

Source: Tetra Tech 2011

Based on data gaps identified in an earlier report, a water-quality monitoring plan was developed. Water quality parameters identified for further monitoring includes nutrients, bacteria, metals, organics, pesticides, temperature, pH, total suspended solids, DO, and conductivity. A water quality monitoring plan will provide data for watershed modeling efforts, characterize pollutant loading, and evaluate effectiveness of projects implemented in the watershed.

Figure 3.2-5 Ventura River Monitoring Stations

Source: Tetra Tech 2011

The scope of the project included the planning, and construction of two water quality monitoring stations, water quality sampling and analysis, and data management and analysis. The first phase of implementing the water quality monitoring plan consisted of determining the appropriate locations for the monitoring stations, and selecting the suitable equipment for the automated collection of composite water quality samples. Tasks for the second phase included purchase of monitoring equipment, the installation of station enclosures and equipment, and calibration of monitoring equipment. Tasks for the third phase included coordination of monitoring events that took place during various weather conditions, collecting composite water quality samples during monitoring events and analyses of appropriate parameters, assembling hydrologic information associated with each monitoring event, documenting all aspects of the water quality monitoring events (including interrogation of monitoring equipment and submitting water samples to an appropriate state-approved laboratory for chemical analysis).

Additional tasks in this effort included assembling the data in an database, reviewing the data for QA/QC, evaluating data using water quality standards established in the California Toxics Rule, L.A. Basin Plan, the Ocean Plan, and producing a final water quality report based on the data summarizing water quality conditions within the Ventura River watershed.

3.2.3.2 Point Source Representation

One point source was simulated in the model: the OVSD wastewater treatment plant (CA0053961). Available discharge monitoring data for aluminum consisted of nine samples collected from 2006 to 2010. The range in aluminum concentration was 130 to 360 µg/L, with an average concentration of 225.7 µg/L. The loading series was created using the flow time series developed during the hydrology calibration with a constant concentration applied equal to the average concentration of the observed discharge data.

3.2.3.3 Calibration Results

Calibration focused on the two stations where observed data coincided with the model simulation period of 1996 to 2007: Ventura River at Foster Park and Ventura River at Ojai Valley Sanitation. The Ojai Valley station had 50 percent more observed data to compare to so it received greater focus. Adjustments were made to accumulation load by land use category and subsurface (interflow and groundwater) concentrations during calibration to obtain a fit to observed, instream data. A series of diagnostic graphs and statistics were prepared for both load and concentration to facilitate the process. Select graphs and statistics are shown below and demonstrate a reasonable fit to monitored aluminum in the Ventura River watershed.

The calibration largely relies on comparisons of continuous model output to point-in-time and point-in-space observations. Time series of observed and simulated aluminum concentration show that the trends in observed values are tracked reasonably well, particularly given limits on the amount of data available for comparison (i.e., 10 to 15 paired data points).

The deviations do not appear to have a strong bias of under-or over-prediction. The average concentration is underpredicted slightly at both stations with average errors of -15.32 percent and -3.68 percent. At both stations, this statistic is strongly influenced by one high, observed concentration that was underpredicted: in March 2006 at Ojai Valley and in January 2005 at Foster Park. Accordingly, median errors, which are not as heavily influenced by just a few large deviations, are positive. And at Ojai Valley, median error is less than 1 percent.

A comparison of model predictions of load to observed load plotted against flow also shows a reasonable agreement. Regression lines developed for both sets of data nearly coincide. While additional data for calibration would likely strengthen this relationship, the agreement provides evidence that trends in, and distribution of, load at these two sites are similar over the range of flows.

Total aluminum load at the outlet of the watershed over the full simulation period (10/1/1996-9/30/2007) was 624.15 tons/year (Table 5). The OVSD wastewater treatment plant represented a very small fraction of this load: 0.76 tons/year.

3.3 Ojai Basin Groundwater Monitoring Plan

The District plans to conduct routine monitoring of groundwater levels and groundwater quality from select wells within the Ojai Basin. To clarify the effort required for this process, a groundwater monitoring plan was developed to describe the collection of data on groundwater levels and quality, estimate the budget for sampling events, and propose a reporting format for the collected information. The information developed from this monitoring plan can be used to gauge the effectiveness of the Ojai Basin Groundwater Model, developed by OBGMA, and recharge projects such as the San Antonio Creek Spreading Grounds Rehabilitation Project (described above in Section 2.6).

The following information is excerpted from the report entitled Ojai Basin Groundwater Monitoring Plan by DBS&A (2010b). The objective of the monitoring program is to assess groundwater levels and groundwater quality on a semi-annual basis in the various stratified aquifers of the Ojai Basin. As documented below, several wells have been identified to meet this objective without the need for drilling or converting a significant number of production wells to depth discrete monitoring wells. The acquired data will be combined with existing well data and surface stream gauging stations throughout the larger area. The results of groundwater quality/level monitoring will be documented in semi-annual reports.

3.3.1 Monitoring Wells

Of the dozen stratified aquifers in the Ojai Basin that can be correlated, most wells have been drilled and perforated through multiple zones. The following wells, however, are perforated through only a few of the zones and can be used to focus on the conditions of individual aquifers; locations of these wells are shown on Figure 3.3-6:

- 2010 San Antonio Creek Spreading Grounds Rehabilitation Project Depth Discrete Monitoring Well: This is a County-owned monitoring well that has five perforated casings intervals ranging in depth from 95 to 295 feet. The deepest of these is perforated in the Sespe formation, while the four shallower zones are perforated in zones that comprise the more permeable strata of Ojai Valley alluvium. Not all zones are perennially saturated. Designed as part of the San Antonio Spreading Grounds Rehabilitation Project, this well will be monitored under the basin-wide monitoring program as well.
- Rusin East Well: This privately-owned well was designed and constructed in 2008 to extract groundwater only from an intermediate series of aquifers. Importantly, the two sets of perforations in the well extend only from 320 to 440 and the upper aquifers are sealed off via a cement annular seal that extends to 130 feet below ground surface. Water levels in this well

are typically higher than other nearby wells due to the confined pressure of the intermediate aquifer system.

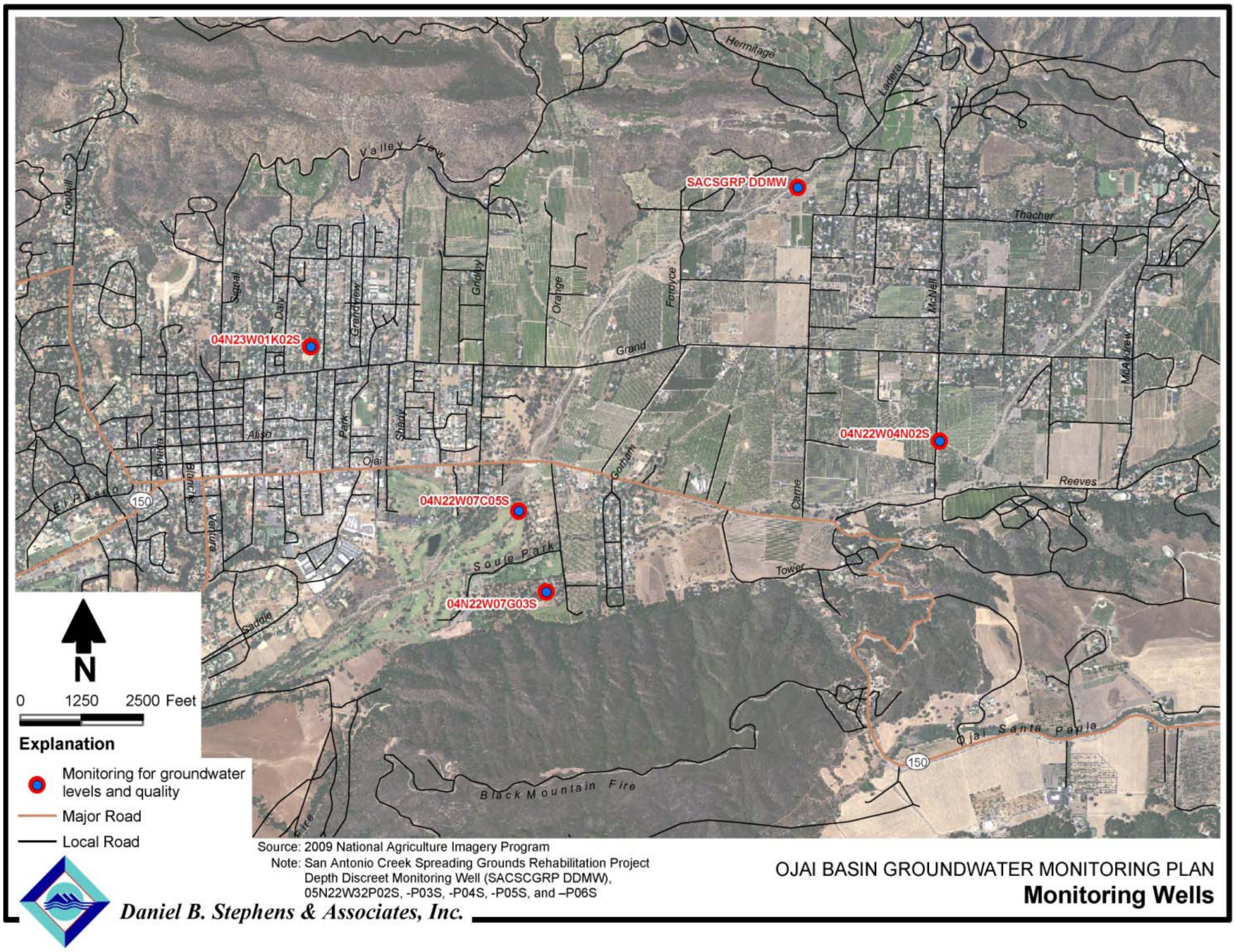


Figure 3.3-1 Monitoring Wells

Source: DBS&A 2010b

- Soule Park older well: This 14-inch-diameter steel cased well, owned by the County-affiliated Soule Park Golf Course, has been recently replaced by a well drilled a few hundred feet to the north. Similar perforation intervals exist in this older well compared to the new well, and this well may be used for monitoring during pumping of the new well to understand aquifer parameters. This well may also be a candidate for modification due to the presence of well defined aquitards in this portion of the basin.
- Mollan Well: This privately owned well is currently monitored for water levels by the District, but due to its limited and shallow perforations (90 to 130 ft), the well will be included in the monitoring program.

- Ruch Well: This privately owned well is perforated only in the upper zones of the Basin, from approximately 70 to 140 feet below ground surface. This well has been documented to be one of the first in the basin to flow artesian in any given year.

3.3.2 Water Level Measurements

Water level measurements provide a measure of water potential (hydraulic head) at specific geographic locations and depths. The primary purpose for measuring water levels in monitoring wells is to determine depth-to-water, horizontal and vertical groundwater flow directions, and gradients. These measurements, when converted to elevation relative to a standard datum (such as mean sea level or the North American Vertical Datum) and posted on a map, can be contoured to prepare potentiometric surface maps, and used to evaluate where and at what rate groundwater is moving in specific aquifers in the Basin.

Water levels were measured on a semi-annual basis in the above wells to provide water level data to evaluate groundwater gradients and flow directions. March and September were targeted as the months in which monitoring events will occur to coincide with the historic highs and lows of groundwater levels, based on most available data in the Basin. The water level measurements were conducted over a one to two day period to represent static conditions as amenable to well owners pumping and irrigation schedules. Well owners were asked to deactivate or idle well pumps for a period of 24 hours, if possible, before water level measurements commence to allow for pre-measurement water level recovery and stabilization.

Measurements within geographic areas were collected in the shortest possible time so that the data can be assumed to have been collected under comparable conditions. Water level measurements were made using an electric sounder, and performed in accordance with procedures described in the DBS&A standard operating procedures (DBS&A 2010b, Appendix A). Where wells are equipped with an airline or pressure transducer, and obtaining static water levels with an electric sounder is not feasible, the existing infrastructure was used for obtaining depth to water measurements.

3.3.3 Water Quality Sampling and Analysis

Water quality samples were collected on a semi-annual basis from the wells specified on Figure 3.3-1. Permanent production well pumps already present at each well were used to collect groundwater samples, as applicable. Temporary pumps/and/or bailer(s) were used to extract groundwater samples from wells without permanent pumps. In coordination with well owners' pumping schedules, as applicable, each well pumped for a 24-hour period before sampling to reach a steady pumping water level. If typical pumping periods were not at least 24-hours in length, a maximum pumping period was targeted.

Near the end of each pumping period, a pumping water level was obtained and water samples collected. Field personnel followed standard operating procedures as applicable for well purging and sample collection (DBS&A 2010b, Appendix A). Field parameters measured during well purging include pH, temperature, oxidation reduction potential, electrical conductivity, DO, and turbidity. All water quality meters were calibrated at the beginning of each sampling day using factory-recommended calibration solutions. If turbidity was present in excess of 5 nephelometric turbidity units, the samples were field-filtered using a manually operated positive-displacement pump equipped with a nominal 0.45 micron disposable filter.

Fruit Grower's Laboratory, Inc., located in Santa Paula, CA, performed laboratory analyses. The analytical suite for groundwater monitoring events are listed below:

- Field measurements.
- Irrigation suitability (alkalinity, bicarbonate, boron, calcium, carbonate, chloride, copper, electrical conductivity, fluoride, gypsum requirement, hydroxide, iron, magnesium, manganese, nitrate, pH, potassium, sodium, sodium absorption ratio, sulfate, TDS).
- Perchlorate.

Irrigation suitability was selected to provide a good representation of general water chemistry, and an incentive for well owners to cooperate with the monitoring program. Perchlorate was selected as an analyte due to its detection during the GAMA program in the two wells included in the Ojai Basin in 2007 sampling (Montrella and Belitz 2009, as cited in DBS&A 2010b).

Field quality control measures implemented during the quarterly groundwater sampling events will be performed according to the standard operating procedures (DBS&A 2010b, Appendix A) and QAPP (DBS&A 2010a, as cited in DBS&A 2010b). The required quality control sample frequencies and field quality control measures include but are not limited to:

- Collection of 1 field duplicate, 1 equipment blank, and 1 matrix spike.
- Providing accurate, detailed field documentation.
- Proper sample packaging and shipment.

3.3.4 Reporting Format

On a semi-annual basis, the acquired data was combined with existing well data and data from surface stream gauging stations throughout the larger area (collected by others), and these results documented in formal reports. All data analysis, interpretation, and report preparation was directed and reviewed by a DBS&A senior scientist and State of California Professional Geologist.

Section 1.0 of each report presents introductory information pertaining to the project history and hydrogeology, purpose and scope, and report organization. Section 2.0 summarizes the monitoring event activities including groundwater level measurements, sample collection, QA/QC procedures, and the analytical program. Section 3.0 presents the groundwater monitoring data including groundwater conditions and analytical results. Section 4.0 presents recommendations for program modifications, extensions, or reductions. The laboratory analytical report, including chain-of-custody forms, is attached as Appendix A to the report.

Measurements within geographic areas were collected in the shortest possible time so that the data can be assumed to have been collected under comparable conditions. Water level measurements were made using an electric sounder, and performed in accordance with procedures described in the DBS&A standard operating procedures. Where wells were equipped with an airline or pressure transducer, and obtaining static water levels with an electric sounder is not feasible, the existing infrastructure was used for obtaining depth to water measurements.

3.4 Upper and Lower Ventura River Basin Groundwater Budget and Approach to a Groundwater Management Plan

To improve the understanding of the groundwater basins along the Ventura River, a groundwater budget was developed based on available data and a hydrogeologic analysis performed to estimate the groundwater inputs and outputs in the Upper and Lower Groundwater basins (or sub-basins) which are generally located above and below Foster Park. In addition, the report also proposed an approach for the development of a groundwater management plan for the basins to insure a long-term sustainable, reliable, and good-quality water supply.

Information in this discussion is excerpted from the report entitled Groundwater Budget and Approach to a Groundwater Management Plan, Upper and Lower Ventura River Basin by DBS&A (2010a).

The sub-basins extend along the Ventura River Valley from the mouth of the river at the Pacific Ocean to just south of Matilija Canyon. Water users in the Ventura River watershed have no access to imported water and are therefore dependent upon maintaining an adequate supply of usable quality local water resources. For this reason, protection of local groundwater is vital, and an adequate understanding of groundwater storage volume and water quality trends is necessary. This report presents a groundwater budget for the sub-basins and an approach to a groundwater management plan (GWMP), as the first steps in planning for long-term protection.

The general approach for the groundwater budget is to estimate, based on available data and hydrogeologic analyses, the magnitude of all groundwater inputs and outputs within each of the sub-basins. Inputs include infiltration from precipitation, infiltration from irrigation, surface water recharge to groundwater, recharge from domestic septic systems, inflow from bedrock to the alluvial aquifer, and groundwater inflow from upgradient sub-basins. Groundwater outputs include municipal groundwater extractions, domestic groundwater extractions, agricultural groundwater extractions, industrial groundwater extractions, groundwater discharge to surface water, groundwater outflow, and groundwater consumption by riparian vegetation.

The resulting budget provides an estimate of the net gain or loss of the volume of groundwater in storage within the sub-basins per year. For the Upper Sub-Basin, a net gain of 1,466 AFY (Table 3.4-1) is estimated for the budgeted time period (WY 1997 through 2007). The primary inputs to groundwater in this sub-basin are infiltration and surface water recharge from Lake Casitas and the Ventura River, while the primary outputs are municipal and agricultural extractions. The estimated net gain in groundwater storage is relatively small and is consistent with long-term hydrographs of wells within the Upper Sub-Basin that indicate stable groundwater levels with 5 to 10-year rise and decline cycles.

Table 3.4-1 Groundwater Balance Upper Ventura Sub-Basin

Category	Parameter	Upper West (AFY)	Upper East (AFY)	Upper (Combined)[a] (AFY)
Groundwater Inputs	Infiltration from precipitation	893	4,181	5,073
	Infiltration from irrigation	222	2,891	3,113
	Net surface water to groundwater	2,003	2,290	4,293

Table 3.4-1 Groundwater Balance Upper Ventura Sub-Basin

Category	Parameter	Upper West (AFY)	Upper East (AFY)	Upper (Combined)[a] (AFY)
	Septic system recharge	18	120	139
	Bedrock to alluvial [b]			113
Groundwater Outputs	Extractions (domestic)	1	16	17
	Extractions (municipal)	0	7,385	7,385
	Extractions (agricultural)	0	1,898	1,898
	Groundwater outflow to Lower Sub-basin [b]			535
	Consumption by riparian vegetation [b]			1,430
			Final Balance [c]	+1,466

Notes:
a: Numbers may not add exactly because of rounding
b: Values not calculated independently for East and West Sub-basins
c: Sum of groundwater inputs minus sum of groundwater outputs
Source: Daniel B. Stephens & Associates 2010

For the Lower Sub-Basin, a net loss of 2,423 AFY (Table 3.4-2) is estimated for the budgeted time period. The primary inputs are infiltration and inflow from the Upper Sub-Basin, while the primary outputs groundwater discharge to surface water and discharge to the Pacific Ocean. There are currently no water levels monitored by Ventura County within the Lower Sub-Basin for comparison to the budget.

Table 3.4-2 Groundwater Balance Lower Ventura Sub-Basin

Category	Parameter	AFY[a]
Groundwater Inputs	Infiltration from precipitation	616
	Infiltration from irrigation	655
	Net surface water to groundwater	5
	Septic system recharge	319
	Bedrock to alluvial [b]	535
Groundwater Outputs	Extractions (domestic)	1,254
	Extractions (municipal)	1
	Extractions (agricultural)	522
	Groundwater outflow to Lower Sub-basin [b]	2,412
	Consumption by riparian vegetation [b]	365
	Final Balance [b]	-2,423

Notes:
a: Numbers may not add exactly because of rounding
b: Sum of groundwater inputs minus sum of groundwater outputs
Source: Daniel B. Stephens & Associates 2010

The intention of a GWMP is to provide a framework to manage groundwater to ensure a long-term, sustainable, reliable, good-quality water supply suitable to the political, legal, institutional, hydrogeologic, and economic conditions and constraints that exist in a groundwater basin. This report presents an approach to development of a GWMP for the sub-basins, including specifications for public participation, interagency involvement, coordination with the Ventura River Watershed Council, literature review and technical analysis, establishment of management objectives, and development of a monitoring program. The following outline provides an approach to development of a GWMP.

Component 1. Develop a map showing the area of the Basin, with the area that will be subject to the GWMP, as well as the boundaries of other local agencies that overlie any portion of the Basin. As a delineated groundwater basin with two delineated groundwater sub-basins, maps of the basins have been developed by both state and county agencies.

Component 2. Provide a written statement to the public describing the manner in which interested parties may participate in development of the GWMP. The statement should be provided to the public via local newspapers and/or other media, with distribution throughout the Basin. Documentation of public notification will be included in the GWMP.

Component 3. Establish a plan to involve other agencies whose boundaries overlie the Basin in development of the GWMP. This may include involvement via agency representative participation in the Ventura River Watershed Council (see Component 4).

Component 4. Establish a process for the Ventura River Watershed Council to serve as the designated advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the GWMP and provide a forum for resolution of controversial issues.

Component 5. Describe, in detail, the area to be managed under the GWMP, including (1) the physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin; (2) a summary of the availability of historical data; (3) issues of concern; and (4) a general discussion of historical and projected water demands and supplies.

Component 6. Establish management objectives (MOs) for the groundwater basin that is subject to the plan. MOs are intended to contribute toward a more reliable supply for long-term beneficial uses of groundwater in the plan area.

Component 7. For each MO in Component 6, describe how meeting the MO will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area, and describe existing or planned management actions to achieve MOs.

Component 8. Adopt monitoring protocols for the monitoring and management of groundwater levels, groundwater quality, potential inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels of quality.

Component 9. Describe the monitoring program, including the following:

- A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.
- A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, or monitoring).
- A QAPP for monitoring in the basin.
- Standard operating procedures for monitoring in the basin.

Component 10. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning agencies or activities.

Component 11. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s) prepared annually or at other frequencies and should include the following:

- Summary of monitoring results, including a discussion of historical trends.
- Summary of management actions during the period covered by the report.
- Discussion, supported by monitoring results, of whether management actions are achieving progress in meeting MOs.
- Summary of proposed management actions for the future.
- Summary of any plan component changes, including addition or modification of MOs during the period covered by the report.
- Summary of actions taken to coordinate with other water management and land use agencies and other government agencies.

Component 12. Provide for the periodic reevaluation and updating of the plan by the Ventura River Watershed Council.

3.5 Upper San Antonio Creek Watershed Giant Reed Removal Project

Giant reed (*Arundo donax*) is an invasive plant that consumes large quantities of water; displaces native vegetation and wildlife; disperses readily during floods; and exacerbates flooding, erosion, and fire intensity. The Upper San Antonio Creek Watershed Giant Reed Removal Project was implemented to substantially reduce the abundance and distribution of giant reed from the Upper San Antonio Creek Watershed, including Upper San Antonio, McNell, Thacher, and Reeves Creeks.

The distribution of giant reed within these creeks is patchy; overall, its percent cover relative to other vegetation is fairly low (less than about 20 percent). However, there are a few locations where its percent cover is as much as 76 percent. Figure 3.5-1 provides a giant reed distribution map of the project area. The project also involved the opportunistic removal of castor bean (*Ricinus communis*) in areas where it occurs in close proximity to the giant reed. The intended outcome of the Project is the re-colonization of native vegetation and the restoration of native habitats. A total of 212 acres were targeted for giant reed removal (District 2010c)

The “cut and daub” method was used to remove the giant reed and treatments only occurred when surface water was not present. The method involved manually cutting off the canes of the giant reed and painting the freshly cut surface with a glyphosate-based herbicide that is approved and labeled for use near and in open water, such as Aquamaster®. Treatment began in June 2010 and ended in December 2011.

Glyphosate is a broad-spectrum, non-selective, post-emergent herbicide that readily and completely biodegrades in soil and has little potential for leaching into groundwater. The primary MCL for glyphosate in drinking water sources or water bodies with a MUN (municipal and domestic supply) beneficial use designation has been set by the USEPA at 700 parts per billion (ppb). This is the equivalent of 700 parts of glyphosate to 999,999,300 parts of water and is the level of protection that the USEPA believes would not cause potential short-term or long-term health effects. Therefore, as a protective measure, the threshold for glyphosate for this project was also set at 700 ppb.

Aminomethylphosphonic acid (AMPA) is a breakdown product of glyphosate as the result of microbial metabolism. The laboratory method used to analyze for AMPA also measured glyphosate and glufosinate. Glufosinate is similar to glyphosate in its chemical structure and use. There are no regulatory limits for AMPA or glufosinate.

The District and the Stream Team routinely monitored for glyphosate within the treatment area to ensure that the water quality BMPs used during the Project were effective. The District also periodically monitored for AMPS. All sampling was constrained by the need for surface water to be present for collection of samples. Periodic stormwater monitoring also occurred.

Four routine sampling sites were monitored for the term of the project (Figure 3.5-2). Site 1 was southwest of Soule Park above the confluence of San Antonio Creek and Stewart/Fox Canyon (Pirie Creek), and downstream of the densest giant reed population to be targeted in this project. Site 2 was at the San Antonio Creek Crossing on Ojai Avenue near the entrance to Soule Park Golf Course. Site 3 was downstream of the Thacher Creek crossing of Ojai Avenue just south of the bridge. Site 4 is at the Reeves Creek crossing on McAndrew Road on the eastern (upstream) side of the bridge. Water quality data will be stored by the District for a period of at least 20 years from the date of sampling. Laboratory results were posted online within 1 month of receipt from the laboratory. Water quality data from certified laboratories were periodically uploaded to California Environmental Data Exchange Network and posted online on the District’s website. Water quality data were entered and evaluated on a monthly basis or more frequently, as required. Monitoring results are shown in Tables 3.5-1 and 3.5-2.

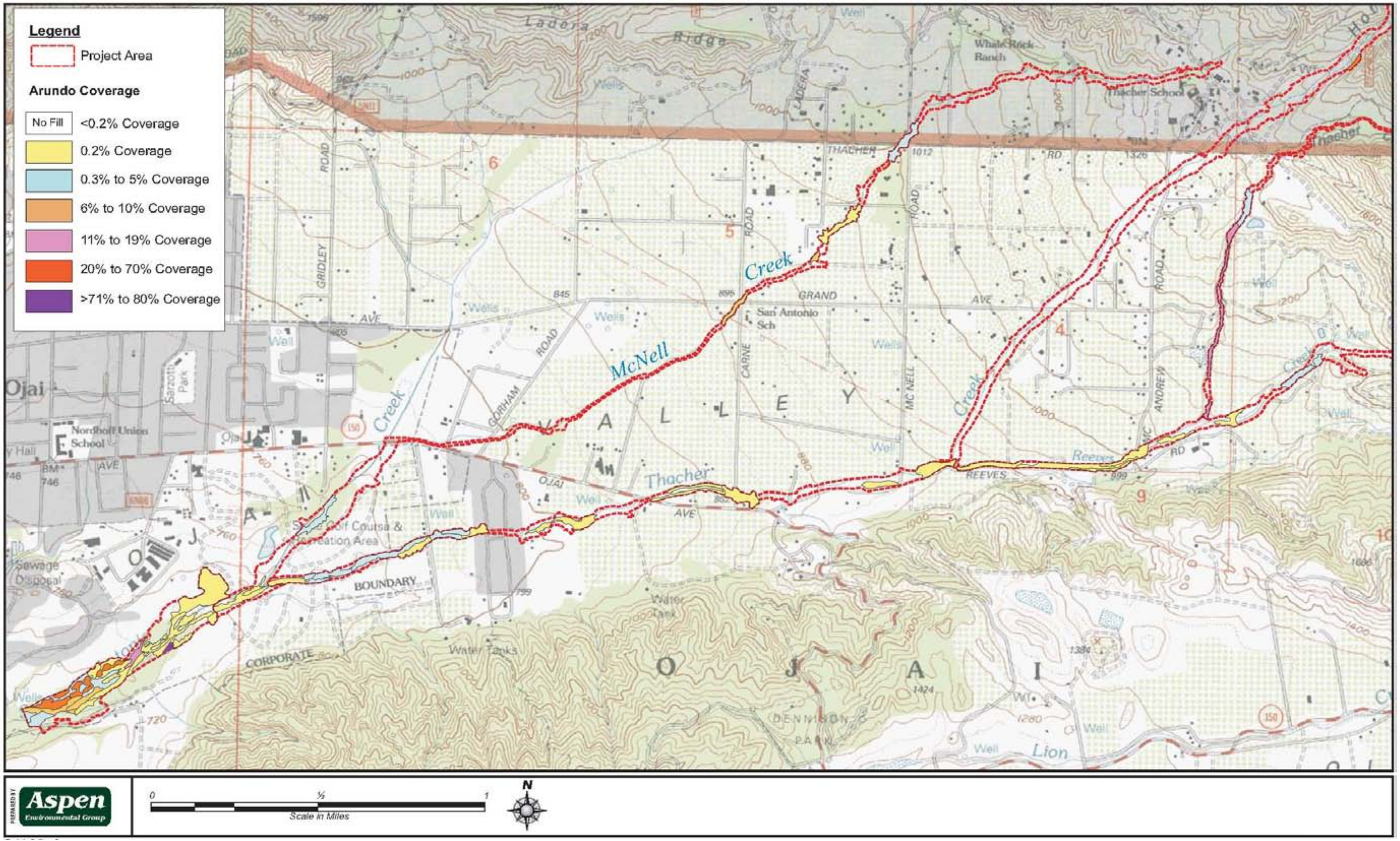


Figure 3.5-1 Giant Reed Percent Cover and Distribution

Source: District 2010c

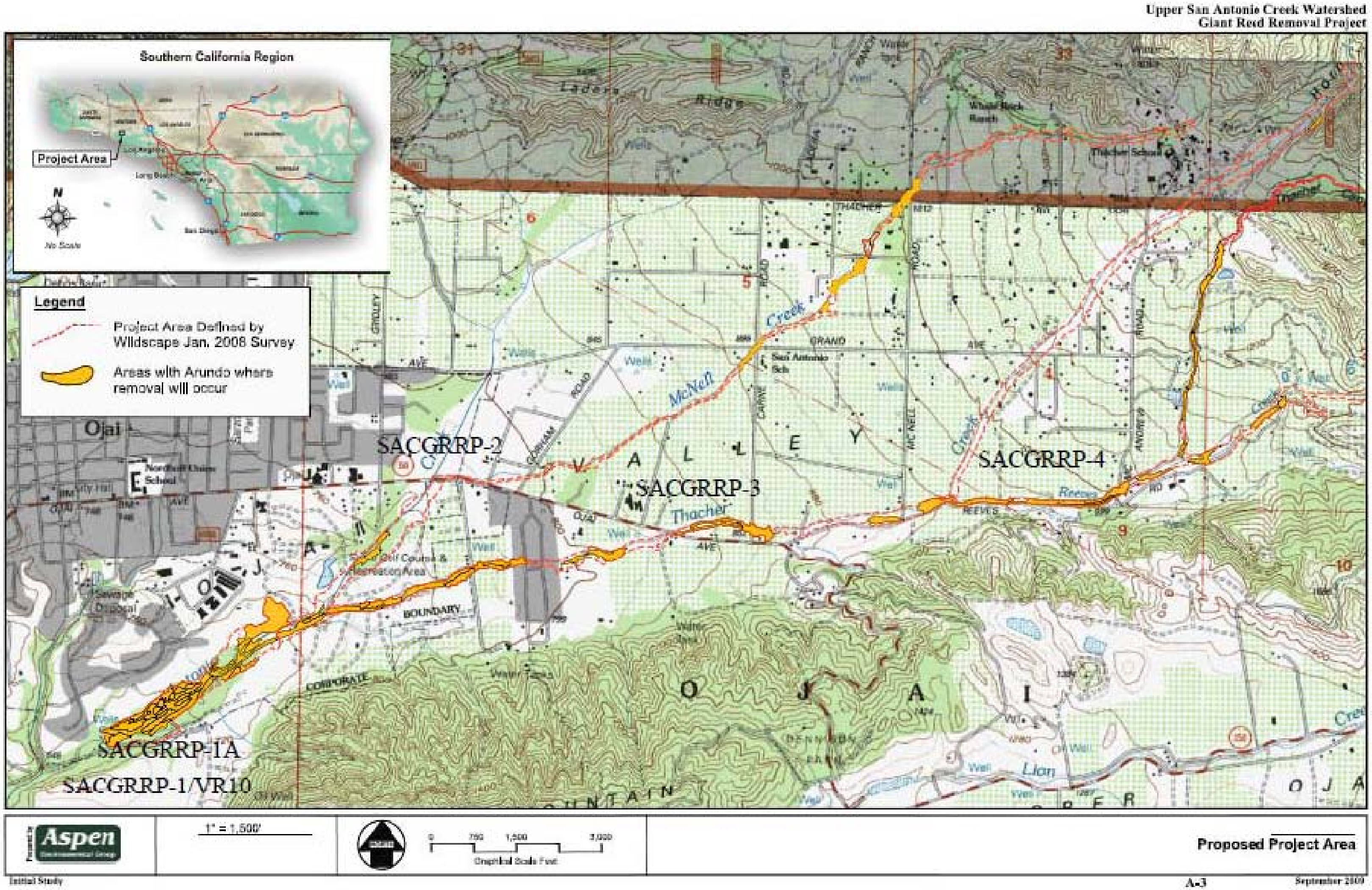


Figure 3.5-2 Project Area and Monitoring Sites

Source: District 2010c

Table 3.5-1 Routine Glyphosate Monitoring – Sites 1 to 4 and Soule Park

Sample Date	Organization	Site 1/VR10 (ug/l)	Site 1A (ug/l)	Site 2 (ug/l)	Site 3 (ug/l)	Site 4 (ug/l)	Soule Park (ug/l)
03/06/2010	Stream Team	ND	—	—	—	—	—
04/26/2010	VCWPD	ND	—	Dry	Dry	ND	—
05/03/2010	Stream Team	ND	—	—	—	—	—
06/07/2010	VCWPD	ND	—	Dry	Dry	Dry	—
06/09/2010	Stream Team	ND	—	—	—	—	—
06/30/2010	VCWPD	—	ND	Dry	Dry	Dry	—
07/14/2010	Stream Team	ND	—	—	—	—	—
08/04/2010	VCWPD	-	ND	Dry	Dry	Dry	—
08/09/2010	Stream Team	ND	—	—	—	—	—
08/30/2010	VCWPD	—	ND	Dry	Dry	Dry	—
09/15/2010	Stream Team	ND	—	—	—	—	—
09/29/2010	VCWPD	—	ND	Dry	Dry	Dry	—
10/02/2010	Stream Team	ND	-—	—	-	—	—
11/01/2010	VCWPD	—	ND	Dry	Dry	Dry	—
11/09/2010	Stream Team	ND	—	—	—	—	—

Source: District 2010e

Table 3.5-2 Special Testing – Site 1/1A

Sample Date	Organization	AMPA (ug/l)*	Glyphosate (ug/l)*	Glufosinate (ug/l)*
04/26/2010	VCWPD	0.03	ND	ND
12/20/2010	VCWPD	0.81	0.79	<0.02
04/26/2010	VCWPD	0.03	ND	ND

* The special testing method detection limit (MDL) for AMPA, glyphosate, and glufosinate is 0.02 ug/l. The MDL is the minimum concentration of a substance that can be identified, measured, and reported with a 99-percent confidence that the concentration is greater than zero.

ND = Not Detected

ug/l = micrograms per liter, equivalent to parts per billion

Dry = sampling could not occur because no water was present at the site

Source: District 2010e

Chapter 4

Water Demand and Water Budget

4.1 Introduction

This section provides a summary and analysis of water demand for the Ventura River watershed, which relies entirely on local water resources for water supply. Data collected from various previous investigations has been compiled and presented in a combined form to illustrate both the level of understanding of water demand and the types of data that will need to be addressed to improve the accuracy of a water budget for the watershed.

Wholesale and retailed water service within the watershed is provided by:

- Casitas (Municipal Water District) provides service within a 150-square mile area that includes the Ojai Valley and much of the lower Ventura River watershed. Casitas operates and maintains the Casitas Dam, Robles Diversion, and Robles-Casitas Canal (collectively referred to as the Ventura River Project) under contract with the U.S. Bureau of Reclamation to supply surface water from the Ventura River and Coyote Creek. Additionally, Casitas operates a single groundwater well in Mira Monte. Casitas provides water to retail customers, as well as several other public and private retail water operations.
- Golden State Water Company (Golden State) provides service to an area that is approximately the limits of the City of Ojai. Golden State relies on groundwater extractions from the Ojai Basin and supplements the groundwater supply with additional water from Casitas' service connections.
- Hermitage Mutual Water Company provides service to a limited area in the foothills north of the Ojai Valley. It relies on wells in the Ojai Basin and a supplemental connection to Casitas.
- Meiners Oaks Water District provides service in Meiners Oaks. It relies primarily on two wells in the Ventura River and has relied on Casitas only during infrequent system emergencies.
- Senior Canyon Mutual Water Company provides service in the east end of the Ojai Valley. It relies on three wells in the Ojai Basin and surface water diversions, with Casitas as a secondary source of water to buffer peak demands and as a drought contingency supply.
- Siete Robles Mutual Water Company services a single housing development located southeast of the City of Ojai. It relies on a well in the Ojai Basin and one service connection to Casitas that is used occasionally.
- Sisar Mutual Water Company provides service in the northeast area of the Upper Ojai Valley. It relies on groundwater wells and on a connection to Casitas as an emergency water source.
- Tico Mutual Water Company provides service in Mira Monte. It relies on one well in the Mira Monte area and one 2-inch service connection to Casitas as a backup supply.

- Ventura (City) provides service to the entire city and some adjacent unincorporated areas. Its water portfolio includes shallow wells in the Ventura River near Foster Park, rights to reclaim water from the OVSD Wastewater Treatment Plant, several connections to a Casitas pipeline, and groundwater sources from the east end of Ventura.
- Ventura River County Water District provides service to Casitas Springs, Rio Via, Monte Via and Oak View, and relies on four wells in the Ventura River and supplemental water from Casitas.

4.2 Water Demand

4.2.1 Municipal and Industrial (M&I) Demand

The overall M&I water usage (demand) for an average water year can be calculated from deliveries reported by Casitas along with the groundwater extractions for municipal and domestic uses in the Upper and Lower Ventura sub-basins, the Ojai Basin, and the Upper Ojai Basin, as provided in Table 4-1 below. These cumulative water deliveries are representative of the basin as a whole because Casitas provides water service to a large portion of the watershed, and the remaining areas receiving M&I supplies are supported by Golden State (City of Ojai) and the City of Ventura, and the various smaller water providers (which primarily rely on groundwater with supplemental supplies from Casitas).

Table 4-1 Estimated 2010 Municipal and Industrial Water Demand

Source/Location	Amount (AF)	Note
Casitas	9,674	Sum of 2010 urban water demand and sales to other retail agencies, not including City of Ventura[1]
Golden State	1,741	2010 (groundwater) demand, not including sales from Casitas[2]
Ventura (City)	3,085	Pro-rated share of 2010 Ventura City demand within watershed[3]
Upper and Lower Ventura Sub-Basins	8,657	Estimated annual domestic & municipal extractions, 1997-2007[4]
Upper Ojai Basin	11	Extractions in 2008 by Sisar Mutual Water Company[5]
Total	23,169	Total of all extractions within watershed for M&I use

Sources:

1: Casitas 2011, Tables 6 and 9, not including 300 AF of groundwater from Mira Monte well.

2: Kennedy/Jenks 2011c, Table 4-1, not including supplemental water delivered by Casitas.

3: Pro-rated estimate based on population residing within the Ventura River watershed. Total 2010 water demand in service area for the City of Ventura (including residential, commercial, industrial, institutional/government, landscape and other uses) is 16,983 AF (Kennedy/Jenks 2011a, Table 2-5). Population within the Ventura River watershed is estimated at 18,121 (for Ventura County census tracts 21.02, 22, 23 & 24, per census tract data from California Department of Finance 2011), which is 16 percent of total service area population (of 113,478, per Kennedy/Jenks 2011a, Table 2-1). Water demand for Petroleum Recovery Operations (of 368 AF) was added to the pro-rated total, as it is assumed that this demand occurs entirely within the watershed.

4: DBS&A 2010a, Tables 13 and 14.

5: Casitas, 2011, Table 8.

It should be noted that the available data does not allow development of an estimate for a consistent timeframe (as the estimate in Table 4-1 is primarily for 2010, except for groundwater extractions). Thus some variations in the estimate are likely due to annual variations in climatic conditions. In addition, the OBGMA assumes that all water extractions outside the Golden State service area are for irrigation use (as discussed below).

An alternate estimate of M&I demand could be generated to reflect the potential that some of the water extracted from the Ventura River is utilized outside the watershed (e.g., in areas located east of downtown Ventura). The City of Ventura reports 4,200 AF of extractions (in 2010) from the river (and associated basins) for M&I use. If the estimate of City's extractions were pro-rated, based on estimate of 16.0 percent of population that resides in the watershed (Table 4-1, Note #3), then total M&I water demand could be adjusted downward by approximately 3,228 AF, if that proportionate share of water was assumed to be utilized within the service area of the City of Ventura but outside the Ventura River Watershed.

4.2.2 Agricultural

Although extensive portions of the watershed are occupied by agricultural land uses, the water supply requirements for these lands is not well documented, as much of the agricultural uses are supported by groundwater, and pumping for that purpose is not reported outside the Ojai Basin.

Casitas reports:

> "[Casitas] provides water directly to 3,445 acres and supplements groundwater use on approximately 2,168 acres of irrigated crop lands. The total irrigated lands which are receiving [Casitas] water is 5,613 acres which is primarily avocado and citrus orchards, and a limited amount of flowers, strawberries, apples and walnuts. Agricultural water demand will fluctuate depending on weather conditions, but generally demands an annual average of two and a half acre-feet per acre for inland areas and two acre-feet per acre on the coast" (Casitas 2010).

For 2010, Casitas estimated agricultural water demand at 6,398 AF. Note however, this estimate does not account for groundwater extractions on the estimated 2,168 acres of agricultural lands for which Casitas provides supplemental water.

The Groundwater Budget and Approach to Groundwater Management Plan, Upper and Lower Ventura River Basin, provides an estimate of groundwater extractions for agricultural uses that overlay the upper and lower groundwater basins in the watershed, including those areas serviced by Casitas:

> "…agricultural extraction was estimated from existing SCAG land use data… and the locations of active agricultural wells within the Sub-basins... Those land use areas designated as irrigated agriculture or orchard/vineyard, for which active agricultural wells were either co-located or reasonably proximal, were assumed to provide all irrigation via groundwater extraction. These land use areas were then multiplied by water application rates for the land use types available from [the California Department of Water Resources]…" (DBS&A 2010a).

Using this methodology, DBS&A estimated agricultural water use at 2,420 AFY for an irrigated area of 1,429 acres (in the areas overlying the Upper and Lower Ventura sub-basins).

The OBGMA reports:

> "Beginning in 1993, the Ojai Basin Groundwater Management Agency has kept a record of reported groundwater extractions in the basin… [including] extractions by the Golden State Water Company for residences and businesses in the City of Ojai, primarily domestic… and extractions from private wells, primarily for irrigation use..." (OBGMA 2011).

For 2010, total groundwater extraction for irrigation use (which is herein assumed to be agricultural use) was 3,229 AFY, although the acreage of irrigated lands is not reported.

The Golden State Water Company, which serves the City of Ojai, does not identify any agricultural water use within their service area (Kennedy/Jenks 2011c). In addition, no agricultural water use estimates were available for the Upper Ojai Valley area.

The total estimated agricultural water demand for an average water year is summarized in Table 4-2.

Table 4-2 Estimated 2010 Agricultural Water Demand

Source/Location	Amount (AF)
Casitas	6,398[1]
Golden State	0
Ventura (City)	0
Upper and Lower Ventura Sub-Basins	2,420[2]
Ojai Basin	3,229[3]
Upper Ojai Basin	689[4]
Total	12,736

1: Casitas 2011

2: DBS&A 2010a

3: OBGMA 2011

4. DWR 2004, reduced by 11 AF to account for reported M&I use

4.2.3 Total Water Demand

Table 4-3 combines M&I and agricultural demand and provides an estimate of the total water demand within the Ventura River watershed.

Table 4-3 Estimated 2010 Total Water Demand

Source/Location	M&I Demand (AF)	Agricultural Demand (AF)
Casitas	9,674	6,398
Golden State	1,741	0
Ventura (City)	3,085	0
Upper and Lower Ventura Sub-Basins	8,657	2,420
Ojai Basin	0	3,229

Table 4-3 Estimated 2010 Total Water Demand

Source/Location	M&I Demand (AF)	Agricultural Demand (AF)
Upper Ojai Basin	11	689
Subtotals	23,169	12,736
Total Water Demand (AF)	35,905	

Sources: Tables 4-1 and 4-2

4.3 Water Budget

A water budget for the Ventura River watershed would sum all of the water inputs and outputs and permit the identification whether the net effect is a surplus or a deficit in water resources. To identify long-term trends, a long period of historical record (e.g., 20 to 30 years) would be needed, to account for changes in annual precipitation patterns, particularly to assess conditions during drought periods.

A comprehensive water budget could address whether the water resources in the Ventura River watershed are sufficient to meet total water demand (Table 4.3), particularly during drought conditions. If water demand exceeds available resources, then some sources would be expected to decline over time (e.g., groundwater levels).

Table 4.4 provides a watershed-wide water balance developed by Tetra Tech (Tetra Tech 2009a) for the purposes of calibrating the HSPF model. However, the input and output categories are very broad and don't provide an opportunity to corroborate these results with other data sources, many of which address portions of the watershed (e.g., the tributary area for Lake Casitas or the Ventura River groundwater sub-basins). For example, the average annual evaporation and rainfall loss in Lake Casitas is estimated at 2,630 AF (Casitas 2011b).

Table 4-4 Ventura River Watershed Water Balance

	Parameter	AFY1	Percent
Upland Balance			
Input	Precipitation	322,008	93%
	Irrigation	14,349	4%
	Change in storage	8,723	3%
	Total Input	345,080	
Output	Evapotranspiration	215,414	62%
	To stream	113,275	33%
	To deep groundwater	16,391	5%
	Total Output	345,080	
Waterbody Balance			
Input	Runoff	113,275	94%
	Diversions in	0	0%
	Upstream in	0	0%

Table 4-4 Ventura River Watershed Water Balance

	Parameter	AFY1	Percent
	Groundwater in	4,252	4%
	Point source	2,491	2%
	Net precipitation	198	0%
	Total Input	120,216	
Output	Downstream out	84,880	71%
	Diversions out	19,691	16%
	Stream to groundwater	7,375	6%
	Net reach and reservoir loss	8,270	7%
	Total Output	120,216	

1: The original source summed values for an 11-year period from 1997-2007, so those values have been averaged for a single year.

Source: Tetra Tech 2009a

DBS&A developed a groundwater budget model for the Upper and Lower Ventura sub-basins, which identified a potential surplus in the Upper Basin (Table 3.4-1) and a potential deficit in the Lower Basin (Table 3.4-2) for the period between 1997 and 2007. However, the lack of some groundwater data (e.g., water levels in the Lower Basin, outflows to the ocean, and extractions for agriculture) limits the applicability of the results for other purposes, such as a water budget.

The possible elements of a comprehensive water budget are listed in Table 4-5. For each element, a brief description is provided, along with an assessment of the availability of this information for the watershed.

Table 4.5 Key Elements of Water Budget

Inflows	
Surface Water	Groundwater
Total Precipitation Consists of rainfall measurements Data are widely available from rain gauge records	Inflow from Precipitation Consists of recharge to groundwater Estimates are widely available.
Surface Runoff Consists of surface flows in rivers and creeks Data are generally available from stream gage records, although not all records are complete.	Recharge from Irrigation Consists of the deep percolation of irrigation water from farmland and pastures Estimates are widely available, but rely on inadequate records for agricultural irrigation amounts
M&I Return Flow Consists of flows from wastewater treatment plants and miscellaneous runoff (e.g., urban runoff, including flows from over-irrigation of landscaped areas). Data are available for wastewater discharge, but other flows are not generally available.	Inflow from Rivers, Lakes & Septic Systems Consists of the deep percolation of water from rivers, lakes, and septic system return flows. Estimates are generally available for Lake Casitas, but only marginally available for the Ventura River, due to incomplete understanding of subsurface geology. Estimates are generally available for septic systems.

Table 4.5 Key Elements of Water Budget

Inflows	
Surface Water	Groundwater
Groundwater Accretions Consists of surface water in streams and creeks that infiltrates into groundwater basins. Estimates are generally available.	Surface Water Accretions Consists of inflows to creeks and rivers from subsurface groundwater, via seeps, springs, and baseflow. Estimates are generally available, but limited by incomplete understanding of subsurface geology
Outflows	
Agricultural Diversions Consists of surface water that is diverted to irrigate pastures and farmland. Data are not available, but estimates can be developed based on crop usage information	Agricultural Pumping Consists of water used for irrigation of farmland and pastures. Aggregate data are available for the Ojai basin, but unavailable for other areas. Estimates generally available based on crop types and climatic data.
M&I Diversions Consists of surface water diversions by water districts Data are widely available from Casitas and City of Ventura	M&I Pumping Consists of groundwater pumping by water suppliers. Data are widely available for public agencies, but generally not available for private water companies.
Evapotranspiration Consists of the sum of evaporation and transpiration by plants Estimates are available based on data provided by D, but relies on aggregating vegetation types into broad categories. More precise estimates are widely available for crop types.	Evapotranspiration-Riparian Consists of the transpiration by plants that can access subsurface water, typically along creeks and rivers. Estimates are generally available, but rely on broad assessments of vegetative cover.
Outflow to Ocean Consists of runoff from the Ventura River at the estuary. Data are generally available based on a stream gage near Foster Park, but the record is not complete because of occasional storm damage to the gauge.	Outflow to Ocean Consists of subsurface flows at the Ventura River Estuary. Estimates are generally available, but based on incomplete understanding of subsurface hydrology.

Notes:

Widely available: data or estimate is available from a variety of accessible sources

Generally available: some data or estimates are available, but not for the entire watershed

Not available: data has not been collected or is not reported.

Sources: Tetra Tech 2009a, 2009b, 2010; DSB&A2010, and Dunne and Leopold 1978

4.4 Safe Yield

The concept of safe yield has been applied to reservoirs and groundwater basins, and traditionally has been interpreted as the amount of water than can be extracted without causing a long term decline in water levels and/or damage to natural or human uses. The concept of safe yield has been widely debated, due to the complex variables involved and the inability to adequately account for all potential losses. As a result, discussions of water yield, particularly for watersheds, more commonly focus on the term “sustainable yield” in recognition of a long term goal to ensure that water extractions can be sustained over time, and thus account for variations in water availability related to changes in precipitation patterns.

No assessments of safe or sustainable yield for the entire watershed have been prepared, and given the data limitations related to development of a water budget, a meaningful estimate cannot currently be prepared without improved data for several components of the watershed system. Identification of those limitations and recommendations to address them could facilitate development of an estimate of the safe, or sustainable yield; these are provided in Chapter 6.

In 2004, Casitas prepared a report on Water Supply and Use Status (Casitas 2004), which provided an estimate of safe yield for Lake Casitas (including surface water diversions and groundwater extractions from a single well in Mira Monte), based on a period of record from 1945 to 1980, including a critical drought period from 1945 to 1965. The calculation of safe yield was described as:

> "…based on the storage volume of Lake Casitas (the aquifer), the surface water and groundwater supply managed by Casitas, and the length of time that the water supply needs to last (i.e., the longest drought on record). The safe yield is an interpolated value that is held to be consistent of the period of the critical drought, bring the level of storage to the desired minimum volume."

The report concluded that during the critical drought period, the safe yield was 20,840 AF, assuming no storage capacity at Matilija Dam and the ongoing implementation of operating conditions imposed by the Biological Opinion for diversions at the Robles Fish Passage Facility. Casitas' 2010 UWMP uses that estimate (parsed as 20,540 AF for the lake and 300 AF for the single groundwater well) as the water supply for the district.

Daniel B. Stephens & Associates recently completed the Ojai Basin Groundwater Model Report (DBS&A 2011) provides a Groundwater Mass Balance analysis that estimated average groundwater inputs (including precipitation, irrigation, septic systems, and spreading grounds) at 6,780 AFY and average groundwater outputs (including pumping wells, discharge to streams, evapotranspiration, and outflow to bedrock) at 6,816 AFY), which would result in a net change in storage of approximately -30 AFY.

The estimates of the safe yield for Casitas' service area and groundwater mass balance in the Ojai Basin could be a starting point for the calculation of the entire watershed's safe or sustainable yield, if sufficient information can be identified for the other water resources in the watershed.

Chapter 5

Review of Applicable Watershed Management Plans

5.1 Introduction

To provide relevant information to inform development of a comprehensive and integrated Ventura River Watershed Management Plan, this Report includes a summary of other watershed management plans that may be applicable to the Ventura River watershed (based on physical characteristics and location), the identification of lessons learned from those plans, and recommendations that can inform development of a watershed management plan for the Ventura River.

5.2 Identification of Applicable Watershed Plans

In the past decade, one watershed plan and several related studies have been developed within Ventura County. These include the ongoing watershed management effort in Calleguas Creek and various studies related to the management of the Santa Clara River, although those efforts are more focused on the river corridor itself.

Within Los Angeles County, watershed plans and studies have been prepared for Arroyo Seco, Ballona Creek, Compton Creek, Coyote Creek, Dominguez Channel, Rio Hondo, Tujunga Wash, and the Upper San Gabriel River. In addition, a watershed and open space plan was prepared for the Los Angeles and San Gabriel rivers.

Several watershed planning studies also have been conducted in Santa Barbara County, focusing on Carpinteria Creek, Mission Creek (including Arroyo Burro and Sycamore creeks), Rincon Creek, and San Jose Creek, but none of these has resulted in the development of complete watershed plans.

To identify which of these plans or studies are applicable to development of a management plan for the Ventura River watershed, several factors were considered, including location (e.g., within or outside Ventura County); importance of local water supplies (because the Ventura River watershed is entirely dependent on local supplies); major focus on water quality (because both surface and groundwater quality are key issues in the Ventura River watershed); and the extent of involvement of a local watershed group in development of the plan (because it is assumed that the Ventura River Watershed Council will participate in development of a watershed plan).

Based on these factors, three applicable watershed plans were identified:

- Ballona Creek Watershed Management Plan (LACDPW 2004), because surface water quality was a major focus of the plan, and the stakeholder-led Ballona Creek Watershed Task Force guided development of the plan.

- Calleguas Creek Watershed Management Plan (Calleguas Steering Committee 2004), because Calleguas Creek is located in Ventura County, surface water quality is a key issue, and stakeholders were involved in development of the plan.
- Tujunga-Pacoima Watershed Management Plan (The River Project 2008), because this plan is focused on enhancing water supply and improving both surface water and groundwater quality.

5.3 Review of Applicable Watershed Plans

5.3.1 Ballona Creek

5.3.1.1 Purpose

The Ballona Creek Watershed Task Force, composed of stakeholders, adopted the following goal:

> "To develop and facilitate implementation of a Comprehensive Watershed Management Plan for the Ballona Creek Watershed that sets forth pollution control and habitat restoration actions to achieve ecological health."

Thus, this watershed plan is primary focused on the improvement of surface water quality and the enhancement and restoration of habitat.

5.3.1.2 Organization and Content

The plan is organized as follows:

- Executive Summary, which provides a useful overview that can be quickly read and was the basis for a brochure developed after the plan was adopted.
- Chapter 1, Background, which gives an overview of the historical and planning context relevant to plan development.
- Chapter 2, Existing Conditions, which includes a concise summary of existing conditions in the watershed, providing the reader with the context for the subsequent goals and objectives.
- Chapter 3, Goals and Objectives, which includes a list of "issues of interest" that were identified by the task force, and those issues are subsequently reflected in list of "watershed problems" that could be addressed by the plan. The inclusion of the issues and problems in this section provide the reader with a clear understanding of how the Goals and Objectives were derived.
- Chapter 4, Methods and Mechanisms, which includes lists of priority actions, BMPs, and existing and pending projects. The plan also includes 10 demonstration projects that provide multi-purpose examples of projects that would improve surface water quality, enhance groundwater recharge, and provide pockets of native habitat.
- Chapter 5, Community-Based Monitoring, which describes how existing monitoring efforts could be integrated to form a Community-Based Monitoring program (primary for surface water quality) that would assure consistency between both public and private (e.g., non-governmental organizations) monitoring efforts. This chapter includes an analysis of data gaps and provides specific recommendations to address those gaps.

- Chapter 6, Opportunities for Stakeholder Involvement and Funding, which provides a specific list of actions that should be undertaken by federal, state, and local agencies; non-governmental organizations; and individuals. This chapter also discusses funding opportunities, including opportunities to fund the demonstration projects.
- Chapter 7, Next Steps, which identifies next steps for plan implementation, organized according to whether they relate to water, land, and planning.

5.3.1.3 Lessons Learned

The Ballona Creek Watershed Management Plan was completed in 2004 and is the earliest of the three watershed plans identified as applicable to the Ventura River watershed. Development of the plan was funded by a Proposition 13 grant from the State of California, which was administered by the County of Los Angeles. Development of the plan was led by a steering committee, although major elements of the plan (such as the goals and objectives) were derived from a consensus of the stakeholders that were members of the task force. Following adoption of the plan, a watershed coordinator was hired to foster its implementation.

Although the Ballona Creek plan was a broad attempt to address the stakeholder-identified issues and forge a comprehensive vision for the future of the watershed, few of the actions and projects identified in the plan have been implemented. With a wide range of policy recommendations, the plan did not adequately anticipate the issues required to work across jurisdictional boundaries. The demonstration projects were proposed to be located on various public sites, but the entities responsible for those sites were not involved in their selection or conceptual planning, and thus, there was little impetus for project implementation. Because no single entity is responsible for implementation of the plan, many of the recommended actions have not been implemented, or have been implemented in other forums (e.g., TMDL implementation is discussed via a process established by the Regional Water Quality Control Board). The watershed coordinator hired after adoption of the plan did implement some of the plan recommendations, but lack of funding limited the scope of those actions. Most of the projects that have been implemented in the watershed were either driven by regulatory requirements (e.g., TMDLs), or have been relatively small-scale projects that have not generated much public awareness. The Ballona Creek Watershed Task Force recently began meeting again recently (after a hiatus). Many of the watershed-related activities have been subsumed by a non-profit organization (Ballona Creek Renaissance), which is focused on restoration activities along the creek and educating the public about watershed-friendly landscape practices.

5.3.2 Calleguas Creek

Stakeholders first organized to discuss watershed conditions in 1996, and considerable effort was expended to characterize watershed conditions and to evaluate options to address the identified problems. The Phase I Watershed Plan was completed in 2004. An Addendum was completed in 2006, thus creating the Phase II plan, which was proposed to serve as an Integrated Regional Water Management Plan (IRWMP) until that effort was combined with the county-wide IRWMP effort lead by the Watersheds Coalition of Ventura County. Although the watershed plan was completed almost 7 years ago, numerous planning activities are still underway, generally focused on the issues of surface water quality (and TMDL compliance) and flooding and erosion on specific reaches of the creek.

5.3.2.1 Purpose

As described in the watershed plan:

> "The Calleguas Creek Watershed Management Plan is a comprehensive, stakeholder driven effort to work cooperatively and responsibly to develop a comprehensive plan that would guarantee the long term health of natural resources in the watershed. In the first phase, this included development of action recommendations and technical tools to address coordinated environmental and resource management by public agencies and private sector participants. [Phase II focused] on how responsible parties in the watershed can act collectively to address significant water quality improvements and meet the mandatory standards of the federal Clean Water Act and California Porter-Cologne Act."

The objectives of the Phase II Management Strategy (which is distinct from Phase II of the Watershed Management Plan) are to set guiding principles for future stream protection by:

- Identifying and generating a cost-effective, economical, and environmentally friendly programmatic solution.
- Identifying and generating a comprehensive system of concepts and scenarios that will address the flooding and sedimentation issues.
- Promoting a more natural stream condition.
- Providing multiple benefits and opportunities.

5.3.2.2 Organization and Content

The watershed plan is organized as follows:

- Chapter 1, Introduction, which provides a brief summary of the plan contents.
- Chapter 2, Action Recommendations, which includes actions developed by watershed management plan subcommittees that focus on water resources and water quality, habitat and recreation, flood protection and sediment management, agriculture, land use, and public outreach and education.
- Chapter 3, Past Work Products, which summarizes the results of various studies that were conducted prior to development of the watershed plan and include the goals adopted by several of the subcommittees.
- Chapter 4, Watershed Overview, which summarizes of the physical, hydrologic, and biological characteristics of the watershed and synthesis much of the work completed in the past work products described in Chapter 3.
- Chapter 5, Watershed Definitions, which provides a primer on watershed planning and the concepts used in this form of integrated planning.

5.3.2.3 Lessons Learned

The watershed plan reflects the substantive body of work that was completed prior to development of the plan; however, the plan organization could be viewed as somewhat backwards. What could be considered introductory material (e.g., watershed definitions) appears in the last chapter, the overview of the watershed is in Chapter 4, and the summary of previous work in provided in Chapter 3. Chapter 2 presents a detailed list of actions, but other than acknowledging that those actions were generated by various subcommittees, it is not clear to the reader how those groups formulated those actions.

Although a full range of issues is addressed in the plan, including habitat, recreation, and land use, the emphasis of the recommended actions (seven are related to flooding and stormwater runoff and six are related to TMDLs) suggests that that flooding and surface water quality are the primary emphasis. As noted above, the primary emphasis of Phase II was compliance with federal water quality regulations (e.g., TMDLs), and most of the planning activities that have occurred since completion of the plan relate to TMDL compliance and protection from flooding and erosion. Since many of the plan participants are focused on addressing those issues, it is possible to conclude that the plan was focused on the key issues of many plan participants. The ongoing activity related to those issues suggests that many of those same participants have continued to support implementation of the actions and strategies identified in the plan.

5.3.3 Tujunga-Pacoima

5.3.3.1 Purpose

The watershed plan identifies its purpose as follows:

> "This plan is intended as a resource for anyone interested in working towards a sustainable future in this region. It aims to educate and inspire and to provide local advocates, urban planners, agencies, elected officials, policy-makers, individual property owners, residents, and youth a road map and a toolkit to do the following:
>
> - Develop a more holistic understanding of the our local environment.
> - Facilitate widespread watershed awareness and education.
> - Empower the community to be directly engaged in the decision making process.
> - Catalyze actions to sustain support and implementation of the Plan over the long term.
> - Improve coordination and integration among agencies.
> - Enhance communication and collaboration between agencies and other stakeholders.
> - Bring together key agencies with other stakeholders to plan the financing and implementation of large-scale watershed retrofitting."

5.3.3.2 Organization and Content

The watershed plan is organized as follows:

- Chapter 1, Introduction, which includes a watershed primer ("Watersheds 101"), a discussion of why traditional land use planning models need to be modified, and a description of how the plan was developed and what the plan is intended for (which is summarized as the purpose above).

- Chapter 2, Watershed Conditions, which provides a summary of the existing conditions in the watershed and is based on a much more detailed companion report entitled "State of the Tujunga."
- Chapter 3, Goals and Objectives, which 3 identifies the goals and objectives as having been generated through a collaborative stakeholder process.
- Chapter 4, Projects, which describes the process used to identify a total of 216 projects and subsequently select 37 projects as a "preferred scenario" based on an analysis of the projected project benefits. Each of the preferred projects is described on a two-page fact sheet.
- Chapter 5, Quantifying Benefits, which describes the modeling effort utilized to quantify the benefits of projects on a watershed scale (e.g., the net effect on surface water quality) and the limitations in that approach.
- Chapter 6, Studies and Programs, which identifies a series of studies to address data gaps that were identified during development of the plan and various programs that could expand watershed awareness and provide specific tools that could enhance implementation of watershed concepts.
- Chapter 7, Policy Recommendations, which address land use, water supply, stormwater quality, public safety, parks and open space, habitat and native vegetation, coordination and planning, and funding.
- Chapter 8, Next Steps, which provides specific recommendations for individuals, Los Angeles City Neighborhood Councils, local entities, and state and federal agencies.

5.3.3.3 Lessons Learned

The Tujunga-Pacoima Watershed Management Plan was funded by a grant from the CALFED Watershed Program to The River Project, a non-profit organization. It also relied upon in-kind contributions from various groups and companies to extend the scope and content of the plan. Development of the plan was supported by various stakeholder-focused activities, including a Tujunga "Watershed U" (supported by the University of California Cooperative Extension). The development and subsequent implementation of the plan was not supported by a watershed coordinator. Since completion of the plan, the stakeholder group involved in the plan development has not continued to meet.

As noted in the introduction, the plan is focused on the education of individuals, organizations, neighborhood councils, agency staff, and policy makers. The content of the document included sufficient background information to be accessible to readers with limited understanding of watershed concepts. Several of the projects identified in the plan have been implemented, which suggests that the process of vetting projects to identify those with substantive benefits helped to identify projects that are more likely to be pursued. The discussion of policy recommendations was far reaching, but few, if any, of the policy recommendations have been implemented. This is similar to the experience with Ballona Creek, where agencies or institutions have little incentive and no mandate to consider these policy recommendations. The inclusion of specific recommendations for watershed residents does provide a clear opportunity for individual actions that can improve watershed health.

5.4 Recommendations for Ventura River Watershed Management Plan

Although the scope and content of a watershed management plan for the Ventura River have yet to be articulated, based on a review of the applicable watershed plans, the following recommendations may be informative.

- **Identify the intended audience and provide appropriate content**. If the plan is intended to educate watershed residents, then consider inclusion of information that explains the concepts inherent in watershed planning, and move technical information to an appendix (to demonstrate the plan's technical competence) and provide a summary of that information in the body of the plan.
- **Engage watershed stakeholders**. An active and engaged group of participants may enhance the potential for implementation of plan elements. Because so many participants in the Calleguas Creek watershed have a clear interest in resolution of the identified water quality and flood protection issues, many of those entities have remained engaged in ongoing planning activities. Thus, the recommendation is to focus the Ventura River Watershed Plan on those issues that will keep stakeholders engaged over the long term.
- **Clearly define and state the plan's goals and objectives**. The clarity of goals and objectives in the reviewed watershed plans varied, but those with clearly defined goals and objectives make it easier for the reader to understand the intent of the plan. It would also be helpful to provide sufficient information to make it clear how the goals and objectives were identified.
- **Focus the scope of the plan.** The scope of the applicable watershed plans varied considerably, with Calleguas focused most specifically and Tujunga the broadest. Although watershed planning inherently suggests adopting a holistic approach to land, water, and natural resources, addressing all of those issues equally could result in a plan that is too unfocused. It is recommended that once the goals and objectives are identified, to assess which of those issues are already being addressed by existing programs and which are not being addressed. For issues already being addressed, identify how those programs can be enhanced. For issues that are not being addressed, identify solutions and make specific recommendations on how to implement those solutions.
- **Focus on issues where stakeholders can make a meaningful difference.** The inclusion of land use policy recommendations in the Ballona and Tujunga plans has resulted in little change because the responsible institutions have no mandate to consider the changes and little incentive to change. Thus, the recommendation is to limit the scope of policy recommendations if there is little chance to overcome institutional resistance.
- **Work with regulatory programs.** Some existing regulatory programs (e.g., TMDLs) may benefit from enhancements that make them more efficient and effective. The watershed plan should consider how existing regulatory programs are structured and make recommendations that demonstrate that understanding. For example, instead of suggesting a new process, it is suggested that recommendations focus on changes that can be accommodated within existing structures and programs.
- **Prioritize projects that can meet the plan's objectives.** If projects are included, it is recommended that a clear and open decision-making process be used to identify the projects that respond most directly to the plan's goals and objectives (e.g., high-priority or preferred

projects). It is also recommended to avoid inclusion of projects that are located on land that is not controlled by the project proponents.

- **Identify mechanisms and a process to gauge progress towards plan implementation.** Measuring the success of the applicable watershed plans was difficult, either because no clear monitoring mechanisms were identified or no such monitoring is ongoing. Providing the ability to measure success towards implementation can foster a sense of accomplishment and enhance the potential to keep stakeholders engaged.

Chapter 6

Data Gaps

The reports prepared for the V-1 projects described several data gaps that were identified in the development of the HSPF runoff model for the watershed and the groundwater budget for the Ventura River sub-basins. In preparation of this Report, several other data gaps were identified. This section summarizes the data gaps and recommendations to address them.

6.1 HSPF Model

6.1.1 Study Limitations

The Calibration and Validation Baseline Report (Tetra Tech 2009a) identified the following areas where the HSPF model might be further improved:

- There is uncertainty regarding the model's ability to accurately predict high flow peaks at the North Fork Matilija and Happy Valley Drain stream gages. Some improvement could likely be attained by refining the channel hydraulic representation through development of HEC-RAS models for these subwatersheds, which would require assembly of additional information on channel dimensions and structures. Note that as part of the Federal Emergency Management Agency (FEMA) Cooperating Technical Partners (CTP) Program for Happy Valley Drain, a HEC-RAS model was developed and is available for further refinement of HSPF in this area (District 2011b).
- Simulation of event peaks in Happy Valley Drain also was identified as being particularly problematic. The hydrology in this area is complex, including a diversion and a concrete channel. The report noted that detailed survey and small scale modeling of this area might reveal ways in which the model representation could be improved. This also was done as part of the FEMA CTP for Happy Valley Drain.
- Model fit to the Santa Ana and Coyote Creek gages is uncertain due to the lack of information on gage accuracy and bias. New rating tables have apparently not been developed for these gages in a number of years, and adjustments are likely needed to reflect changes in channel dimensions. Measurements to develop a current-day rating curve would assist in interpretation of records from earlier in this decade.
- As noted above, the quality of gage records for Coyote Creek and Santa Ana Creek is uncertain. These gages are useful for providing a broad basis to evaluate model performance. Tetra Tech suggests that field measurements be made on a regular schedule (at least annually) to provide a basis for calibrating and adjusting the Coyote Creek and Santa Ana Creek rating tables.
- No current gauging exists in the southernmost portion of the watershed, downstream of Foster Park. As a result, this portion of the model cannot be directly calibrated. Tetra Tech suggests that a mainstem gage should be installed at an appropriate location near the outlet of the Ventura River. In addition, the Canada Larga peak flow gage should be operated to provide continuous flow records.

- The present-day precipitation monitoring network appears to provide generally good coverage of the watershed. However, quality assurance can likely be improved for the high elevation ALERT gages. In addition, there are fundamental difficulties in extrapolating from point rainfall measurements to total areal precipitation, particularly in regions of high relief. There is a potential to improve total rainfall estimates through use of integrative techniques, such as Doppler radar interpretation.
- Evapotranspiration is a major part of the overall water balance, and is, of necessity, estimated from a small number of stations (many of which report only monthly totals) for the calibration and validation periods. The recently activated California Irrigation Management System (CIMIS) stations within the watershed provide an opportunity to develop better estimates of potential evapotranspiration in the future. Use of these stations would also provide better estimates of irrigation demand.

6.1.2 Data Gaps and Recommendations

The Calibration and Validation Baseline Report (Tetra Tech 2009a) made the following recommendations for improving data collection for future maintenance and refinement of the HSPF model; in addition, there are a number of research-oriented issues that might lead to significant improvements in the model, but could not be addressed within the current scope:

- The most significant limitation on simulation of the water balance is the lack of a detailed groundwater model of the [Ventura River] basins. As described in the report, there are portions of the stream network that both lose to and gain from groundwater. Pumping in the alluvial aquifers also provides a significant influence on low flows in San Antonio Creek and portions of the Ventura River mainstem. Ideally, a dynamic groundwater flow model (e.g., MODFLOW) would be developed and could be linked to provide the reach losses and deep groundwater discharge time series to the HSPF model. Developing such a model represents a considerable effort. In the absence of funding to develop a dynamic model, a simpler mass balance accounting of inputs and outputs to the alluvial aquifers would also be useful for constraining and improving the surface water model.
- During model calibration it was necessary to reduce the default assumptions of irrigation application rates. This should be investigated further, starting with a survey to better determine the extent of irrigated lands and actual irrigation rates. As much of the irrigation supply in the basin comes from groundwater, this could best be done in conjunction with development of a groundwater model or mass balance accounting.
- As part of the current work, a method was developed to account for the potential effects of high sediment concentrations on runoff volumes and flow values using a sediment bulking approach. The validity of this method has not been tested in the Ventura River watershed. Further investigations and fine-tuning of the sediment bulking approach could be pursued if and when data are available to document extremely high sediment concentrations during specific peak runoff events.
- The current work also developed and incorporated a method to account for the hydrologic effects of severe wildfires, which reduce interception, infiltration, and evapotranspiration, leading to increases in both high flows and low flows. These effects were assumed to persist for two years after a major fire. The method appears to perform adequately in general, in particular providing an improved fit to observed flows following the 1979 and 1985 fires.

However, some of the gage data (e.g., North Fork Matilija) suggest that the fire impacts persist for somewhat longer than two years. Some adjustments to the approach – in particular the period of application – may thus be warranted.

6.2 Groundwater Budget Data Gaps and Recommendations

DBS&A (2010a) identified several limitations and data gaps for the groundwater budget developed for the Upper and Lower Ventura River basins. These are summarized in Table 6-1, along with their recommendations.

Table 6-1 Groundwater Data Gaps and Recommendations

Data Gap	Recommendation
The delineation of the groundwater sub-basins is not consistent among various reports, including DWR Bulletin 118 (DWR 2003, as cited in DBS&A 2010a); the District's annual groundwater reports; and previous modeling reports for the Ventura River watershed (Tetra Tech 2009a).	Determine a unified delineation of the sub-basins based on geologic maps of the extent of alluvium (e.g., Appendix A, Plates 1 and 2 of DBS&A 2010a) along the Ventura River and associated creeks.
Several calculations present in DBS&A 2010a rely on reported results of the HSPF model. As discussed in the Calibration and Validation Baseline Report (Tetra Tech 2009a), the Ventura River Watershed Hydrology Model is prone to uncertainty stemming from assumptions in the mathematical formulation, data uncertainty, and parameter specifications.	Following any revision to the Ventura River Watershed Hydrology Model that reduce model uncertainty, revise the groundwater budgets presented in DBS&A 2010a to reflect those changes.
Uncertainty with the surface water hydrology model can be reduced via development of a groundwater model for the (Ventura River) sub-basins and coupling of the groundwater and surface water models.	Develop a groundwater flow model of the sub-basins and couple the groundwater and surface water models. Development and application of a calibrated groundwater model could also be used to reduce uncertainty with estimation of the groundwater budget within the sub-basins.
The approach used by DBS&A (2010a) for estimation of infiltration from precipitation relies on the Maxey-Eakin method, which is the most often used empirical method for this purpose in the semiarid regions of the southwest. However, this approach has not been field-validated within the sub-basins and does not account for area-specific factors that influence recharge rates, such as soil type and slope.	Output from the Ventura River Watershed Hydrology Model be should be generated that is specific to areas within the sub-basins and that these data be used to reduce uncertainty associated with infiltration from precipitation. Additionally, data from the model could be used to reduce uncertainty with estimation of surface water recharge to groundwater.
The time period used by DBS&A (2010a) is WYs 1997 to 2007, to be consistent with the Ventura River Watershed Hydrology Model and because this period is generally representative of conditions over the last several decades.	Selection of a different time period would result in a different estimated groundwater budget. For instance, a groundwater budget calculated during a period of relatively low precipitation would result in a more negative groundwater budget. Additionally, the decrease in municipal extractions by the City of Ventura since 2005 would result in a more positive groundwater budget for the Upper Sub-Basin.
Estimates of groundwater inflow from the alluvial aquifer are prone to uncertainty due to a lack of hydrogeologic data regarding the bedrock formations. Perhaps most significantly, nested groundwater wells are not present for accurate calculation of a vertical hydraulic gradient. The geologic structure of the bedrock also has not been accounted for in the groundwater budget developed by DBS&A (2010a) because DBS&A has not identified any specific data regarding the influence of geologic structure on groundwater flow in this area.	Install nested groundwater monitoring wells or piezometers in the area of the sub-basins that are screened in both the alluvium and the bedrock formations. These wells maybe used to estimate vertical hydraulic gradients and estimate additional hydrogeologic data.
Groundwater flow calculations using Darcy's Law are dependent on estimated values of hydraulic connectivity, hydraulic gradient, and aquifer cross-sectional area. Resulting uncertainty in these calculations may be significant, particularly for the Lower Sub-Basin, where groundwater discharge to the ocean is a primary component of the groundwater budget.	Obtain additional local measurements of hydraulic conductivity via aquifer tests or other methods. Additionally, development of a calibrated groundwater model, as discussed above, could help reduce uncertainty with groundwater flow calculations.

Table 6-1 Groundwater Data Gaps and Recommendations

Data Gap	Recommendation
Because extraction data from agricultural wells within the sub-basins are not reported to a public agency and are, therefore, not available, agricultural extraction was estimated based on co-location of active wells and agricultural land uses. Alternative methods were also used based on extraction rates per well in the adjacent Ojai Basin and Casitas water delivery trends.	Obtain agricultural extractions from individual well owners within the sub-basins and invite well owners to participate in a groundwater monitoring program.
Groundwater extraction rates associated with oil production or other uses in the Lower Sub-Basin are not currently reported to a public agency and are, therefore, not available.	Encourage well owner participation to obtain extraction rates from wells associated with oil production in the Lower Sub-Basin.
The net groundwater/surface water balances presented for each of the sub-basins rely on estimates of surface water inputs and outputs for sections of the Ventura River watershed that contain the sub-basins.	Obtain output from the Ventura River Watershed Hydrology Model that is specific to model areas within the sub-basins that contain surface water bodies. With model output data specific to these specific reaches, uncertainty of the surface water/groundwater balance will be reduced. Install additional surface water gages along San Antonio Creek within the area of the sub-basins and upstream (including the boundary between the Ventura River Basin and Ojai Basin) in order to better quantify groundwater/surface water interactions along that reach.
The estimated annual groundwater budget cannot be compared to measured changes in groundwater storage, due to a lack of monitoring wells within the sub-basins. There are currently no Ventura County-monitored water levels within the Lower Sub-Basin for comparison to the budget (District 2009, as cited in DBS&A 2010a).	Identify several wells within the Lower Sub-Basin for inclusion in a groundwater level and groundwater quality monitoring program, including abandoned wells. Perform an assessment of the change in groundwater storage for comparison to the budget, as measured from monitoring of groundwater levels.

Source: DBS&A, 2010a

6.3 Other Data Gaps and Recommendations

The discussion of the conceptual elements of a water budget (summarized in Table 4-5) identified various data gaps, many of which are addressed above for the HSPF model and the groundwater budget. However, three additional gaps have been identified:

- Aggregate pumping data for agriculture is reported for the Ojai Basin, but is not available for the Ventura River sub-basins and the Upper Ojai area. However, data recently collected by OBGMA and the Fox Canyon Groundwater Management Agency for agricultural uses that rely on groundwater can be used to provide estimates of crop use that could be applied to agricultural areas within the watershed.
- In addition to the lack of a groundwater model on the Ventura River, a model for the Ojai Basin has just recently been developed, but no model exists for the Upper Ojai basin. Development of models for groundwater basins (and linking them to the HSPF surface water model) would improve the accuracy of the model and enhance understanding of groundwater use and trends throughout the watershed.
- During compilation of habitat BMPs in Chapter 7 (below), it was noted that limited sources of information are available on habitat within the watershed, most notably for terrestrial habitat. Relevant information on aquatic habitat is available from the Matilija Dam Ecosystem Restoration Feasibility Study. Other sources do provide relevant information on terrestrial habitat, but not at the scale of the watershed, such as the Los Padres National Forest Management Plan.

Chapter 7

Applicable Best Management Practices

7.1 Introduction

Development of a watershed management plan could be informed by the identification of best management practices (BMPs) that can be implemented to improve water supply, water quality, and habitat. This chapter provides summary of BMPs that are applicable to the watershed and may be useful in development of a watershed plan.

7.2 Water Quality

7.2.1 County of Ventura Technical Guidance Manual for Stormwater Quality Measures

Although many sources identify BMPs to enhance surface water quality, a relevant source for the Ventura River Watershed is provided by the Ventura County Technical Guidance Manual for Stormwater Quality Measures (Larry Walker Associates/Geosyntec Consultants 2011) developed to meet the Planning and Land Development requirements contained in Part 4, Section E of the Los Angeles Regional Water Quality Control Board's municipal separate storm sewer system (MS4) permit (Order 09-0057) for new development and redevelopment projects.

The goal of the Planning and Land Development Program is to minimize runoff pollution typically caused by land development and protect the beneficial uses of receiving waters by employing a sensible combination of:

- Site Design Principles and Techniques.
- Source Control Measures.
- Low Impact Development (LID) BMPs.
- Treatment Control Measures.

7.2.1.1 Site Design Principles and Techniques

Site Design Principles and Techniques integrate stormwater management throughout the site and emphasize conservation and use of existing site features to reduce the amount of runoff and pollutant loading generated from a project site. These principles and techniques are organized around five main concepts: 1) protect and restore natural areas; 2) minimize land disturbance; 3) minimize impervious cover; 4) apply LID BMPs at the watershed and site scale; and 5) implement integrated water resource management practices.

Protect and Restore Natural Areas

Each project site possesses unique topographic, hydrologic and vegetative features, some of which are more suitable for development than others. Sensitive areas should be protected and/or restored, including streams and their buffers, floodplains, wetlands, steep slopes, and high permeability soils. Additionally, slopes can be a major source of sediment and should be properly protected and stabilized. Site design criteria include:

1. Identify and cordon off streams and their buffers, floodplains, wetlands, steep slopes.
2. Reserve areas with high permeability soils for either open space or Infiltration BMPs.
3. Incorporate existing trees into site layout.
4. Identify areas that may be restored or revegetated either during construction or later.
5. Identify and avoid or stabilize areas susceptible to erosion and sediment loss.
6. Concentrate or cluster development on least-sensitive portions of a site, while leaving the remaining land in a natural undisturbed state.
7. Slopes must be protected from erosion by safely conveying runoff from the tops of slopes.
   - Slopes must be vegetated with first consideration given to use of native or drought-tolerant species.
   - Slope protection practices must conform to design requirements or standards set forth by local permitting agency erosion and sediment control standards and design standards. The design criteria described in this fact sheet are intended to enhance and be consistent with these local standards.
8. Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
9. Maintain existing topography and existing drainage divides to encourage dispersed flow.
10. Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought-tolerant plants.
11. Promote natural vegetation by using parking lot islands and other landscaped areas. Integrate vegetated BMPs within parking lot islands and landscaped areas.

Design Criteria to Minimize Land Disturbance

Designing the site to preserve existing hydrology and drainage patterns reduces the need for grading and the disturbance of vegetation and soils. Siting buildings and impervious surfaces away from steep slopes, drainage courses, and floodplains also limits the amount of grading, clearing and disturbance and reduces hydrologic impacts. Design criteria include:

1. Delineate and flag the development envelope for the site by identifying the minimum area needed to build; allow access and provide fire protection; protect and buffer sensitive features such as streams, floodplains, steep slopes and wetlands; and concentrate buildings and paved areas on the least permeable soils, with the least intact habitats.
2. Plan clearing and grading to minimize the compaction of infiltrative soils.

3. Restrict equipment access to the development envelope.

4. Restrict storage of construction equipment within the development envelope.

5. Avoid the removal of existing trees and valuable vegetation, as feasible.

6. For areas in which soil disturbance will occur, consider soil amendments to restore permeability and organic content.

Design Criteria to Minimize Impervious Cover

Minimizing impervious area through site design is an important means of minimizing stormwater pollutants, as impervious areas increase the volume and rate of runoff flow and pollutants deposited on impervious areas tend to be easily mobilized and transported by runoff flow. Design criteria include:

1. Use minimum allowable roadway and sidewalk cross sections, driveway lengths and parking stall widths and lengths.

2. Minimize or eliminate the use of curb and gutter so that roadway runoff drains to LID BMPs is encouraged where slope and density permit.

3. Use two-track/ ribbon driveways or shared driveways.

4. Include landscape islands in cul-de-sac streets.

5. Reduce the footprints of building and parking lots.

6. Utilize permeable pavement to accommodate overflow parking (if overflow parking is needed).

7. Cluster buildings and paved areas to maximize pervious area.

8. Maximize tree preservation or tree planting.

9. Avoid compacting or paving over soils with high infiltration rates.

10. Use pervious pavement materials where appropriate, such as modular paving blocks, turf blocks, porous concrete and asphalt, brick, and gravel or cobbles.

11. Use grass-lined channels or surface swales to convey runoff instead of paved gutters.

Design Criteria to Apply LID BMPs at Various Scales

LID is a decentralized approach to stormwater management that works to mimic the natural hydrology of the site by retaining rainfall onsite. In order to realize the full benefits of water quality protection and runoff volume reduction, LID BMPs should be integrated and considered at the regional/watershed scale and the site scale.

Design criteria at the Regional/Watershed scale include:

1. Consider Density, as higher density development consumes less land and produces less impervious cover per capita than low density development.

2. Identify and Preserve Contiguous Open Space and look for opportunities to link open space preservation with regional open space preservation efforts.

3. Make use of Previously Developed Sites, as this reduces the need for greenfield development, and makes use of existing infrastructure.

4. Locate Development within Close Proximity to Mass Transit to reduce the number of automobile trips, and lessen the water quality impacts associated with transportation.

Design criteria at the Site scale include:

1. Maintain and Restore Natural Flowpaths for Runoff to reduce the amount of clearing and grading and maintain the pre-development hydrology's time of concentration.

2. Maximize Use of Existing Impervious Cover to reduce runoff at a watershed scale.

3. Design Public Spaces and Common Areas to Minimize Stormwater Runoff.

4. Compact Project Design to reduce the amount of impervious cover per capita and increase walkability, and decrease water quality impacts associated with transportation.

5. Encourage Use of Multiple Modes of Transportation.

Implement Integrated Water Resource Management Practices

Integrated Water Resource Management (IWRM) is a process which promotes the coordinated development and management of water, land, and related resources. Many of the concepts of IWRM are documented in the County's IRWMP, a product of an intensive stakeholder process, and address multiple water resource management goals. These practices include:

1. Conserve and Augment Water Supplies: Identify and evaluate the opportunities to recharge groundwater and increase water use efficiency. This can be accomplished through infiltration of stormwater runoff and selection of drought-tolerant landscaping.

2. Protect People, Property and the Environment from Adverse Flooding Impacts: Identify opportunities to utilize BMPs that provide both water quality and water quantity benefits. Provide and maintain setbacks from streams and rivers.

3. Protect and Restore Habitat and Ecosystems in Watersheds: Implement the practices identified in Protect and Restore Natural Areas to integrate habitat and stormwater goals. Landscaping selection for stormwater management practices may also further encourage and attract wildlife.

4. Provide Water-Related Recreational, Public Access and Educational Opportunities: Integrate recreation and stormwater management by creating multi-functional BMPs and designing

courtyards and open spaces that accommodate both people and stormwater runoff. Consider providing educational signage for BMPs located in public spaces, where appropriate.

7.2.1.2 Site-Specific Source Control Measures

Source Control Measures are low-technology practices designed to prevent pollutants from contacting stormwater runoff or to prevent discharge of contaminated runoff to the storm drainage system. Control measures are identified for specific types of sites or activities that have been identified as potential significant sources of pollutants in stormwater. These measures include:

S-1: Storm Drain Message and Signage: Signs are typically stenciled or affixed near the storm drain inlet to inform the public that dumping of wastes into storm drain inlets is prohibited and/or the drain discharges to receiving water. Message markers or placards are required at all storm drain inlets within the boundary of a development project.

S-2: Outdoor Material Storage Area Design: stormwater contamination may be prevented by eliminating the possibility of stormwater contact with the material storage areas either through diversion, cover, or capture of the stormwater, or by minimizing the storage area.

S-3: Outdoor Trash Storage Area Design: construct the storage area base with a material impervious to leaks and spills; install a screen or wall around trash storage area to prevent off-site transport of loose trash; use lined bins or dumpsters to reduce leaking of liquid wastes; use water-proof lids on bins/dumpsters or provide a roof to cover enclosure to prevent rainfall from entering containers; berm or grade the waste handling area to prevent run-on of stormwater; and post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

S-4: Outdoor Loading/Unloading Dock Area Design: construct floor surfaces with material that is compatible with materials being handled in the loading/unloading area; cover loading/unloading areas to a distance of at least 3 feet beyond the loading dock or install a seal or door skirt to be used for all material transfers between the trailer and the building; grade or berm storage areas to prevent run-on from surrounding areas; direct runoff from downspouts/roofs away from loading areas; do not locate storm drains in the loading dock area as direct connections to storm drains from depressed loading docks are prohibited; and provide means, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the storm drainage system.

S-5: Outdoor Repair/Maintenance Bay Design: construct the vehicle maintenance/repair floor area with Portland cement concrete; cover or berm areas where vehicle parts with fluids are stored; cover or enclose all vehicle maintenance/repair areas; berm or grade the maintenance/repair area to prevent run-on and runoff of stormwater or runoff of spills; direct runoff from downspouts/roofs away from maintenance/repair areas; grade the maintenance/repair area to drain to a dead-end sump for collection of all wash water, leaks and spills, as direct connection of maintenance/repair area to storm drain system is prohibited; do not locate storm drains in the immediate vicinity of the maintenance/repair area; provide means, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the storm drainage system.

S-6: Outdoor Vehicle/Equipment/Accessory Washing Area Design: construct the vehicle/equipment wash area floors with Portland cement concrete; provide a cover that extends over the entire wash area; berm or grade the maintenance/repair area to prevent run-on and runoff of stormwater or runoff of spills; grade or berm the wash area to contain the wash water within the covered area and direct the wash water to treatment and recycle or pretreatment and proper connection to the sanitary sewer system; obtain approval from the governing agency before discharging to the sanitary sewer; direct runoff from downspouts/roofs away from wash areas; do not locate storm drains in the immediate vicinity of the wash area; provide means, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the storm drainage system.

S-7: Fueling Area Design: fuel dispensing areas must be paved with Portland cement concrete; use asphalt sealant to protect asphalt paved areas surrounding the fueling area; the dispensing area must be covered, and the cover must not drain onto the dispensing area; the dispensing area shall have a 2% to 4% slope to prevent ponding and must be separated from the rest of the site by a grade break that prevents run-on of stormwater to the extent practicable; grade the fueling area to drain toward a dead-end sump; direct runoff from downspouts/roofs away from fueling areas; do not locate storm drains in the immediate vicinity of the fueling area; provide means, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the storm drainage system.

S-8: Proof of Control Measure Maintenance: To ensure that ongoing inspection and maintenance is provided, the local permitting agency will require a Maintenance Agreement from the owner/operator of stormwater control measures and a Maintenance Plan that provides an operation plan and schedule and a site map and describes: the maintenance and cleaning activities and schedule; equipment and resource requirements necessary to operate and maintain facility; and the responsible party for operation and maintenance.

7.2.1.3 Low Impact Development BMPs

LID BMPs, which are distributed, small-scale stormwater BMPs that are designed to mimic natural hydrologic patterns and retain runoff on the project site. These include Infiltration, Rainwater Harvesting, and Evapotranspiration BMPs.

Infiltration BMPs

INF-1: Infiltration Basin: An infiltration basin consists of an earthen basin constructed in naturally pervious soils (Type A or B soils) with a flat bottom and provided with inlet structure to dissipate energy of incoming flow and an emergency spillway to control excess flows. An optional relief underdrain may be provided to drain the basin if standing water conditions occur. A forebay settling basin or separate Treatment Control Measure must be provided as pretreatment. An infiltration basin functions by retaining the SQDV in the basin and allowing the retained runoff to percolate into the underlying native soils over a specified period of time. The bottoms of infiltration basins are typically vegetated with dry-land grasses or irrigated turf grass.

INF-2: Infiltration Trench: Infiltration trenches are long, narrow, gravel-filled trenches, often vegetated, that infiltrate stormwater runoff from small drainage areas. Infiltration trenches may include a shallow depression at the surface, but the majority of runoff is stored in the void space within the gravel and infiltrates through the sides and bottom of the trench.

INF-3: Bioretention: Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based Filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plantings. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. For areas with low permeability native soils or steep slopes, bioretention areas can be designed with an underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration.

INF-4: Drywell: A dry well is a shaft or hole or pit whose depth is greater than its width that is filled with aggregate or a prefabricated storage chamber or pipe segment that is designed specifically for the alleviation of flooding and the disposal of storm water. Drywells are similar to infiltration trenches in their design and function, as they are designed to temporarily store and infiltrate runoff, primarily from rooftops or other impervious areas with low pollutant loading. Dry wells can be used to reduce the increased volume of stormwater runoff caused by roofs of buildings. Dry wells can also be used to indirectly enhance water quality by reducing the amount of stormwater quality design storm runoff volume to be treated by other downstream stormwater management facilities.

INF-5: Permeable Pavement: Permeable pavements contain small voids that allow water to pass through to a stone base. They come in a variety of forms; they may be a modular paving system (concrete pavers, grass-pave, or gravel-pave) or poured in place solutions (porous concrete, permeable asphalt). All permeable pavements with a stone reservoir base treat stormwater and remove sediments and metals to some degree. While conventional pavement result in increased rates and volumes of surface runoff, porous pavements, when properly constructed and maintained, allow some of the stormwater to percolate through the pavement and enter the soil below. For porous pavements to function properly over an expected life span of 15 to 20 years, they must be properly sited and carefully designed and installed, as well as periodically maintained.

INF-6: Proprietary Infiltration: A number of vendors offer proprietary infiltration products that use durable prefabricated structures to enhance rates of stormwater infiltration and provide subsurface storage.

Rainwater Harvesting BMPs

RWH-1: Cistern: While rain barrels are less than 100 gallons, cisterns range from 100 to 10,000 gallons in capacity. Cisterns collect and temporarily store runoff from rooftops for later use as irrigation and/or other non-potable uses.

Evapotranspiration BMPs

ET-1: Green Roof: Green roofs (also known as eco-roofs and vegetated roof covers) are roofing systems that include a soil/vegetative cover over a waterproofing membrane. Green roofs rely on highly porous media and moisture retention layers to store intercepted precipitation and to support vegetation that can reduce the volume of stormwater runoff via evapotranspiration.

7.2.1.4 Treatment Control Measures

Treatment Control Measures are engineered technologies designed to remove pollutants from stormwater runoff prior to discharge from the project site. These measures include Vegetated/Multi-use, Proprietary, and Pre-Treatment BMPs.

Vegetated/Multi-Use BMPs

VEG-1: Bioretention with Underdrain: Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plantings. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Bioretention with an underdrain is a treatment control measures that can be utilized for areas with low permeability native soils or steep slopes. Bioretention may also be designed without an underdrain to serve as a retention BMP in areas of high soil permeability.

VEG-2: Planter Box: Planter boxes are bioretention treatment control measures that are completely contained within an impermeable structure with an underdrain (they do not infiltrate). These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, plantings, and an underdrain within the planter box.

VEG-3: Vegetated Swale: Vegetated swales are open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels, provide the opportunity for stormwater volume reduction through infiltration and evapotranspiration, and reduce the flow velocity in addition to conveying stormwater runoff.

VEG-4: Vegetated Filter Strip: Filter strips are vegetated areas designed to treat sheet flow runoff from adjacent impervious surfaces or intensive landscaped areas such as golf courses. Filter strips decrease runoff velocity, filter out total suspended solids and associated pollutants, and provide some infiltration into underlying soils. While some assimilation of dissolved constituents may occur, filter strips are generally more effective in trapping sediment and particulate-bound metals, nutrients, and pesticides.

VEG-5: Dry Extended Detention Basin: Dry extended detention (ED) basins have been designed to detain the stormwater quality design volume (SQDV), for 36 to 48 hours to allow sediment particles and associated pollutants to settle and be removed. Dry ED basins do not have a permanent pool; they are designed to drain completely between storm events. By modifying the outlet control structure and providing additional detention storage, Dry ED Basins can also enhance flood protection or reduce downstream hydromodification.

VEG-6: Wet Detention Basin: Wet detention basins are constructed, naturalistic ponds with a permanent or seasonal pool of water (also called a “wet pool”). Aquascape facilities, such as artificial lakes, are a special form of wet pool facility that can incorporate innovative design elements to allow them to function as a stormwater treatment facility in addition to an aesthetic water feature. Wetponds require base flows to exceed or match losses through evaporation and/or infiltration and must be designed with the outlet positioned and/or operated in such a way as to maintain a permanent pool.

VEG-7: Constructed Wetland: A constructed treatment wetland is a system consisting of a sediment forebay and one or more permanent micro-pools with aquatic vegetation covering a significant portion of the basin. The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and the associated physical, chemical, and biological processes are a fundamental part of constructed treatment wetlands.

VEG-8: Sand Filter: Sand filters operate much like bioretention facilities; however, instead of filtering stormwater through engineered soils, stormwater is filtered through a constructed sand bed with an underdrain system. As stormwater passes through the sand, pollutants are trapped in the small pore spaces between sand grains or are adsorbed to the sand surface.

Proprietary LID BMPs

PROP-1: Proprietary Biotreatment: Proprietary biotreatment devices are manufactured treatment BMPs that incorporate plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their non-proprietary counterparts. Incoming flows are typically pretreated to remove larger particles/debris, filtered through a planting media (mulch, compost, soil, and plants), collected by an underdrain, and delivered to the stormwater conveyance system.

PROP-2: Cartridge Media Filter: Cartridge media filters are manufactured devices that typically consist of a series of cylindrical vertical filters contained in a catch basin, manhole, or vault that provide treatment through filtration and sedimentation. The basin may be divided into multiple chambers where the first chamber acts as a pre-settling basin for removal of coarse sediment while another chamber acts as the filter bay and houses the filter cartridges.

Pretreatment/Gross Solids Removal BMPs

PT-1: Hydrodynamic Device: Hydrodynamic separation devices (alternatively, swirl concentrators) are devices that remove trash, debris, and coarse sediment from incoming flows using screening, gravity settling, and centrifugal forces generated by forcing the influent into a circular motion. By having the water move in a circular fashion, rather than a straight line, it is possible to obtain significant removal of trash, suspended sediments and attached pollutants with less space as compared to wet vaults and other settling devices. Several types of hydrodynamic separation devices are also designed to remove floating oils and grease using sorbent media.

PT-2: Catch Basin Insert: Catch basin inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media (oil absorbent pouches) to remove floating oils and grease. Catch basin inserts are selected specifically based upon the orientation of the inlet.

7.3 Water Supply

The California Urban Water Conservation Council was created to increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private entities. The Council's goal is to integrate urban water conservation Best Management Practices into the planning and management of California's water resources. A Memorandum of Understanding was signed by nearly 100 urban water agencies and environmental groups in December, 1991. Since then the Council has grown to 389 members. Those signing the MOU pledged to develop and implement fourteen comprehensive conservation Best Management Practices (BMPs), which as of 2009, were reorganized as follows into two broad categories: Foundational BMPs and Programmatic BMPs.

7.3.1 Foundational BMPs

7.3.1.1 Utility Operations Programs

Water utilities throughout California are implementing water conservation programs and providing services to the customers they serve. There are four subcategories that comprise signatory utility operation program responsibilities.

1) Conservation Coordinator (formerly BMP 12)

Designate a person as the agency's responsible conservation coordinator for program management, tracking, planning, and reporting on BMP implementation.

2) Water Waste Prevention (formerly BMP 13)

a) New Development

Enact, enforce, or support legislation, regulations, ordinances, or terms of service that (1) prohibit water waste such as, but not limited to: single-pass cooling systems; conveyer and in-bay vehicle wash and commercial laundry systems which do not reuse water; non-recirculating decorative water fountains and (2) address irrigation, landscape, and industrial, commercial, and other design inefficiencies.

b) Existing Users

Enact, enforce, or support legislation, regulations, ordinances, or terms of service that prohibit water waste such as, but not limited to: landscape and irrigation inefficiencies, commercial or industrial inefficiencies, and other misuses of water.

c) Water Shortage Measures

Enact, enforce, or support legislation, regulations, ordinances, or terms of service that facilitate implementation of water shortage response measures.

3) Wholesale Agency Assistance Programs (formerly BMP 10)

This section addresses assistance relationships between regional wholesale agencies and intermediate wholesale agencies as well as between wholesale agencies and retail agencies.

a) Financial Investments and Building Partnerships

When mutually agreeable and beneficial to a wholesaler and its retail agencies, a wholesaler will provide financial assistance and help build partnerships to accomplish conservation.

b) Technical Support

When requested, wholesale water agencies will provide conservation-related technical support and information to retail agencies they serve, which may include: workshops and support advice addressing conservation program planning, design, implementation, and evaluation.

c) Program Management

When mutually advantageous, wholesale and retail water agencies will join together to plan, design, implement, manage, and evaluate regional conservation programs.

d) Water Shortage Allocations

Wholesale agencies shall pursue water shortage allocation policies or plans which minimize disincentives to long-term water conservation, and encourage and reward investments in long-term conservation shown to advance regional water supply reliability and sufficiency.

e) Non-Signatory Reporting

To the extent possible, wholesale water agencies will provide reports on BMP implementation within their service area by retail water agencies that are not signatories to the MOU.

f) Encourage CUWCC Membership

Wholesale agencies will encourage all of their retail agencies to become MOU signatories, provide information to assist the CUWCC in recruitment targeting, and may assist in paying CUWCC dues for their retail agencies.

7.3.1.2 Educational Programs

Public Information Programs (formerly BMP 7)

Implement a public information program to promote water conservation and water conservation-related benefits. Implementation shall consist of at least the following actions:

1) The program should include, when possible, but is not limited to, providing speakers to employees, community groups and the media; using paid and public service advertising; using bill inserts; providing information on customers' bills showing use for the last billing period compared to the same period the year before; providing public information to promote water conservation measures; and coordinating with other government agencies, industry groups, public interest groups, and the media.

2) The program should include, when possible, social marketing elements which are designed to change attitudes to influence behavior. This includes seeking input from the public to shape the water conservation message; training stakeholders outside the utility staff in water conservation priorities and techniques; and developing partnerships with stakeholders who carry the conservation message to their target markets.

3) When mutually agreeable and beneficial, the wholesale agency or another lead regional agency may operate all or part of the public information program.

School Education Programs (formerly BMP 8)

School education programs have been implemented to reach the youngest water users at an early age and enforce the need to engage in water conservation as a life-long behavior. Implementation shall consist of at least the following actions:

1) Implement a school education program to promote water conservation and water conservation-related benefits.

2) Programs shall include working with school districts and private schools in the water suppliers' service area to provide instructional assistance, educational materials, and classroom presentations that identify urban, agricultural, and environmental issues and conditions in the local watershed. Educational materials shall meet the state education framework requirements and grade-appropriate materials shall be distributed.

3) When mutually agreeable and beneficial, the wholesale agency or another lead regional agency will operate all or part of the education program.

7.3.2 Programmatic BMPs

7.3.2.1 Residential

Residential water users throughout California depend on a reliable and safe supply of water for their homes. This BMP will define the best and most proven water conservation methods and measures those residents, working in conjunction with water agencies, can implement.

1) Residential Assistance Program (formerly BMPs 1 & 2)

Provide site-specific leak detection assistance that may include, but is not limited to, the following: a water conservation survey, water efficiency suggestions, and/or inspection. Provide showerheads and faucet-aerators that meet the current water efficiency standard as stipulated in the WaterSense Specifications (WSS) as needed.

2) Landscape water Survey (formerly BMP 1)

Perform site-specific landscape water surveys that shall include, but are not limited to, the following: check irrigation system and timers for maintenance and repairs needed; estimate or measure landscaped area; develop customer irrigation schedule based on precipitation rate, local climate, irrigation system performance, and landscape conditions; review the scheduling with customer; provide information packet to customer; and provide customer with evaluation results and water savings recommendations.

3) High-Efficiency Clothes Washers (HECWs) (formerly BMP 6)

Provide incentives or institute ordinances requiring the purchase of high-efficiency clothes washing machines (HECWs) that meet an average water factor value of 5.0. If the WaterSense[1]

[1] The U.S. Environmental Protection Agency created the WaterSense program to help consumers make smart water choices that save money and maintain high environmental standards without compromising performance. Products and services that have earned the WaterSense label have been certified to be at least 20 percent more efficient without sacrificing performance.

specification (WSS) is less than 5.0, then the average water factor value will decrease to that amount.

4) WaterSense Specification Toilets (formerly BMP 14)

Provide incentives or ordinances requiring the replacement of existing toilets using 3.5 or more gpf (gallons per flush) with a toilet meeting WSS.

5) WaterSense Specifications for Residential Development

Provide incentives such as, but not limited to, rebates, recognition programs, or reduced connection fees, or ordinances requiring residential construction meeting WSS for single-family and multi-family housing until a local, state or federal regulation is passed requiring water efficient fixtures.

7.3.2.2 Commercial, Industrial, and Institutional

The goal of this BMP is to implement comprehensive yet flexible best management practices, allowing each water agency to tailor the implementation of each practice to fit local needs and opportunities. The goal is to implement measures to achieve the water savings goal for Commercial, Industrial, and Institutional accounts of 10 percent of the baseline water use over a 10-year period.

1) Implement Commercial, Industrial, and Institutional conservation measures that result in well-documented savings, including:

- Hi-Efficiency Toilets.
- Hi-Efficiency Urinals.
- Ultra Low Volume Urinals.
- Zero Consumption Urinals.
- Commercial High- Efficiency Single Load Clothes Washers.
- Cooling Tower Conductivity Controllers.
- Cooling Tower pH Controllers.
- Connectionless Food Steamers.
- Medical Equipment Steam Sterilizers.
- Water-Efficient Ice Machines.
- Pressurized Water Brooms.
- Dry Vacuum Pumps.

2) Implement unique conservation measures to achieve the agency's water savings goals. Sample measures include, but are not limited to: industrial process water use reduction, industrial laundry retrofits, car wash recycling systems, water-efficient commercial dishwashers, and wet cleaning.

7.3.2.3 Landscape

The goal of this BMP is that irrigators, with assistance from (water agency) signatories, will achieve a higher level of water use efficiency consistent with the actual irrigation needs of the plant materials. Reaching this goal would reduce overall demands for water, reduce demands during the peak summer months, and still result in a healthy and vibrant landscape for California.

1) Accounts with Dedicated Irrigation Meters

a) Identify accounts with dedicated irrigation meters and assign evapotranspiration (ETo) based water use budgets equal to no more than an average of 70% of the annual average local ETo per square foot of landscape area. Recreational areas (portions of parks, playgrounds, sports fields, golf courses, or school yards in public and private projects where turf provides a playing surface or serves other high-use recreational purposes) and areas permanently and solely dedicated to edible plants, such as orchards and vegetable gardens, may require water in addition to the water use budget.

b) Provide notices each billing cycle to accounts with water use budgets showing the relationship between the budget and actual consumption.

c) Offer site-specific technical assistance to reduce water use to those accounts that are 20% over the reference ETo budget.

2) Commercial/Industrial/Institutional Accounts without Meters or with Mixed-Use Meters

a) Develop and implement a strategy targeting and marketing large landscape water use surveys to commercial/industrial/institutional (CII) accounts with mixed-use meters.

b) In un-metered service areas, actively market landscape surveys to existing accounts with large landscapes, or accounts with landscapes which have been determined by the purveyor not to be water efficient.

7.4 Habitat

BMPs to improve habitat functions for the Ventura River watershed have yet to be articulated in a concise format or centralized manner. However, BMPs can be inferred from several sources, including (1) land use policies that regulate future development; (2) policies that govern site planning; (3) goals and policies that govern management of the national forest lands within the watershed; and (4) conditions included in recent permits that regulate construction and maintenance activities within or adjacent to the Ventura River.

7.4.1 Land Use Policies

In 1996, the County Board of Supervisors, all City Councils within Ventura County and the Local Agency Formation Commission adopted revised Guidelines for Orderly Development to maintain the consistent theme that urban development should be located within incorporated cities whenever or wherever practical, which may preserve open space, including those lands which contain native habitat.

The Ventura County General Plan includes several relevant goals for Open Space (in Section 3.2.1):

(1) Preserve for the benefit of all the County's residents the continued wise use of the County's renewable and nonrenewable resources by limiting the encroachment into such areas of uses which would unduly and prematurely hamper or preclude the use or appreciation of such resources.

(4) Retain open space lands for outdoor recreational activities, parks, trails and for scenic lands.

(6) Recognize the intrinsic value of open space lands and not regard such lands as "areas waiting for urbanization."

In addition, Section 3.2.2 identifies the following Open Space policies:

(1) Open Space should include areas of land or water which are set aside for the preservation of natural resources, including, but not limited to, areas required for the preservation of plant and animal life, including habitat for fish and wildlife species; areas required for ecologic and other scientific study purposes; rivers, streams, bays, and estuaries; and coastal beaches, lakeshores, banks of rivers and streams, and important watershed lands.

(2) Open Space should also include areas set aside for managed production of resources, including, but not limited to, forest lands, rangeland, agricultural lands not otherwise designated Agricultural; areas required for the recharge of groundwater basins; bays, estuaries, marshes, rivers, and streams which are important for the management of commercial fisheries; and areas containing major mineral deposits, including those in short supply.

A report on Roads and Biodiversity Project: Guidelines for Safe Wildlife Passage (Ventura County Planning Division, 2005) acknowledges that in the review of future development proposals, the Ventura County Initial Study Assessment Guidelines requires consideration whether such development could adversely affect wildlife corridors, which are described as:

“An area as defined by a qualified biologist, which experiences recurrent fish or wildlife movement and which is important to fish or wildlife species seeking to move from one habitat area to another.”

The Assessment Guidelines provide the following threshold criterion, as determined by a qualified biologist, for impacting movement corridors:

“A significant impact to a migration corridor would result if a project would substantially interfere with the use of said area by fish or wildlife. This could occur through elimination of native vegetation, erection of physical barriers or intimidation of fish or wildlife via introduction of noise, light, development or increased human presence.”

The City of Ventura General Plan (City of Ventura, 2005) states that the City “…must pursue an “Infill First” strategy… [to] help avoid sacrificing farmland and sensitive areas in our hillsides and along our rivers.” The Ventura City General Plan also includes several policies and actions that are relevant to habitat in the watershed:

Policy 1B: Increase the area of open space protected from development impacts.

Action 1.8: Buffer barrancas and creeks that retain natural soil slopes from development according to State and Federal guidelines.

Action 1.9: Prohibit placement of material in watercourses other than native plants and required flood control structures, and remove debris periodically.

Action 1.10: Remove concrete channel structures as funding allows, and where doing so will fit the context of the surrounding area and not create unacceptable flood or erosion potential.

Action 1.11: Require that sensitive wetland and coastal areas be preserved as undeveloped open space wherever feasible and that future developments result in no net loss of wetlands or "natural" coastal areas.

Action 1.12: Update the provisions of the Hillside Management Program as necessary to ensure protection of open space lands.

Policy 1C: Improve protection for native plants and animals.

Action 1.17: Require development to mitigate its impacts on wildlife through the development review process.

Action 1.18: Require new development adjacent to rivers, creeks, and barrancas to use native or noninvasive plant species, preferably drought tolerant, for landscaping.

Action 1.19: Require projects near watercourses, shoreline areas, and other sensitive habitat areas to include surveys for State and/or federally listed sensitive species and to provide appropriate buffers and other mitigation necessary to protect habitat for listed species.

Action 1.22: Adopt development code provisions to protect mature trees, as defined by minimum height, canopy, and/or trunk diameter.

Action 1.24: Require new development to maintain all indigenous tree species or provide adequately.

The City of Ojai General Plan (Ojai, 1997) includes a policy to formulate a land use pattern that takes optimum advantage of natural and cultural resources in the Ojai Planning Area. In addition, the Conservation Element of the General Plan identifies the following policies to protect biological resources within the city and it's Area of Interest:

- …to allow no loss of existing resource value for rare, endangered and unique species habitat, except to provide for the maintenance of flood control facilities.
- …to allow no loss of existing resource value for regionally significant Oak Woodland/Savanna.
- …to allow no loss or the existing resource value or regionally significant riparian habitat.

- …to allow in Woodland/Brushland Ecotone areas no loss or existing resource value within "core" oak woodland and sycamore tree areas while minimizing/limiting loss or remaining existing resource value.
- …to minimize loss of resource value of locally significant stands of oak and sycamore trees.
- …to minimize the loss of resource values of locally significant stands of native brush land consistent with the best practiced methods for fire protection.

7.4.2 Site Planning

Section 7.1.1.1 above identifies Site Design Principles and Techniques that have the potential to preserve habitat on sites that are subject to development.

7.4.3 National Forest Lands

The Land Management Plan (Part 2) for the Los Padres National Forest (US Forest Service, 2005) identifies several relevant strategies for national forest lands within the watershed, including the Matilija Wilderness and portions of area identified in the plan as the Highway 33 Corridor. The plan includes several recommendations relevant to habitat, including:

- Focus on reducing risks from wildland fire to maintain water and scenic quality and improve steelhead and arroyo toad habitat.
- Work with Caltrans to designate and approve Road Spoil Disposal Sites along California State Highway 33.
- Work collaboratively with federal and state agencies and water management entities to restore steelhead trout to habitat upstream of Matilija Dam.

In addition, the following practices have been adapted from the Program Strategies and Tactics included in Appendix B of the Land Management Plan:

- Protect and manage wilderness to improve the capability to sustain a desired range of benefits and values, and so that changes in ecosystems are primarily a consequence of natural forces.
- Identify linkages between natural areas that are needed for maintenance of biodiversity and work to secure long-term habitat linkages.
- Prevent the introduction of new invasive and non-native species, conduct early treatment of new populations and contain and control established populations.
- Manage chaparral in selection locations to protect the life and property of human inhabitants, to improve wildlife forage, and to protect watersheds from the adverse impacts of large, destructive, high-intensity fires. In some watersheds, manage for even-aged patch sizes of 5,000 acres or less.
- Restore vegetation through reforestation or other appropriate methods after major fire events, severe drought, or other events or activities that degrade or cause the loss of plant communities.

7.4.4 Construction and Maintenance Activities in Riverine and Riparian Areas

Many agencies (i.e., Casitas, Golden State, Meiners Oaks County Water District, OVSD, the City of Ventura, and Ventura River County Water District) operate water supply and use facilities in, and near, the Ventura River and its tributaries that require maintenance, repair, and replacement due to normal operations and under emergency situations. Some of these activities could directly, or indirectly, affect sensitive species or their habitat in the Ventura River Watershed.

The measures listed in Table 7-1 represent recommended BMPs that shall be used to avoid or minimize adverse impacts on sensitive species and their habitat during temporary maintenance or repair work of water supply and use facilities. These measures are common conditions from Section 404 permits and Section 1602 Agreements recently issued to local agencies for work along the Ventura River and its tributaries.

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
Protection for Wildlife and Aquatic Species	Minimize maintenance/construction activities during the recognized breeding and nesting season for sensitive species in areas subject to disturbance. If work must be done during this period that could affect such species, a qualified wildlife biologist shall survey the proposed work area and the riparian area within a distance of 500 to 1,000 feet upstream and downstream from the work area. Survey methods shall conform to the current agency guidelines for the sensitive species. Survey results, analyses, and recommendations, along with field notes shall be provided to the USFWS and CDFG prior to commencing work or within 2 weeks of completion of the field surveys, whichever is earlier. Surveys will be reported to the California Natural Diversity Data Base.
	To the extent feasible, construction activities within the stream channel shall be limited to the dry period of the year, typically from April 1 to November 1 or when the stream flows are minimal or absent. If instream work must be done during the period April 1 to November 1, a qualified biologist will survey the area to confirm the presence/absence of sensitive species prior to construction/maintenance activities. The sensitive species survey techniques shall be approved by the relevant agency. Survey results, analyses, and recommendations, along with field notes shall be provided to the appropriate agency prior to commencing work or within 2 weeks of completion of the field surveys, whichever is earlier. Surveys will be reported to the California Natural Diversity Database.
	Should any sensitive species be found during pre-project surveys and work must be done in identified areas during sensitive periods, develop and implement a plan for the protection of these species. This Plan shall be approved by the appropriate agency prior to commencing work. The results of any surveys and protective measures instituted, as part of the protection and monitoring plan, shall be provided to the appropriate agency within one week from implementation.
	Work areas shall be fenced to prevent access to sensitive areas within the riparian corridor or channel such as pools, seeps or wet spots that provide habitat for wildlife. Clearly defined and fenced work areas shall be established to reduce incidental take of species of special concern, through injury, damage or death due to straying of construction equipment and personnel.
	Workers shall be trained by a biologist to avoid and minimize activities that might affect wildlife. Worker education and well-defined operational procedures should be implemented, with the cooperation of the biologist, to avoid and minimize the take of species of special concern during creek maintenance activities.
	Prior to repair or maintenance activities, if fish or native aquatic vertebrates are present, a fish and native aquatic vertebrate relocation plan will be implemented by a US Fish and Wildlife Service (USFWS) approved biologist when cofferdams, water bypass structures, and silt barriers are installed to ensure that fish and native aquatic vertebrates are not stranded. If any of the species are present in the work area, a USFWS-approved biologist shall assist with the capture, handling, and monitoring of the sensitive species.

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
Revegetation / Restoration Measures	Where feasible, revegetate the restored bank within the work area (including construction areas, access roads, etc.). Revegetation shall include planting native trees and shrubs local to the area.
	Planting, maintenance, monitoring and reporting activities shall be overseen by a specialist experienced with restoration of native plants.
	All plants shall be planted in randomly spaced, naturally clumped patterns.
	A plant palette and planting plan shall be prepared by a biologist familiar with restoration of native plants. The Plan shall include plantings of both overstory and understory vegetation and shall be consistent with the recommended list of native plants for the area as determined by the California Native Plant Society. The Plan shall also include a description of the proposed numbers, container sizes, and planting location, by species, the proposed monitoring activities (locations, techniques, scheduling, etc.), maintenance operations with particular emphasis on watering methods and schedules; the removal of invasive plant species, area treated, techniques to be used, and schedule and success criteria for controlling invasive plants; and any/all other references to revegetation and restoration activities specified by the permitting agencies.
	All planting should be done, after the first wetting rains between October 1 and February 1 to take advantage of the winter rainy season, dormancy of foliage, and rooting period to ensure optimum survival of plantings.
	A coarse mulch should be placed around plantings to minimize water loss and discourage weed growth. Mulch should be 3 to 4 inches deep and should be placed in a minimum area 1.5 times the diameter of the dripline of the plant or 2 feet in diameter, whichever is greater. The mulched area should be maintained throughout the course of restoration, unless otherwise authorized by the permitting agency. Mulch should not be placed directly against the mainstem of the plants.
	Plant material for revegetation shall be derived from cuttings, materials salvaged from disturbed areas, and/or seeds obtained from randomly selected native trees and shrubs occurring locally within the same drainage.
	Any replacement tree/shrub stock, which cannot be grown from cuttings or seeds, shall be obtained from a native plant nursery, and shall not be inoculated to prevent heart rot. The Operator shall provide a list of all materials which must be obtained from other than onsite sources.
	Restoration shall include the recontouring of the streambed to its original grade for areas of temporary impacts, including access roads.
Removal of Non-Native Vegetation	Remove any non-native vegetation (tree tobacco, castor bean, giant cane, etc.) from work areas and dispose of it in a manner and a location which prevents its reestablishment. Removal shall be done at least twice annually during the spring/summer season, as needed, through the turn of restoration.
	Giant cane, if present, shall be cut to a height of 6 inches or less, and the stumps painted with an herbicide approved for aquatic use within 5 minutes of cutting. Herbicides shall be applied at least three (3) times during the period from May 1 to October 1 to eradicate these plants. Where proposed methods for removing giant cane deviate from this procedure, present the alternate method, in writing, to the appropriate permitting agency for review and approval, prior to the onset of work.
	Whenever possible, invasive species shall be removed by hand or by hand-operated power tools rather than by chemical means. Where control of non-native vegetation is required within the bed, bank, or channel of the stream and the use of herbicides is necessary, there is a possibility that the herbicides could come into contact with the water, in which case only those herbicides approved for aquatic use (i.e., AquaMaster) shall be utilized. If surfactants are required, they shall be restricted to non-ionic chemicals (i.e., Agri-Dex), which are approved for aquatic use. Apply herbicides in accordance with state and federal law. No herbicides shall be used where threatened or endangered species occur. No herbicides shall be used when wind velocities are above 5 miles per hour.

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
Pollution, Sedimentation, Diversion/Dewatering, and Litter	When necessary, applicants shall prepare and implement a program to control water pollution effectively during construction/maintenance activities (i.e., Storm Water Pollution Prevention Plan). To further minimize storm water pollution, specific BMPs targeted at preventing potentially hazardous materials from entering receiving waters shall be employed during work activities (i.e., dewatering operations, material delivery and storage practices, material use, spill prevention practices, solid waste management, vehicle and equipment cleaning and fueling, fuel storage, vehicle and equipment maintenance, etc.).
	No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete or washings thereof, oil or petroleum products or other organic or earthen material from any maintenance, construction, or associated activity of whatever nature shall be allowed to enter into or placed where it may be washed by rainfall or runoff into, waters of the State. When work is completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high water mark of any stream.
	Comply with all litter and pollution laws. All contractors, subcontractors and employees shall also obey these laws and it shall be the responsibility of the operator to ensure compliance.
	Any equipment or vehicles driven and/or operated within or adjacent to the channels or basins shall be checked and maintained daily, to prevent leaks of materials that if introduced to water could be deleterious to aquatic life.
	Stationary equipment such as motors, pumps, generators, and welders, located within or adjacent to the stream shall be positioned over drip pans.
	No equipment maintenance shall be done within or near any stream channel where petroleum products or other pollutants from the equipment may enter these areas under any flow.
	Field personnel shall be appropriately trained in hazardous material control, and clean up of accidental spills. The cleanup of spills shall begin immediately.
	Raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from activities, shall be prevented from contaminating the soil and/or entering the waters of the state. Any of these materials, placed within or where they may enter a stream, by the Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.
	Precautions to minimize turbidity/siltation shall be taken into account during implementation of the activities within the riverine and riparian zones. Incorporate erosion controls into the planning, construction, and follow up process for all maintenance activities. Erosion control and sediment-detention devices shall be installed prior to construction and all phases of routine maintenance projects to control sediment and minimize water quality impacts. Select applicable BMPs for which materials are available and plan to have the necessary materials on hand for implementation before starting work. This may require that the work site be isolated and that water be diverted around the work area by means of a barrier, temporary culvert, new channel, or other means approved by the permitting agencies. Precautions may also include placement of silt fencing, hay or straw bales, sandbags, and/or the construction of silt catchment basins, so that silt or other deleterious materials are not allowed to pass to downstream reaches.
	The performance of erosion control BMPs should be monitored daily during maintenance/construction activities. Added attention should be given to the monitoring of BMPs after storm events, and BMPs should be maintained, upgraded, or augmented with additional BMPs as needed.
	Flow diversions shall be done in a manner that will prevent pollution and/or siltation and provide flows to downstream reaches. Flows to downstream reaches shall be provided during all times that the natural flow would have supported aquatic life. Said flows shall be of sufficient quality and quantity, and of appropriate temperature to support fish and other aquatic life both above and below the diversion. Normal flows shall be restored to the affected stream immediately upon completion of the work at that location. A relocation plan shall be implemented to ensure that fish and native aquatic vertebrates are not stranded.

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
	The Operator shall coordinate project site dewatering, if needed, with a fisheries biologist qualified to perform relocation activities. Also, a qualified fisheries biologist shall be present during implementation of diversion structures.
	Pump intakes placed in stream water shall be fitted with (1/8) inch or smaller mesh screens for January 1 through March 30, and (1/4) inch or smaller mesh screens thereafter to prevent the entrainment of fish or amphibians that failed to be removed. The intake should be checked periodically for impingement of fish and amphibians. Properly sized bypass pipes or gravity-fed pipe systems, if used, shall be installed to prevent increases in water temperature and decreases in dissolved oxygen.
	Wastewater shall be discharged from the work area to an upland location where it will not drain sediment-laden water back to the stream channel.
	When activities require the moving of equipment across a flowing stream, such activities shall be conducted without increasing stream turbidity. For repeated crossings, the operator shall install a temporary bridge, culvert, or rock-fill crossing pursuant to the design standards located in the California Department of Fish and Game's "Culvert Criteria for Fish Passage" (April 2003) and in conjunction with the NOAA Fisheries Southwest Region's "Guidelines for Salmonid Passage at Stream Crossings" (September 2001).
	If a stream's low flow channel, bed or banks have been temporarily altered, these shall be returned as nearly as possible to their original configuration and width, without creating future erosion problems.
Temporary Work Areas and Temporary Vegetation Removal	Limit the disturbance or removal of vegetation. The disturbed portions of any stream channel within the ordinary high water mark (OHWM) of the stream shall be restored to their original condition.
	Restoration shall include the revegetation of stripped or exposed work and/or mitigation areas with vegetation native to the area.
	The work areas for construction shall be flagged to identify their limits within the streambanks. Work areas shall not exceed 100 feet upstream or 100 feet downstream of the centerline of the project area. Vegetation shall not be removed or intentionally damaged beyond these limits. Construction areas, access ramps, and roads shall be flagged and restored as specified above
	In areas of temporary disturbance, where vegetation must be removed, native trees and shrubs, with diameter breast heights (dbhs) of 2 inches or less, shall be cut to ground level with hand operated power tools rather than by grading. No replanting will be required for vegetation of this size and type if it is cleared in this manner. There should be no cutting or removal of native trees 4 inches or greater (diameter at breast height – dbh), except willows, for which there should be no cutting or removal of trees 6 inches or greater dbh.
	If any oaks (*Quercus* spp.) and sycamores (*Platanus* spp.) must be removed they shall be replaced in kind. The replacement ratios (using rooted plants in liners or direct planting of acorns) for plants which are to be removed shall be as follows: plants less than 5 inches dbh shall be replaced at 3:1; plants from 5 to 12 inches shall be replaced at 5:1; trees from 12 to 24 inches shall be replaced at 10:1; trees from 24 to 36 inches shall be replaced at 15:1; all oaks greater than 36 inches shall be replanted at a ratio of 20:1. The replacement ratio for damaged trees shall be 2:1 for plants with dbh less than 12 inches. The replacement ratio for damaged trees shall be 5:1 for plants with dbh greater than 12 inches.

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
Equipment and Access	Staging/storage areas for equipment and materials shall be located outside of the stream and away from storm drain inlets.
	Vehicles should be clean and free of any weed seeds prior to arriving at the work site to prevent the introduction or spread of noxious weeds. No fueling, repair, or vehicle washing shall be performed in the stream channel or in areas at the top of the channel bank that may flow back into the stream channel. No washing of vehicles should occur at the work site. No fueling or equipment servicing should be done within 50 feet of the edge of the riparian zone. For stationary equipment (i.e., pumps and generators) that must be fueled onsite, containment shall be provided in such a manner that any accidental spill of fuel shall not be able to enter the watercourse or contaminate sediments that may come in contact with the water.
	Where technically feasible, vehicles and heavy equipment shall not be driven or equipment operated in water covered portions of the stream channel, or where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed, except as necessary to complete the authorized work. When technically feasible, restrict construction activities to scoured areas or to areas dominated by non-native vegetation to avoid damaging native trees and shrubs.
	Where technically feasible, the use of heavy equipment shall be avoided in a channel bottom with rocky or cobbled substrate. Instead, manual labor should be used whenever practical. If manual labor in rocky substrate is not feasible, a rubber tire loader/backhoe is the preferred vehicle by the Services and the amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized
	Access to the work site shall be via existing roads and access ramps, unless otherwise specified or approved by the Services. If no ramps are available in the immediate area, a ramp should be constructed in the footprint of the project. Any temporary ramp shall be removed upon completion of the project. Where feasible, ramps should be graded within the elevated bank area, down to but not in the channel bottom.
	Vehicles may be driven on the streambed to traverse the distance to the work site from the access point, and in the immediate vicinity of the work area, and only as necessary to accomplish the authorized work.
	When temporary access is removed, remaining disturbed soil shall be stabilized and seeded with appropriate native seed mix immediately after work completion. If a stream's low flow channel, bed or banks have been altered during operations, channel topography and geometry shall be restored to pre-project conditions to the extent possible, without creating future erosion problems.
Fill and Spoil	Fill shall be limited to the minimal amount necessary to accomplish the activities. Fill construction materials, other than on-site alluvium, shall consist of clean silt-free gravel or river rock.
	Rock riprap may be used to repair eroded slopes that previously contained riprap, allowing for in-kind replacement or repair of existing facilities. Material for backfilling an eroded slope area may be obtained from onsite alluvium.
	Where feasible, to facilitate recovery of vegetation and provide additional protection from erosion on ungrouted riprap banks, the Operator shall place branches from willow trees into the open toe-trench and within the wick zone of the shaped sideslope, prior to placing the filter rock and unconcreted armor rock.
	Spoil storage sites shall not be located within a stream, where spoil can be washed back into a stream, or where it will cover aquatic or riparian vegetation. Upslope erosion control BMPs (i.e., blankets/geotextile fabrics, coir fabric/netting, mulching, planting, silt mat, etc.) shall be used to protect and stabilize stockpiles and exposed soils to prevent movement of materials. Avoid placing temporary spoil stockpiles at the top of unstable slopes or at the edges of slopes. Remove temporary stockpiles to permanent disposal locations before the rainy season or, if work is conducted during the rainy season, as soon as feasible and before the next rain storm.

7.4.5 Measures Recommended by the Draft Southern California Steelhead Recovery Plan

In July 2009 the National Marine Fisheries Service (NMFS) released the draft Recovery Plan for the endangered Southern Steelhead (NMFS 2009). Recommendations for the recovery of this Distinct Population Segment for the Ventura River watershed include a number of best management practices and actions that in the view of the NMFS would lead to the recovery of the species in Southern California. Inclusion of these recovery actions can help assure that projects defined within the watershed management plan are consistent with the requirements for the federal endangered species act. Recovery actions (from Table 8-6 in NMFS 2009) include:

- Conduct hydrological analysis(groundwater).
- Develop and implement a groundwater monitoring program.
- Develop and implement a water management plan.
- Develop and implement a restoration and management plan for the Ventura River Estuary.

Review development and management plans for all recreational areas (e.g., Emma Wood State Beach, City of Ventura Seaside Wilderness Park, E.P. Foster Memorial Park, Matilija Reservoir, Camp Comfort) to provide for the restoration and protection of the Ventura River Watershed, estuary, Coyote Creek, Matilija Creek, San Antonio Creek and riparian/floodplain area. Develop and implement an integrated wildland fire and hazardous fuels management plan, including monitoring, remediation and adaptive management, to reduce potentially catastrophic wildland fire effects to steelhead and their habitat and preserve natural ecosystem processes (including sediment deposition)

- Develop, adopt, and implement land-use planning policies and standards.
- Relocate agricultural development.
- Relocate livestock grazing and water sources.
- Develop and implement a plan to minimize disturbance of instream habitats and riparian vegetation.
- Develop and implement a flood control maintenance program.
- Develop and implement a plan to restore natural channel features where feasible.
- Develop and implement a plan to vegetate levees and minimize herbicide use near levees.
- Develop and implement a non-native species monitoring program.
- Develop and implement a plan to assess the impacts of non-native species and develop control measures.
- Develop and implement a public educational program on non-native species impacts.
- Review and modify applicable County and/or City Local Coastal Plans.
- Develop and implement a public educational program.
- Review U.S. Forest Service Los Padres National Forest Land Management Plan (Southern California National Forest Vision, Forest Strategy, and Design Criteria).

- Relocate roadways outside of riparian corridor and restore abandoned roadways.
- Retrofit storm drains to filter runoff from roadways and developed areas.
- Develop, adopt, and implement urban land-use planning policies and standards.
- Review California Regional Water Quality Control Board Central Coast Region Watershed Plans and modify applicable stormwater permits.
- Review, assess and modify if necessary all National Pollutant Discharge Elimination System (NPDES) wastewater discharge permits (e.g., OVSD Wastewater Treatment Facility).
- Develop and implement a watershed-wide sediment management plan.
- Develop and implement a plan to minimize runoff from agricultural activities.
- Develop, adopt, and implement recreational land-use planning policies.
- Physically modify or remove passage barriers in the Ventura River, Matilija and San Antonio Creek sub-watersheds to allow unimpeded volitional migration of steelhead to upstream spawning and rearing habitats.
- Physically remove Matilija Dam to allow unimpeded volitional migration of steelhead to upstream spawning and rearing habitats.
- Review, assess and modify, if necessary, residential wastewater septic treatment facilities.
- Review and modify aggregate mining operations.
- Develop and implement a plan to remove and maintain quarry and landslide debris from the channel.

Chapter 8

Future Actions to Improve Water Sustainability and Ecosystem Functions

8.1 Recommended Actions

Based on the information contained in the previous chapters, the following actions are recommended to improve the sustainability of water resources, improve ecosystem functions, and facilitate development of the watershed plan.

8.1.1 Watershed Management Plan

Based on lessons learned from review of other applicable plans, the recommendations (in Chapter 5) are summarized as follows:

- Identify the intended audience and provide appropriate content.
- Engage watershed stakeholders.
- Clearly define and state the plan's goals and objectives.
- Focus the scope of the plan.
- Focus on issues where stakeholders can make a meaningful difference.
- Work with regulatory programs.
- Prioritize projects that can meet the plan's objectives.
- Identify mechanisms and a process to gauge progress towards plan implementation.

8.1.2 Stakeholder Involvement

The creation of the Ventura River Watershed Council provided a forum for discussion of issues at the watershed scale. In addition, the implementation of the "Watershed U" expanded awareness of watershed issues and generated substantial interest in how individual actions could improve watershed conditions. To enhance and extend stakeholder involvement:

- Continue meetings of the Watershed Council and consider extending invitations to relevant organizations or entities that have not participated regularly.
- Improve and regularly update the Watershed Council's webpage, to provide a consistent source of meeting notices, agendas, and other relevant information and consider providing links to relevant information for other organizations and groups involved in watershed restoration.

- Build upon stakeholder interest by publicizing meetings and workshops that provide useful information for residents and land-owners, such as: water conservation, stormwater management, or watershed-friendly gardening.

8.1.3 Watershed Coordinator

Without a specific individual or entity responsible to assure an ongoing dialog, making progress towards resolution of issues in the watershed will be difficult. Although it has been suggested that the current Watershed Coordinator will work to secure future grants that would continue to fund the position indefinitely, this concept is not assured. It does not appear likely that alternative funding sources will be available for all of the coordinator's current responsibilities. Instead, it is more likely that funding might be available for more focused studies, which might limit the ability of the coordinator to work on a broad spectrum of issues. To assure long-term funding of the position:

- The Ventura River Watershed Council and the District should work together to identify a mechanism(s) to assure continued funding of a watershed coordinator.

8.1.4 Data Gaps

Various water resource data gaps have been identified, which limit the potential for assessment of long-term trends in groundwater level or development of a water budget. However, the scope, cost and priority of addressing these data gaps have not been identified, which limits their potential for implementation. To develop a conceptual plan to address water resources data gaps:

- The District should convene a technical advisory group to assess and prioritize data gaps that limit development of a comprehensive water budget, with input from the Ventura River Watershed Council.

8.1.5 Ventura River Groundwater Management Plan

The groundwater budget report developed by DSB&A outlined an approach for the development of a groundwater management plan for the Ventura River basins, and suggested that the Ventura River Watershed Council could serve as the sponsoring entity for that effort. However, it is not clear that the Watershed Council has the resources or technical expertise to develop and implement such a plan.

- The Ventura River Watershed Council should conduct a facilitated discussion about the opportunities and constraints for development of a groundwater management plan and forward their recommendations to the Watershed Protection District and all public and private water purveyors that utilize groundwater.

8.1.6 Water Budget

A watershed-wide water budget could be used to determine whether the water resources in the Ventura River watershed are sufficient to meet total water demand. To promote development of a watershed water budget:

- The technical advisory group convened by the Watershed Protection District should develop an outline of the scope of work for a water budget and identify options to fund development of the water budget, including improved estimates of water demand, with input from the Ventura River Watershed Council.

8.1.7 Matilija Dam

Removal of the Matilija Dam has been the subject of study and discussion for many years, but progress has been slow, in part due to insufficient federal funding. Following completion of the Feasibility Study by US Army Corps of Engineers, issues arose concerning the Corps' preferred solution, which would move sediment via a slurry pipeline to several downstream sites. The Matilija Dam Project Fine Sediment Study Group (Study Group) was subsequently convened to reach consensus on how to move the project forward, which identified several options (such as re-routing water around the dam) that could require a non-federal fund source (e.g., for additional notching of the dam). To keep the proposal moving forward:

- The entities involved in the Study Group should convene a technical advisory group to develop a scope of work for technical studies that would determine the feasibility and cost of implementing the alternative options recommended in the Study Group's Final Report.

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Chapter 9
Flood Management Issues in the Watershed

A number of characteristics of the Ventura River watershed associated with flood management are described in Chapter 2 of this report, including precipitation (Section 2.1.2); topography (Section 2.3); fires (Section 2.5); surface water flows and flooding, including the roles of Matilija and Casitas reservoirs and the Robles Fish Passage Facility (Section 2.6.2); water management facilities, including debris and detention basins (Section 2.9.1); and flood protection levees (Section 2.9.3). This section provides an expanded discussion of flood management issues, including the following:

- Nature of flood hazards.
- History and consequences of flooding in the watershed.
- Areas at risk of flooding.
- Identified deficiencies in flood management structures.
- Proposed flood management improvements.
- Revenue sources to implement flood management projects and programs.
- Flood protection and floodplain management measures and policies that are relevant to the watershed.

9.1 The Nature of Flood Hazards

The Ventura River watershed is vulnerable to hazards associated with flooding. Prevailing storm patterns, along with steep topography (ranging from sea level to approximately 6,000 feet in the upper portions of the watershed) and the east-west orientation of the mountains, frequently create the potential for significant precipitation. This can result in flooding along stream channels and on alluvial fans, leading to inundation of flood-prone areas.

Since 1992, there have been five flood events that resulted in significant damage and a subsequent Presidential disaster declaration for Ventura County. In addition, damage that is not substantial enough to qualify for a disaster declaration, but may cost county residents, businesses, and taxpayers millions of dollars, occurs with a long-term probability of every 5 years. The risks posed by these hazards will increase as the county's population continues to grow (URS 2005).

Nationwide, floods result in more deaths than any other natural hazard. Physical damage from floods includes the following (URS 2005):

- Inundation of structures by water and sediment, causing damage to structural elements and contents.
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features.

- Impact damage to structures, roads, bridges, culverts, and other features from high-velocity flow and from debris carried by floodwaters and road closures. Debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater effects.
- Destruction of crops, erosion of topsoil, and deposition of debris and sediment on croplands.
- Release of sewage and hazardous or toxic materials as wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.
- Damage to cultural or historic artifacts, such as the aqueduct from the Mission period.
- Damage to Native American sites that are often found along streams and creeks.
- Damage to wildlife and fish habitat, destruction of nesting or breeding grounds, and injury to or death of wildlife.

Floods also cause economic losses through closure of businesses and government facilities, disrupt communications, disrupt the provision of utilities such as water and sewer, result in excessive expenditures for emergency response, and generally disrupt the normal function of a community (URS 2005).

Ventura County typically receives most of its rain between November and March. The average annual precipitation ranges from 15.1 inches at the coast to 28.8 inches in the mountains northwest of Ojai. Floods typically occur during the season of highest precipitation, particularly during heavy rainfalls when the ground is saturated, or in the first few years following a fire. Prevailing weather patterns during the winter and the topography and orientation of the mountain ranges in the northern half of the county combine to produce extremely high-intensity rainfall. Based on information available through WY 2005, the peak historic rainfall intensity recorded by a Ventura County rain gage occurred on February 12, 1992, when a rate of approximately 4.04 inches per hour was observed during a 15-minute period at the Wheeler Gorge gage approximately 3 miles northeast of Matilija Dam (URS 2005).

Such rainfall intensities can produce flooding, particularly in small watersheds with steep slopes, saturated soils, and sparse vegetation, where runoff collects quickly and creates the potential for local flash floods. *The National Weather Service defines a flash flood as one in which the peak flow travels the length of a watershed within a 6-hour period*. These floods arise when storms produce a high volume of rainfall in a short period of time. They often strike with little warning and are typically accompanied by high-velocity flows (URS 2005).

9.1.1 Flood History and Consequences

Damaging floods in Ventura County were reported as early as 1862 and on average, floods causing substantial damage have a long-term probability of occurring every 5 years. A 1945 report by the District reported that floods of sufficient magnitude to cause extensive damage occurred in 1862, 1867, 1884, 1911, 1914, 1938, 1941, 1943, and 1944 (Warren 1945, as cited in URS 2005). Major floods on the Ventura River and peak discharges are listed in Table 2.6-4.

The 1938 flood caused an estimated $1.3 million in damage to homes, businesses, agricultural land, transportation facilities, and utilities in the Ventura River area. In the City of Ventura, residents were evacuated from their homes as floodwaters flowed through the west end of the city. Live Oak Acres also was heavily damaged, along with the Foster Park diversion works and oil field equipment north of the City of Ventura (FEMA 2010).

The 1943 flood threatened the west end of the City of Ventura. The flows did not, however, overtop the channel banks, and evacuation was not required. People were evacuated from their homes in Live Oak Acres, and rail and highway traffic were disrupted when landslides and washouts blocked transportation arteries (FEMA 2010).

Flood damage was estimated in excess of $16 million in the Ventura River watershed during the January and February 1969 floods. Major watercourses throughout the watershed were severely eroded or aggraded, depending on streambed slopes. Debris and boulders carried by flood flows from the mountains surrounding the Ojai Valley resulted in reduced channel capacities and bank overflow through orchards and residential areas (FEMA 2010).

The 1978 flood (the largest recorded on the Ventura River) caused extensive damage to roads, bridges, sewer systems, agricultural property, and flood control facilities in the upper Ventura River watershed. Traffic was disrupted by extensive road damage that occurred throughout the watershed. Some flood channels filled with debris and changed their course. Substantial damage to residential property occurred in Casitas Springs, Live Oak Acres, and Hawthorne Acres (FEMA 2010).

9.1.2 Areas at Risk of Flooding in the Ventura River Watershed

9.1.2.1 Adjacent to the Ventura River

Although the District and Corps have implemented various structural improvements along the Ventura River and several tributary streams, the potential for flood hazards still exists along the Ventura River and at other locations in the watershed. Reclamation's 2007 study, *Hydrology, Hydraulics and Sediment Studies of Alternatives for the Matilija Dam Ecosystem Restoration Project*, provided a summary of the areas at risk for hazards associated with flooding along the Ventura River, identified by reach and river mile (RM). These are briefly described below.

Reach 6b – RM 16.5-15.0

Reach 6b begins immediately downstream of Matilija Dam and extends downstream to the canyon mouth. This reach contains little development except the "Matilija Hot Springs" facility. While events do not inundate the swimming pool itself, flows above the 50-year event inundate the lower grounds (Reclamation 2007).

Reach 6a – RM 15-14.15

Reach 6a begins at the canyon mouth and extends downstream to Robles Diversion Dam. There are at least two houses situated along the south bank of the river on the floodplain surface–one upstream and one downstream of the Camino Cielo Bridge. There are nine structures that appear to be primarily vacation cabins, located upstream of the Camino Cielo Bridge on the north bank of the channel. They are located at a variety of elevations; at least five of these are less than 1 foot above the floodplain surface, and many are located within 50 feet of the channel bank. These structures have a considerable risk of inundation. All but the structures on the high terrace are within the 100-year floodplain (Reclamation 2007).

In the Meiners Oaks area, approximately 20 structures are located along Oso Road and North Rice Road between RM 14.4 and 14.15 within Reach 6a. All of the structures are constructed at grade, with no significant first floor elevation above the ground (Reclamation 2007). According to the latest Digital Flood Insurance Rate Map (1-20-2010 DFIRM), this area is in the AE Hazard Zone. (An AE Hazard Zone is an area subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply).

The Robles Diversion Dam is located at the end of Reach 6a. The diversion crosses the Ventura River channel and is located within the 100-year floodplain (Reclamation 2007).

Reach 5 – RM 14.15 – 11.27

Reach 5 starts from downstream of Robles Diversion Dam and continues to the Baldwin Road Bridge. There is no functional levee in this reach. South of Meyer Road, a stable, residence, and appurtenant structures are located at grade with no significant first floor elevation above the 100-year floodplain (Reclamation 2007).

Reach 4 – RM 11.27 – 7.93

Reach 4 starts from downstream of Baldwin Road Bridge and continues to the confluence with San Antonio Creek. The Live Oak Acres Levee begins at RM 9.39 on the right bank upstream of the Santa Ana Boulevard Bridge and extends along the populated area of Live Oak Acres to approximately RM 10.23. The levee itself is joined to the fill of Burnham Road at the upstream end by the Riverside Dike, reducing the potential for the levee to be overtopped from the upstream end. Hydraulic modeling indicates this levee would contain a 100-year flood; however, the Santa Ana Boulevard Bridge creates a flow constriction that could result in backwater upstream of the bridge, thereby increasing the potential for the levee to be overtopped (Reclamation 2007).

Reach 3 – RM 7.93-5.95

At least 50 mobile homes in Casitas Springs are located close to the channel at RM 7.85, where there is no protective levee. The channel at this location is less than 10 feet deep, and extensive vegetation is present. The Casitas Springs Levee starts on the left bank at approximately RM 6.84 and extends upstream to approximately RM 7.77. Numerous structures are located on Ranch Road, Edison Drive, and Sycamore Drive at Casitas Springs, but the levee does not provide sufficient protection from a 100-year flood. At least three residences are located on the east bank of the river downstream of Casitas Vista Bridge (~ RM 6.8). Foster Park is located within the 100-year floodplain and is at risk of flooding (Reclamation 2007).

Reach 2 – RM 5.95-0.6

Along this reach of the river, numerous residences, businesses, a school, the Ojai Valley Wastewater Treatment Plant, and the City of Ventura Water Filtration Plant are located on the west side of the channel. These structures are all located in or near the 100-year floodplain. The Ventura Levee extends from the Pacific Ocean at RM 0.05 to RM 2.37. Hydraulic modeling indicates that flood flows up to a 500-year flood would be confined to the main channel on the west side by the Ventura Levee (Reclamation 2007).

9.1.2.2 San Antonio Creek Watershed

The NRCS conducted a study (NRCS 2010) of the San Antonio Creek watershed to evaluate flood hazards in rural areas that are not mapped by FEMA. The upper reaches of the San Antonio Creek watershed include canyons with steep terrain that can produce large volumes of debris and sediment, which is then discharged into the Ojai Valley, including alluvial fans located at the base of canyons. The NRCS found that frequent flooding resulted in erosion and deposition in the San Antonio Creek watershed, negatively affecting agriculture, residences, wildlands adjacent to riparian areas, infrastructure (including residences temporarily isolated by washed-out stream crossings), and critical habitat for steelhead.

Numerous orchards adjacent to the stream have non-engineered levees and in some areas, ditches, used to direct overland flood flows around and away from orchards and structures. However, even with these measures, damages from flooding often adversely affects citrus groves, roadways, and structures located on alluvial fans and floodplains. Floods in alluvial fans are highly unpredictable because they tend to break through existing channels and form new channels in loose fan sediments, delivering flood flows to unexpected locations. These conditions are exacerbated by channel obstructions in some areas (NRCS 2010).

On the floodplains and lower alluvial fans of the San Antonio Creek watershed, stream channels are well-defined, but tend to meander. Streambanks in these areas are formed from coarse cobble material, gravels, and sands received from upstream land areas, which are easily eroded. When debris and sediment are deposited in the stream channel during high flows, subsequent flows can be directed into the stream banks, causing erosion (NRCS 2010).

The channel of San Antonio Creek downstream of the City of Ojai is relatively confined, with limited floodplain development and sediment storage. Woody riparian vegetation along the lower portion of the creek is well established and helps promote a stable stream profile, although the storms of January 2005 caused widespread flooding and bank erosion along this reach (NRCS 2010).

9.1.2.3 Cañada de San Joaquin

Cañada de San Joaquin is a tributary to the Ventura River and flows in an east-west direction, draining a 1.5-square-mile drainage area north of the City of Ventura. Because the existing drainage facilities upstream of Highway 33 provide between a 4-year to 40-year level of flood protection, the adjacent areas experience flooding in larger storm events. The District has developed a pre-design project to address the deficiencies through the construction of new facilities that can accommodate projected flows from a 100-year event if the benefit/cost ratio warrants it (Kasraie Consulting 2012). This pre-design project will be completed by June 2012.

9.2 Identified Deficiencies in Flood Control Structures

Structural flood protection measures in Ventura County include dams, levees, debris and detention basins, groin fields, rock revetments, and the channelization of some watercourses. These measures are intended to provide partial or complete protection from the 100-year flood event, which is defined as having a 1 percent chance of annual recurrence (FEMA 2010). Flood protection structures on the Ventura River are described in Chapter 3 and include debris and detention basins and dams (Section 2.91), and three levees (Section 2.9.3): Ventura Levee (VR-1), Casitas Springs Levee (VR-2), and Live Oak Acres Levee (VR-3).

9.2.1 Levee Certification

FEMA is undertaking a nationwide effort to have levee owners certify existing flood control levees. As part of this effort, the District is evaluating the VR-1 and VR-3 levees and preparing documents for the certification process based on FEMA's regulatory requirements as identified in Title 44 of the Code of Federal Regulations (CFR), Section 65.10 (44 CFR 65.10). FEMA did not request that the VR-2 levee be included in this process because a Letter of Map Revision (LOMR) based on a District project was underway at the time the Ventura River levees underwent the initial screening process. A FEMA LOMR modifies the effective Flood Insurance Rate Map for the community.

Certification criteria are as follows:

- Design criteria (freeboard, closures, embankment protection, embankment and foundation stability, settlement, and interior drainage).
- Operations plans and criteria (for closures and interior drainage).
- Maintenance plans and criteria.
- Actual certification requirements (i.e., as-builts, forms, documentation, and data).

As part of the Phase 1 process, Tetra Tech and AMEC (2009a and 2009b) were contracted by the District to evaluate the VR-1 and VR-3 levee systems and to recommend a levee categorization to facilitate the levee certification. Levee categorizations are as follows:

- Category 1 – Levees meet 44 CFR 65.10 requirements and all data or complete documentation is available.
- Category 2 – Levees may meet 44 CFR 65.10, but additional data or documentation is needed.
- Category 3 – Levees do not currently meet 44 CFR 65.10.
- Not a Levee – Based on physical conditions, an estimated low water surface elevation, no special flood hazard area has been delineated, and/or the structure was not built to provide flood protection.

A levee that is assigned a Category 1 or 2 rating will be further evaluated in the Phase 2 or 3 processes, respectively, in order to finalize its certification status. A levee that is assigned a Category 3 rating will require a Pre-Design Study in the Phase 4 process and implementation of the required improvements to achieve certification status.

9.2.1.1 Ventura Levee (VR-1)

The field investigation identified several critical issues that must be resolved prior to certification. These include deficient toedown protection (against erosion at the base of the levee), encroachments into the landward side embankment upstream of the ocean outlet and upstream of Main Street, and the presence of extensive vegetation within the channel.

Engineering analyses will also need to be performed to verify that this levee meets the National Flood Insurance Program (NFIP) Section 65.10 requirements (Tetra Tech and AMEC 2009a).

Approximately 1.4 miles of the Ventura River thalweg[2], from Station 64+00 to Station 138+50, is either below or very close to the existing levee toedown. There are no geological features, such as bedrock, or manmade features, such as rock groins, that would prevent the thalweg of the river from migrating toward the levee and undermining the toedown. Thus, the levee has the potential to fail from toedown undermining during major flood events (Tetra Tech and AMEC 2009a).

Based on the review and comparison of existing data and observations from the field investigation, it was recommended that the VR-1 levee system be classified as a Category 3 Levee (Tetra Tech and AMEC 2009a).

9.2.1.2 Live Oak Acres Levee (VR-3)

The field investigation identified several critical issues that must be resolved prior to certification. The most significant issues are the revetment failure, scouring/bank stability, and the presence of extensive vegetation. Engineering analyses will also need to be performed to verify that this levee meets the NFIP Section 65.10 requirements. Based on the review of existing data and observations from the field investigation, it was recommended that the VR-3 levee system be classified as a Category 3 Levee (Tetra Tech and AMEC 2009b).

Reclamation (2007) prepared a hydrology, hydraulics, and sedimentation study to support the design and/or improvement of two levees along the Ventura River in order to mitigate flood impacts from the proposed Matilija Dam Ecosystem Restoration Project. In this study, Reclamation noted that hydraulic modeling indicates the Live Oak Acres Levee would contain the 100-year flood, but the 500-year flood would overtop the levee at approximately RM 9.47 because of the backwater caused by the Santa Ana Boulevard Bridge. The Live Oak Acres Levee may also be subject to erosion as evidenced by damage caused by the January 2005 flood at approximately RM 9.4.

9.2.2 Santa Ana Boulevard Bridge

The Santa Ana Boulevard Bridge is on the downstream end of the Live Oak Acres Levee, and it is designed to convey the 100-year flood, but the calculated water surface elevation is only about 1-foot below the bridge soffit. Currently, deposition occurs on the upstream side of this bridge, and the County has a program to excavate the riverbed to maintain flow capacity. The bridge creates a constriction in the river, increasing velocities, producing scour around the bridge abutment, and creating a backwater condition upstream. Following the 1998 flood, a large berm was constructed on the east bank, downstream of the bridge, to prevent future erosion. While the rock protecting the berm is too small to eliminate erosion, the berm is over 50-feet-wide and will significantly delay erosion (Reclamation 2007).

[2] The thalweg is the line defining the lowest points along a river bed.

Another berm is located on the west bank of the river and extends for approximately 250 feet downstream of the bridge. This berm protects some buildings, but it is constructed of river bed material and can be easily eroded during high flow events (Reclamation 2007).

9.2.3 Live Oak Creek Diversion

Reclamation's 2007 study also provides relevant information on Live Oak Creek Diversion, which enters the Ventura River from the west side just upstream of Live Oak Acres at approximately RM 10.15. Live Oak Creek Diversion has an invert elevation of approximately 457.5 feet where it crosses under Burnham Road (All elevation references in this section are based on the 1988 North American Vertical Datum [NAVD]). It was designed to carry the 100-year flood; however, the design assumed an elevation of 456.5 feet at the confluence with the Ventura River. Since that time, the drain exit has aggraded to 458 feet, which has created a slight adverse slope in the drain from Burnham Road to the Ventura River, and aggradation is expected to continue. Because the 100-year flood surface water elevation for the Ventura River is estimated at approximately 465 feet at this location, water and sediment from the Ventura River can enter the drain, causing backwater effects and sediment deposition. Conveyance of the drain is likely to be compromised during large storm events.

9.2.4 East Side Vanes

Along the East Bank of the Ventura River, from RM 9.7 to 9.4, several properties are located at the top of a very steep, high terrace that appears to be composed primarily of old alluvial deposits. The base of this terrace may be subject to erosion during high flows, the top of the terrace may erode due to surface runoff. There is evidence of recent bank failure at RM 9.6. Most residences along this reach appear to be built 25 feet or more away from the edge of the terrace, but various fences, utility poles, and other accessory structures are within a few feet of the edge. The County installed protective vanes along this bank in the summer of 2005 to prevent further erosion at the base of the terrace. There are five vanes beginning approximately 1,200 feet upstream of Santa Ana Boulevard Bridge and extending approximately 1,300 feet further upstream. However, the presence of the vanes may increase the probability of erosion of the levee on the west bank of the river (Reclamation 2007).

9.3 Proposed Flood Management Projects

To support ongoing watershed protection efforts, the District developed the IWPP as the culmination of a series of long-range planning efforts. The objectives of the IWPP include the provision of a systematic process for the inclusion of projects into the District's Capital Improvement Program (CIP) and to improve the long-range District planning process (District 2011a).

The IWPP process achieves these objectives by gathering information about existing flooding, operations and maintenance, drainage facility deficiencies, access, and environmental concerns in the District's jurisdictional areas and developing a prioritized project list based on the gathered information. Projects are proposed to address identified issues, and are ranked relative to each other using a scoring matrix. The highest priority projects are the subject of further study. If the proposed alternative is found to be cost-effective and environmentally friendly, the project can be selected for inclusion in the CIP, and funded in priority order as resources become available.

The District's current CIP includes numerous projects to address flood management issues in the Ventura River watershed (Table 9-2), including several discussed above.

Table 9-2 Projects included in the Capital Improvements Program

No.	Project Name	Status	Description
1	Cañada de San Joaquin 30 Percent Pre-Design	In progress, to be completed by June 2012	Evaluate deficiencies, develop alternatives to correct flooding problems, and provide a 30 percent pre-design for selected alternative.
2	Cañada Larga Channel Improvements, State Highway 33	In the CIP, low priority pending funding	Excavate approximately 1,500 linear feet of channel and/or construct levee.
3	Dent Canyon Basin Retrofit	Completed September 2011	Modify outlet pipe and emergency spillway of the existing debris basin. Objective is to bring the basin outlet facilities up to District standards.
4	Dron Creek Detention/Debris Basin	In CIP, pending funding	Construct debris basin(s) in the canyon(s) north of Gridley Road. Additional feasibility study will be required to develop a detailed design concept and to determine the potential for causing erosion in the downstream channel.
5	East Ojai Alluvial Fan Flood Insurance Study (FIS) CTP	In CIP, slated for completion by June 2012	Prepare an FIS as part of a FEMA-granted CTP to delineate the floodplain more accurately.
6	Fox Canyon from Southern Pacific Rail Road to Grand Avenue Channel Improvements	In CIP, pending funding	Replace the existing concrete channel and increase flow capacity to mitigate local flooding.
7	East Ojai Avenue from Fox Street to Park Road (Lateral to Fox Canyon)	In CIP, pending funding	Upgrade the 1,156-ft long underground 36-inch corrugated metal pipe that is undersized to carry 255 cfs (100-year flood flow) from the area.
8	Fresno Canyon Flood Mitigation	In CIP, waiting for FEMA Hazard Mitigation Grant Program funding	Construct a bypass of reinforced concrete pipe from upstream of Highway 33 to the Ventura River. The purpose of this project is to provide 100-year flood protection from Fresno Canyon to the community of Casitas Springs.
9	Happy Valley Drain CTP FIS	In CIP, slated for completion by June 2012.	Prepare an FIS of the upper reach of Happy Valley Drain in the City of Ojai as part of a FEMA-granted CTP to delineate the floodplain more accurately.
10	Howard Avenue Drain/Oakview	In CIP, pending funding	Extend the 36-inch drain pipe from Howard Avenue upstream 1,060 feet to Brandt Avenue within the existing 12-foot-wide easement to collect stormwater.
11	Lower Ventura River, Cañada de San Joaquin CTP FIS	In CIP, slated for completion by December 2012	Perform an FIS of the lower reach of the Ventura River, including the Cañada de San Joaquin tributary, in the City of Ventura (an element of FEMA CTP agreement).
12	Matilija–Giant Reed Removal, State Highway 150	In progress, expected completion at end of 2012	Removal of *Arundo donax* and other invasive species from the mainstem of the Ventura River. This project is a mitigation component of the Matilija Dam Ecosystem Restoration Project.
13	Matilija Dam–California River Parkways Trailhead	Construction completed, project files will be closed by April, 2012	Construction of earthen equestrian trail, paved and concrete walkway, equestrian parking and staging area, parking bays, two American Disability Act compliant parking spaces, driveway approaches, fences, metal pipe.

Table 9-2 Projects included in the Capital Improvements Program

No.	Project Name	Status	Description
14	Matilija Dam–Camino Cielo Bridge Replacement	Work on hold pending funding	Replace the existing bridge at Camino Cielo. This project is a mitigation element of the Matilija Ecosystem Restoration Project. There are a number of other projects related to Matilija Dam Removal that are on hold pending agreements between the District, State of California, and USACE on technical issues.
15	Matilija Dam–Preliminary Engineering Design	Project schedule based on federal appropriations to the USACE. Local sponsor responsible for 25% of Corps $8 million budget. Subsequent environmental documentation and permitting likely, but unknown at this time.	Preconstruction, Engineering, and Design (PED) to Remove Matilija Dam. The objective is to provide fish passage of the endangered steelhead trout and enhanced habitat quality in the Matilija Creek and reduce flood control maintenance cost.
16	Matilija Dam–Santa Ana Boulevard Bridge Modification	Preliminary design in progress	Add a fourth span to the Santa Ana Boulevard Bridge. This Project is a mitigation element of the Matilija Dam Ecosystem Restoration Project.
17	Matilija Dam Ecosystem Restoration–Live Oak Acres Levee (VR-3)	In CIP, pending funding from USACE and other agencies	Modify and upgrade the existing Live Oak Acres Levee and Floodwall to mitigate impacts from the removal of Matilija Dam.
18	Matilija Dam Ecosystem Restoration–Meiners Oaks Levee	In CIP, pending funding from USACE and other agencies	Construct levee along the left bank of the Ventura River in the vicinity of Meiners Oaks to protect the residents.
19	Ojai Valley Trail Bridge at San Antonio Creek	Construction in progress, expected completion date May 2012	Construction of an equestrian and pedestrian bridge across the San Antonio Creek near the confluence with Ventura River to replace the current low flow crossing. Project enhances fish passage to San Antonio Creek and provides access for pedestrian and horseback riders across the creek during high flows.
20	Prince Barranca, Detention Basin/Channel Improvements	In CIP, pending funding	Revise the preliminary design to construct a detention/debris basin in the canyon to reduce design flood flows to the capacity of the existing flood conveyance facilities.
21	V-1: Ventura River Watershed Assessment and Management Plan	In progress, slated to be completed February 2012	This is a Proposition 50-funded project with a number of elements that include development of a watershed model of the Ventura River watershed using HSPF and development of water budget and groundwater monitoring plan for the lower Ventura River.
22	V-2: San Antonio Creek Spreading Grounds Rehabilitation Project	Construction start is planned for August 1, 2012; 4 month's duration (to be completed by December 1, 2012); all permit work is completed	Increase groundwater storage and recharge in the Ojai Valley Groundwater Basin by rehabilitating four existing, relict spreading ground ponds, and constructing a new intake structure, monitoring well, diversion piping/channels and four passive percolation ponds.
23	San Jon Barranca, System Improvements	In CIP, pending funding	Construct floodwalls upstream of Harbor Boulevard to prevent flooding of San Jon Road and Harbor Boulevard. Construct underground drain downstream of Poli Street. Repair existing pipe invert.
24	Senior Canyon Detention Basin	In CIP, pending funding	Complete a detailed feasibility study and construct a debris/detention basin at the existing basin site. The size of the basin is estimated to be more than 100 acre-feet.

Table 9-2 Projects included in the Capital Improvements Program

No.	Project Name	Status	Description
25	Skyline Drain Stabilizer	In CIP, pending funding, on hold for further evaluation	Evaluate, redesign and reconstruct a concreted rock outlet chute at the downstream end of the existing Skyline Drain Channel.
26	Thacher Creek Channel Improvement at Siete Robles	In CIP, pending funding	Construct channel improvements to provide 100-year level of protection and replace the existing deteriorating, inadequate facility.
27	Ventura River Levee (VR-1) Evaluation and Rehabilitation	In progress, working with consultant and USACE on the best approach for funding mechanism	Complete evaluation of all improvements required to enable certification of the existing Ventura River Levee (VR-1). The objective is to provide 100-year level of flood protection and certify the levee so that FEMA will accredit (recognize) the levee as a certified flood control facility.
28	Ventura River Levee at Casitas Springs (VR-2) Certification and Rehab Pre-Design	In CIP, pending funding	Evaluate the Casitas Spring Levee for certification and prepare a pre-design for rehabilitation of the levee to meet FEMA's 44 CFR 65.10 certification criteria.

9.4 Flood Management Revenue Sources

The District's revenue sources are described in the IWPP (District 2011a). They are derived from property taxes, benefit assessments, and land development fees paid by property owners within the county. The benefit assessment revenues are dedicated to fund operations and maintenance and NPDES permit-related activities. A portion of the property taxes collected within a zone is set aside to fund District administration, overhead, and service functions. The remaining revenues are available for flood management studies and the implementation of projects.

Although funds from other agencies, such as FEMA, and the State of California are sometimes available for District projects, the IWPP process only relies on estimates of property tax and land development fees within an IWPP zone over the long-range planning period. Thus, the funding available for flood management is directly related to the number (and value) of developed parcels and the number of new development projects.

As discussed in Chapter 2, most of the Ventura River watershed is undeveloped open space, with over 75 percent of the watershed classified as rangeland and forest. Development is focused in relatively flat areas, including floodplains, along the Ventura River and tributary streams and the floor of the Ojai Valley (Figures 2.2-1 and 2.2-2). The limited extent of existing development (and new development) results in limited revenue for flood management improvements in the Ventura River watershed. Because traditional structural improvements such as levees, are very costly, the District also works to identify and implement other flood management practices that can reduce hazards in flood-prone areas.

It is also important to note that some areas in the Ventura River watershed subject to flooding are located on alluvial fans. As discussed above under Section 9.1.1.2, San Antonio Creek Watershed, floods in alluvial fans are highly unpredictable, and the District cannot provide cost-effective structural improvements in such areas. In these areas, individual property owners need to be proactive to identify flood hazards and implement measures to reduce risk from those hazards, such as those described below.

9.5 Integrated Flood Management Practices

9.5.1 Overview

Traditionally, flood risk management has relied on physical improvements that divert or reduce floodwaters to avoid damage to lives and property located adjacent to rivers and streams. Recently, the emphasis has shifted to more integrated forms of flood management that include a mix of structural and non-structural methods that minimize development in flood prone areas (e.g., floodplains and alluvial fans). These methods seek to enhance the ability of undeveloped floodplains and other open spaces to absorb, store, and slowly release floodwaters during small and medium-sized events. In addition to flooding along rivers and streams, there is increased recognition that other areas may also be subject to flooding, including alluvial fans, which are found in some portions of the Ventura River watershed.

Integrated flood management is an approach to dealing with flood risk that recognizes the interconnection of flood management actions within broader water resources management and land-use planning; the need to consider existing land use; the value of coordinating across geographic and agency boundaries; the need to evaluate opportunities and potential impacts from a system perspective; the importance of environmental stewardship and sustainability; and the value of rural farms and communities (DWR 2011).

Floodplain management is a major element of this strategy and seeks to: 1) minimize impacts of flood flows; 2) maintain or restore natural floodplain processes; 3) remove obstacles within the floodplain; 4) keep structures or other obstacles out of the floodplain; 5) educate and plan for emergency preparedness; and 6) ensure that floodplain management does not adversely affect flood management operations (California Floodplain Management Task Force 2002).

Floodplain regulation is a key component of floodplain management and includes land use policies that guide the development of areas adjacent to streams, rivers, and coastal areas subject to periodic flooding or inundation. Floodplain regulation may include measures to restrict or prohibit development within floodplains, or provide protection to buildings from potential flood damage (such as flood-proofing). Where development is permitted, measures may require protection of buildings from potential flood damage. Measures to reduce potential impacts to other development, such as requiring that new development result in no adverse flood impacts to existing structures, also are under consideration. This may also include acquisition of land in identified floodplains or easements, which will allow the restoration of the natural, beneficial functions and values of the floodplain. Development of runoff detention requirements for medium and high runoff events keep water resources higher in the watershed for delayed release, maintain the existing drainage system, and reduce the need for capital projects to expand the drainage system capacity.

Development and redevelopment policies include land use practices that are designed to reduce flood risks, reduce the severity of potential floods, and expedite recovery after floods. This may include floodplain regulation (described above), stream protection ordinances, storm water management practices, open space preservation, and watershed management programs. The intent of these practices is to reduce risk to structures by requiring rigorous analysis of flood risk and/or limiting development in flood prone areas (including development of critical facilities such as hospitals, schools, police, fire protection, and wastewater treatment); preserving the ability of open spaces to absorb precipitation and slowly release runoff; and reducing the extent of impervious surfaces (DWR 2009). Redevelopment policies may include measures that impose conditions on future construction by restricting the size and placement of structures, encouraging reduction of impervious areas, and encouraging the long-term restoration of streams and floodplains.

Housing and building codes include specific measures that reduce flood damage and preserve egress routes during high water events. The codes may include reference to flood proofing, which consists of measures that render buildings and their contents less vulnerable to floods through structural changes to existing buildings and specific design features for new buildings. These modifications or features can include impervious walls (around structures or properties) without any openings, and valves on sewer lines that automatically close from back pressure. Alternatively, the lowest floor could be completely open, consisting of open columns that create a covered patio or storage area that can allow flood waters to pass.

Floodplain function restoration recognizes that periodic flooding of undeveloped lands adjacent to rivers and streams is a natural function and may be a preferred alternative to restricting flood water to the existing low flow channel (DWR 2009). The erosion, transport, and deposition of sediment create a diverse mosaic of floodplain landforms that vary with time. These landforms support different types of vegetation and affect in-stream habitat quality for fish and other aquatic life. They also form side channels that can provide important fish and wildlife habitat. Many plant and animal species evolved life history strategies that allowed them to exploit the temporal and spatial variability associated with the region's Mediterranean climate and variable hydrologic and geomorphic processes (DWR 2011).

Where rivers and streams have been separated from their adjacent floodplains, floodplain function restoration is a technique to restore the natural ability of undeveloped floodplains to absorb, hold, and slowly release floodwaters. To permit seasonal inundation of undeveloped floodplains, some structural improvements may be needed to constrain flooding within a defined area, along with nonstructural measures to limit development and permitted uses within those areas subject to periodic inundation.

As noted above, the management of watershed lands can have a substantial impact on the nature and magnitude of flood events (DWR 2009), including the following:

- Stewardship of agricultural lands can enhance the ability of agricultural and ranch lands to absorb rainfall and runoff, limit soil erosion, reduce the magnitude of some flood events, and enhance recovery after flood events.
- Ecosystem restoration can enhance the ability of open spaces to absorb rainfall and runoff and enhance recovery after flood events.
- Forest management, including preservation of riparian vegetation along streams and maintenance of forest canopy, may reduce soil erosion, and moderate the severity and frequency of some flood events, and also promote recovery after flood events.
- Watershed management can promote the retention of open space and habitat, which may reduce the severity and frequency of flood events and promote recovery after flood events.

Land areas within and adjacent to rivers and creeks are not the only lands exposed to potential risk from flooding in the watershed. Alluvial fans, which are found around the borders of the Ojai Valley, are gently sloping, fan-shaped landforms that are created over long periods of time by the natural deposition of eroded sediment from an upland source.

When alluvial fan flooding occurs it can be very unpredictable, as it does not necessarily occur as the result of large amounts of rain. Often, it is triggered by intense rainfall over short periods of time (Alluvial Fan Task Force 2010). The natural flooding process that drives alluvial fan sedimentation tends to produce thick deposits of sand and gravel, particularly near the apex of the fan, with relatively minor proportions of fine-grained particles. Fine-grained sediment associated with flood flows may be transported to the valley floor.

Alluvial fan flooding differs from flooding along rivers and creeks because the flows in alluvial fan systems are often highly variable and the soils may be highly erosive, which can result in flows that are a mixture of water, rocks, boulders, trees and structural debris. As a result, flood hazards on alluvial fans cannot be managed by traditional flood management measures.

9.5.2 Relevant Flood Management Practices

The challenge in sparsely developed areas such as the Ventura River watershed is to develop effective flood-control/stormwater management practices in a cost-effective manner given the lack of tax base and limited infrastructure. Some of the BMPs included in Section 7.2.1, *County of Ventura Technical Guidance Manual for Stormwater Quality Measures,* can be effective in minimizing damage from flooding. Additionally, self-sufficiency is important in remote areas, and individual property owners and communities can take steps to protect private property from flood damage.

9.5.2.1 General Floodplain Management Strategies

The Association of State Floodplain Managers (ASFPM) has developed a list of recommended measures (ASFPM 2011), which are listed below, along with the rationales for their use:

- **Establish appropriate freeboard requirements in areas subject to flooding**. Freeboard is the single most effective means for reducing flood risk to a structure in the floodplain. Freeboard places the first floor of a structure above the calculated 1 percent flood elevation in order to allow for nature’s uncertainty and future changes in the watershed that will increase flood levels. Freeboard is relatively inexpensive to incorporate into development, and typically pays for itself in reduced insurance premiums and prevented flood damage within the first 10 years of a structure’s lifetime. Significant Community Rating System (CRS) credit is available for this activity, which leads to lower flood insurance premiums for all policy holders in the community.
- **Promote development design that will reduce flood damage and facilitate emergency vehicular access and/or pedestrian access and evacuation during flood events**. Ensuring that building sites are relatively accessible during floods decreases the likelihood of stranded residents, reduces the need for water rescues which places emergency personnel at risk, and increases public safety.
- **Compensate for the loss of floodplain storage caused by filling in the floodplain, which can result in raising flood elevations, especially with the impact of cumulative fills**.

Floodplains provide the critical and beneficial functions of flood storage, natural habitat, and water quality. The placement of fill impairs these functions and should be avoided. Where some placement of fill is unavoidable, requiring compensatory storage can mitigate some of the negative impacts of floodplain fill.

- **Protect critical facilities and development against damage, and minimize the potential loss of life from flooding**. Facilities that provide critical services, or services that are depended on during storms, should be protected to an even higher standard than other development. Failure to provide flood protection to these types of critical facilities creates severe and unacceptable public safety risk.
- **Track cumulative improvements or damages to structures in special flood hazard areas to ensure that flood protection measures are incorporated**. The vast majority of flood damages to structures amount to less than 50 percent of the value of the structure. Without cumulative substantial damage/improvement provisions, the cycle of flood-repair-flood is typically never broken by mitigating risk. The NFIP Increased Cost of Compliance provisions (which provide added funds to substantially damaged flood insurance claims for mitigating the structure) are most effective in communities with cumulative provisions.
- **Provide guidelines for the placement of fill in special flood hazard areas.** Nearly all floodplain filling activities create negative consequences for adjacent areas. Improperly designed and constructed fill can also jeopardize structures elevated on fill.
- **Delineate a larger area within the 1 percent-annual-chance floodplain for flood-flow conveyance and restrict future encroachments that could increase flood levels**. Communities with flood studies based on FEMA's standard floodway encroachment criteria typically see more frequent and more severe flood events because those standards allow the carrying capacity to be reduced by pinching in the floodway until flood levels raise 1 foot, thus causing the allowable development area to encroach into the natural floodway. Base flood elevations and flood insurance premiums do not account for these increases, leaving communities unprotected during the base flood event, and property owners uninsured or under-insured.
- **Ensure proper design and construction of building foundations to protect building structural integrity against the effects of buoyancy, uplift, debris impacts, and other flood forces**. ASCE-24 provides a standard of practice for flood-resistant design and construction in flood-prone areas.
- **Protect property against impacts of increased flood heights due to anticipated future development anywhere in the watershed, especially in rapidly developing areas**. In many cases, flood studies reflect current conditions at best and, more likely, past conditions since the studies often rely on old data. As watersheds are developed, future flood heights are likely to increase. The flood risk criteria used to site and design a project should rely on conditions the location is likely to experience during the project's lifetime, not past or current conditions.
- **Protect the community against flood damage from materials that may block flood flows or which become buoyant, flammable, explosive, or cause other environmental health issues in floods**. Storage of materials is often difficult to regulate since many areas do not require building permits for storage. Stored materials can become waterborne debris during

floods, endangering adjacent properties, and creating potential debris blockages where bridges or culverts exist.

- **Provide a limited use/development set aside area along a stream for flood damage prevention, resource protection, floodwater storage, water quality, pollutant/sediment removal, and natural stream function**. Most floodplain regulations protect lands adjacent to streams with property protection and flooding conditions in mind. Floodplains provide a wide range of natural and beneficial functions, and many of these resource protection functions can only be achieved with setbacks that preserve a riparian corridor adjacent to streams. Significant CRS credit is available for this activity, if it results in floodplain open space.
- **Prevent increased flood flows and limit increased runoff from a proposed development to pre-development conditions, and to maintain floodplains and stream channels by reducing erosion and sedimentation from construction activities in flood hazard areas.** One of the most effective ways to prevent flooding problems from getting worse over time is to limit the changes in watershed hydrology that increase flood flows. Probably the single most effective way to accomplish this is through storm water regulations that limit increases in runoff that result from new development. Significant CRS credit is available for this activity.
- **Ensure subdivisions, including infrastructure and lots, are created and designed to minimize risk of damage to property and potential loss of life from flooding, and minimize the disturbance of floodplain riparian zones.** Avoidance of floodplains is far preferable to setting standards and allowing building in the floodplain. The cost of a typical residential flood insurance policy is approaching $1,000 dollars, and this does not account for public expenses associated with building in the floodplain.
- **Restrict or prohibit uses of the floodplain which are dangerous to health, safety or property in times of flood, or which cause excessive increases in flood stages or velocities.** Avoidance of floodplains is far preferable to setting standards and allowing building in the floodplain. For many types of critical facilities, the tolerance for even minimal flood risk is extremely low, and complete avoidance of the floodplain should be the standard.
- **Provide a means for a community to regulate development in areas at risk to flooding that have not been mapped on FEMA's Flood Insurance Rate Maps**. At best, most flood insurance studies do not map floodplains in watersheds with drainage areas of less than 1 square mile, floodplain widths less than 200 feet, areas of minimal development, and areas with poor drainage not associated with flooding sources. In many undeveloped areas, some larger watersheds may not have been mapped. Estimates are that nationally, over one-third of flood damage occurs outside of mapped floodplains.
- **Protect new horizontal additions (increase in building footprint) from flood damage** by elevating the lowest floor and all heating, ventilation, and air conditioning equipment to the regulatory base flood elevation. Building an addition below flood level is essentially expanding a non-conforming use–a practice that has been prohibited in many contexts.

9.5.2.2 Ventura County Flood Plain Management Ordinance Strategies

Many of the above measures have been incorporated in the Ventura County Flood Plain Management Ordinance (Ordinance 3954) (URS 2005). The following outlines some of the requirements of the ordinance:

- **Establishment of development permit**: Requires developers to obtain a development permit before any construction or other development begins within a Special Flood Hazard Area.
- **Designation of the floodplain administrator**: Requires the floodplain administrator to implement and enforce the ordinance, review permits and other base flood data, notify other agencies of the alteration/relocation of a watercourse, document floodplain development, and interpret Flood Insurance Rate Maps.
- **Standards of construction**: Requires standards for anchoring new or substantially improved structures and manufactured homes, construction materials, flood proofing, and a freeboard requirement of 1 foot above base flood elevation.
- **Standards for utilities**: Requires utilities and facilities such as sewer, gas, electrical, and water systems to be located and constructed to minimize flood damage.
- **Standards for subdivisions**: Requires all subdivision proposals to identify the Special Flood Hazard Area, elevation of the base flood, and elevation of structures and pads.
- **Standards for manufactured homes**: Requires manufactured homes placed outside of a home park or subdivision to be on a permanent foundation such that the lowest floor is 1 foot above the base flood elevation.
- **Standards for recreational vehicles**: Requires that recreational vehicles located within the Special Flood Hazard Area be on the site for fewer than 180 consecutive days, and be fully licensed and ready for highway use.
- Floodways: Prohibits encroachments, including fill, new construction, substantial improvements, and other new development in the FEMA-designated floodway unless certification by a registered professional engineer is provided to demonstrate that encroachments will not result in any increase in base flood elevation during the occurrence of the base flood discharge.

9.5.2.3 Other Flood Control/Stormwater Management Strategies

In combination with the strategies outlined above, reducing flows to storm drains over impervious surfaces is an effective practice, because such flows can overwhelm tributaries, major collectors, and main rivers during storm events. The overall strategy of increasing porous surfaces in the existing land uses coupled with detention/debris basins to slow the flow of runoff to tributaries and mainstems is key to reducing flood events.

Another strategy that could reduce flows involves the District and groundwater management agencies working cooperatively to increase percolation into water recharge areas. Storm channels with natural bottoms are encouraged so that infiltration can take place. Creating overflow areas and ponds along the storm channel could also slow down flow and allow for infiltration. Slowing the flow can change the timing of the storm peak and allow the floodplain to operate more efficiently. Floodplain managers already hold a monthly meeting to discuss strategies for improving floodplain management.

9.5.2.4 San Antonio Creek Water Management Strategies

The Ojai Water Conservation District has offered a conceptual proposal to optimally balance flood control, aquifer basin recharge, and environmental values in the streambeds of San Antonio Creek and its tributaries in the Ojai Valley (NRCS 2010). In summary:

- Basin streambeds provide a means for brief winter rains to replenish a limited groundwater basin.
- Infrastructure development, such as roads, orchards, and homes are impinging on the natural tendency of streams in the Ojai Basin to deposit coarse sediment, meander, and spread out.
- These streambeds also provide habitat and passage corridors for wildlife and are vulnerable to infestation by invasive plant species, such as *Arundo donax*.

The Ojai Water Conservation District proposes the development of a comprehensive, area-wide plan to address the following three concerns in a simultaneous process:

- Optimize and enhance groundwater recharge.
- Protect life and property from floods and erosion.
- Maintain an attractive and sustainable environment along stream channels.

Development of this plan will require additional research and development, and the Ojai Water Conservation District proposes to solicit funds to pursue this plan. Implementation will require a cooperative approach between local entities and regulatory agencies. This approach would be facilitated by a common understanding regarding the importance of optimizing the three concerns (recharge, flood protection, and habitat maintenance) simultaneously.

9.6 Conclusions

As described in this chapter, many areas in the Ventura River watershed are vulnerable to hazards associated with flooding. Prevailing storm patterns and the topography and orientation of the mountains in the watershed frequently create the potential for significant precipitation, which can result in flooding along stream channels, associated floodplains, and on alluvial fans.

To address flood risks, various structural improvements, including dams, levees, and debris and detention basins, have been implemented on the Ventura River and tributary streams. Even with these improvements, flood management deficiencies have been identified at various locations, and the District has proposed projects to provide structural improvements (listed in Table 9-1). The implementation of these projects is, limited by the availability of funding, which is generated by property taxes and land development fees.

Although additional improvements are proposed for implementation along the Ventura River and tributary streams, flood hazards will still remain at other locations in the watershed, including alluvial fans in the Ojai Valley. Because structural improvements are generally designed to address estimated flood flows from a 100-year event, residual flood risks associated with larger storm events are still present in those locations that receive protection from the structural improvements.

To address residual risks along floodplains, the County has adopted a floodplain ordinance that limits development in these areas or imposes conditions upon such development. Building codes also provide regulatory protection, but they only apply to new development or renovations. Thus, property owners, cities, and other jurisdictions located in areas that are at risk for flooding must be aware of and take appropriate precautions to minimize such risks.

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Chapter 10

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Appendix A

Excerpts from Applicable Watershed Management Plans

Appendix A

Excerpts from Applicable Watershed Management Plans

Tujunga-Pacoima Watershed Plan

- Table of Contents
- State of the Tujunga Table of Contents
- Section 1.6: What this plan is for
- Section 3.0: Goals and Objectives

Ballona Creek Watershed Management Plan

- Table of Contents
- Section 3: Goals and Objectives

Calleguas Creek Watershed Management Plan (Phase I)

- Table of Contents
- Excerpt from Introduction

TUJUNGA/PACOIMA WATERSHED PLAN

April 2008

Prepared by:

The RIVER PROJECT

With assistance from:
PBS&J
Tetra Tech, Inc.
Larry Walker Associates
Everest International Consultants
Los Angeles & San Gabriel Rivers Watershed Council
National Park Service, Rivers Trails & Conservation Assistance Program

CALFED BAY-DELTA PROGRAM

This project was paid for with funding from
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The State of the Tujunga

An Assessment of the Tujunga/Pacoima Watershed

Prepared by The River Project
With funding from the CALFED Bay-Delta Watershed Program

October 2006

Table of Contents

1.6 What This Plan is For

> We can require ourselves to be accountable to our grandchildren and to their great-grandchildren. By making the right choices now, we can promise them bright streams and lasting forests and rewarding employment and welcoming communities.
>
> *—Charles Wilkinson*

This Plan is intended to facilitate positive change. As we undertake to redevelop our region and adapt to change, it can help us shift our planning framework to a more holistic perspective, one that uses the watershed as a basis for decision making.

Shifting existing patterns of development and employing an integrated management context can help us to: increase local water supplies; improve water quality; restore habitat; better manage open-space; make more parks; create new recreational opportunities; and design viable multi-modal transit.

Shifting from the current “silo system” of management to a more cooperative “systems approach” can help us to: partner more effectively; identify necessary funding sources; increase our quality of life; and develop a monitoring plan that will alert us to things that need our attention and tell us what strategies work.

In short, this Plan can show us how to rebuild and sustain a great place.

This plan is intended as a resource for anyone interested in working towards a sustainable future in this region. It aims to educate and inspire and to provide local advocates, urban planners, agencies, elected officials, policy-makers, individual property owners, residents, and youth a road map and a toolkit to do the following:

- Develop a more holistic understanding of the our local environment
- Facilitate widespread watershed awareness and education
- Empower the community to be directly engaged in the decision making process
- Catalyze actions to sustain support and implementation of the Plan over the long term
- Improve coordination and integration among agencies
- Enhance communication and collaboration between agencies and other stakeholders
- Bring together key agencies with other stakeholders to plan the financing and implementation of large-scale watershed retrofitting

This is intended to be a LIVING Plan that will adapt over time through continued participation from and collaboration between all stakeholders. It provides a sound foundation to support consensus decisions and actions now and in the future.

> There can be no purpose more inspiriting than to begin the age of restoration, reweaving the wondrous diversity of life that still surrounds us.
>
> *—E.O. Wilson*

Chapter 3 GOALS AND OBJECTIVES

> The goal of life is living in agreement with nature.
>
> *—Zeno, Greek philosopher*

The following goals and objectives were generated through a collaborative stakeholder process. Each goal includes subgoals and related objectives. Collectively, they reflect a single over-arching goal:

> To revitalize the Tujunga/Pacoima Watershed, balancing water supply, water quality, community open space needs, environmental protection and restoration, and public safety.

■ Optimize Local Water Resources to Reduce Dependence on Imported Water

- Improve groundwater infiltration:
  - > Develop groundwater management strategy for optimum use of local water resources.
  - > Improve quality and quantity of on-site water recharge to the SFV Groundwater Basin.
  - > Restore natural streams, washes, and floodplains in areas of high soils permeability.
- Reduce dependence on imported water:
  - > Facilitate on-site collection systems for stormwater and graywater.
  - > Expand water conservation programs.
  - > Extend the distribution and range of uses for reclaimed water.
- Integrate groundwater infiltration with other public and/or beneficial uses:
  - > Provide for compatible public activities and uses in infiltration areas.
  - > Restore natural streams, washes, and floodplains and associated habitats.

■ Improve Surface Water & Groundwater Quality

- Reduce pollutant loads:
  - > Expand source reduction programs.
  - > Implement Best Management Practices.
  - > Implement institutional controls such as water quality zones, urban forestry, product substitution/source control, and public outreach and education.
- Maximize “nature’s services” before utilizing manufactured solutions:
  - > Reinstate sediment transport to support assimilative capacity.
  - > Increase permeable surfaces throughout the watershed area.
- Implement a citizen-based water quality monitoring program.

Restore Hydrologic Function to the Watershed while Maintaining Public Safety

- Reestablish functional streams:
  - Restore/acquire functional floodplains.
  - Restore natural, bioengineered streambanks.
  - Daylight/reestablish tributary streams where feasible.
  - Develop sediment management strategy.
  - Establish meanders as needed to facilitate dynamic equilibrium of sediment transport.
- Design restoration projects to maintain flood protection:
  - Capture and infiltrate stormwater where it falls to reduce runoff volume in streams.
  - Acquire gravel pits for stormwater detention.
  - Remove or elevate structures in floodways.
  - Implement a flood hazard warning system.

Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats

- Restore, protect, and augment terrestrial and aquatic species habitat:
  - Create habitat corridors along Tujunga and Pacoima washes.
  - Restore riparian habitat along historic tributaries where feasible.
  - Identify, enhance, and restore natural habitat and wildlife corridor between Verdugo and San Gabriel mountains.
  - Acquire land or conservation easements in ecologically sensitive areas, including along streams.
- Integrate fire and vector management strategies into native vegetation zones.
- Reduce extent of invasive, non-native species.
- Expand use of native plants in landscaping through mandate on publicly-owned lands and through incentives on private lands.

Improve and Increase a Network of Public Open Space

- Augment overall open space network to meet the national standard for park space per capita ratio:
  - Protect existing open spaces.
  - Implement a targeted, prioritized program to utilize surplus properties and acquire land from willing sellers.
- Improve connectivity and access to Tujunga and Pacoima washes and the Angeles National Forest using tools such as easements and greenway linkages.
- Develop a design standard for open space that integrates natural resources management with various recreational needs.
- Provide for maintenance and security of parks, open space, and trails.

Create Green Transit Linkages and Recreational Access

- Improve multi-modal transit:
  - > Create a watershed–wide network of pedestrian, equestrian and bicycle routes utilizing BMPs in design.
  - > Connect multi-modal transportation routes to communities, public facilities, transit focal points, greenways, and other open spaces.
  - > Design multi-modal routes for user safety.
- Enhance and expand recreational opportunities to meet needs of local communities:
  - > Determine appropriate recreational uses with local community guidance.
  - > Group activities according to use compatibility.
  - > Provide a diversity of recreational opportunities and experiences within each community.

Promote Watershed Awareness & Increase Stewardship through Public Outreach and Education

- Conduct education and outreach programs to expand appreciation of the natural character of Tujunga & Pacoima Washes and the importance of watershed restoration:
  - > Identify and understand target audiences to develop and deliver most effective outreach and educational programs.
  - > Focus on local eco-system, groundwater/water supply issues, flood safety, sustainable living, and environmental justice.
  - > Develop and deliver an educational curriculum for grades K-12.
  - > Partner with community colleges to gather data, monitor conditions, and implement plan development and also encourage continued participation of local universities.
  - > Use the internet as an informative outreach tool.
- Engage community interest through participation in restoration activities:
  - > Include youth and community groups in watershed restoration activities.
  - > Involve the business community.
  - > Provide opportunities and resources for individuals to participate on their property.
- Protect and interpret natural, cultural, and historic resources.

Implement Watershed-based Planning and Projects

- Implement ordinances and incentives to protect watersheds and streams:
  - > Require “no net gain” of stormwater runoff on developed sites, based on natural conditions.
  - > Create a River Overlay Zone to acquire floodplains opportunistically or through long term programs.
  - > Incentivize multiple-objective developments and BMP integration in private-sector projects.
  - > Develop alternative approaches to land use designations in order to integrate, preserve, and protect natural systems within urban environments.

- Require integrated open space in mixed use, live/work developments:
  - > Recycle underused sites along Tujunga & Pacoima Washes.
  - > Leverage Quimby and other park funds to acquire parkland in developed areas.
  - > Increase park acreage required by General Plan.
- Preserve agricultural zones.

Improve Collaboration among all Agencies, Organizations & Communities in the Watershed

- Institute a comprehensive program to facilitate communication and collaboration:
  - > Involve elected officials and their staff, governmental, regulatory and infrastructure agencies, NGOs, CBOs, professional and business organizations and individuals in a cooperative watershed stewardship program.
  - > Assign a liaison with decision-level capability from each agency to communicate with each other and the stakeholders.
  - > Develop a system that fosters early notification and cooperation amongst all stakeholders prior to all project planning.
- Encourage mutual understanding of the goals, objectives, and roles of each individual agency and organization involved.
- Partner with existing local programs and projects where appropriate.
- Develop a collaborative strategy to finance implementation of the Plan.

BALLONA CREEK

WATERSHED MANAGEMENT PLAN

SEPTEMBER 2004

contents

CHAPTER THREE

goals and objectives

A. STAKEHOLDER ISSUES OF INTEREST

In January 2002, following a series of "start-up" meetings that began in August 2001, the Ballona Creek Watershed Task Force developed a Draft Procedures and Protocols document (included as Appendix A to this Watershed Plan), which articulated objectives and guiding principles for development of this Watershed Management Plan and described stakeholder roles, guidelines for attendance and participation in stakeholder meetings, decision making, sharing of information and subsequent amendments to the document. The Procedures and Protocols document also include a list of Issues of Interest, which were intended to capture specific project suggestions, hopes and aspirations, doubts and concerns about the planning process that lie ahead. These issues were prioritized by task force members in March 2003 and are listed on the following page.

View from Baldwin Hills

B. WATERSHED PROBLEMS

The Issues of Interest, the minutes of the BCWTF, and other sources permitted identification of several watershed problems, which were generalized under the basic themes of water, land, and planning:

WATER

- Water quality in Ballona Creek, the estuary, Marina del Rey and nearby beaches is degraded
- Ballona Creek (and tributaries) and the estuary do not function as natural hydrologic systems
- Dependence on imported water is high and use of reclaimed water is low

- Aquatic, estuarine and riparian habit is poor and limited in area

LAND

- Terrestrial Habitat is poor and limited in area
- Access to Open Space is limited for many communities
- A comprehensive system of bike trails and hiking paths does not exist
- Public appreciation of the value of native plants and preservation of cultural resources is low

PLANNING

- Planning by individual jurisdictions often does not adequately consider downstream or watershed-wide implications
- Many public projects are planned to achieve single, rather than multiple, benefits
- Planning does not always integrate sound scientific concepts and principles
- Public appreciation of the Ballona Creek Watershed is limited
- Ballona Creek is not recognized as a potential focus of sustainable economic development

1. BCWTF Issues of Interest

BCWTF stakeholders subsequently developed a more specific "Issues of Interest" list over the course of four meetings, early in 2002. After sessions of brainstorming, eliminating duplicates, and sorting, problems and project ideas were categorized under larger group headings. Stakeholders participated in a "sticky dot" exercise to identify which general categories were most important to them. The following list, with groupings identified by bold print headings, represents key stakeholder priorities, with categories of the greatest interest or concern listed first, and descending according to a waning frequency of responses.

WATER QUALITY & QUANTITY (SOURCE WATER)

- Beneficial reuse
- Constructed wetlands
- Flood protection
- Groundwater basin
- Groundwater recharge
- North outfall treatment facility
- Permeability
- Reclaimed water
- Seasonal anf annual trends
- Spreading grounds
- Surface waters
- Water retention
- Stormwater / urban runoff
- Beneficial uses for channel or receiving waters
- Contact recreation
- Groundwater protection
- Inventory of the dischargers/discharges
- Noncontact recreation
- Point/nonpoint source pollution
- Sediment quality
- Sources of contamination
- Oil seeps
- Air pollution
- Illegal dumping
- Interim permitting

- List of impaired water bodies [303(d) list]
- National Pollutant Discharge Elimination System (NPDES) permit
- TMDLs
- Regulatory agencies

ECOSYSTEMS

- Connections
- Fisheries
- Greenways
- Habitat
- Invasive plant species
- Natural resources
- Rare, threatened, and endangered species
- Recovery and restoration of native species
- Seawater barrier
- Wetlands restoration
- Wildlife access (fencing and roads)
- Wildlife crossings
- Wildlife communities and biodiversity
- Conservation, preservation, and restoration
- Land subsidence
- Soil

PUBLIC BENEFITS

- Alternative transportation
- Bike/walking path and network (including recreation and commuter uses)
- Every existing city park
- Historic and cultural resources
- Naturescaping/landscaping
- Public access
- Public art
- Urban forestry

SUBSYSTEMS

- Baldwin Hills Park
- Ballona Lagoon Marine Preserve
- Ballona Northeast (Area C—State lands)
- Ballona Wetlands
- Del Rey Lagoon city park
- Grand Lagoon / Canal
- The Harbor
- Marina del Rey
- Oxford Flood Control Basin
- Venice Canals
- Ballona Creek
- Estuaries of Ballona and Centinela Creeks
- Wetlands hydrology improvement
- Centinela Creek
- Sepulveda Channel
- 15+/- tributaries in the Santa Monica Mountains

PUBLIC OUTREACH

- Educational opportunities
- Environmental justice
- Public awareness
- Public safety
- Public participation
- Involving public schools

LAND USE

- Land acquisition strategies
- Land development
- Open space creation
- Playa Vista properties
- Projected growth

MAINTENANCE

ECONOMICS

- Revitalization along the creek
- Tourism and fishing

MAPPING

- Visibility of Watershed boundaries
- Watershed boundary
- Existing springs/creeks
- Historic streams
- Stream daylighting

PUBLIC HEALTH

MONITORING

JURISDICTIONS

VECTOR CONTROL

C. GOALS AND OBJECTIVES

In the Procedures and Protocols document, the BCWTF adopted the following goal:

> To develop and facilitate implementation of a Comprehensive Watershed Management Plan for the Ballona Creek Watershed that sets forth pollution control and habitat restoration actions to **achieve ecological health.**

Ladera Park

To further articulate this overarching goal, on May 20, 2003, the Task Force also adopted the following additional goals:

1. WATER

A. Improve Quality of Surface Water and Groundwater

B. Maintain Flood Protection

C. Restore Natural Hydrologic Function to Ballona Creek and Tributaries Where Feasible

D. Optimize Water Resources to Reduce Dependence on Imported Water

E. Improve Aquatic, Estuarine, and Riparian Habitat Quality and Quantity

2. LAND

A. Improve Terrestrial Habitat Quality, Quantity and Connectivity

B. Improve Access to Open Space and Recreation for All Communities

C. Improve Pedestrian and Bicycle Access and Safety

D. Practice Stewardship of the Landscape

3. PLANNING

A. Coordinate Watershed Planning Across Jurisdictions and Boundaries

B. Implement Multi-Objective Planning and Projects

C. Use Science as a Basis for Planning

D. Involve the Public through Outreach and Education

E. Utilize the Plan in an Ongoing Management Process

F. Realize the Potential of Watershed Restoration for Sustainable Economic Development

To establish criteria that can be used to measure progress, the following objectives have been articulated by the BCWTF:

Ballona Creek Watershed Management Plan Objectives

Goals	*Objectives*
WATER	
Improve Quality of Surface Water and Groundwater	Implement projects, BMPs and other methods to reduce pollutant loads and improve water quality, consistent with TMDL implementation
	Minimize dry weather urban runoff discharge into waterways and the Bay
	Achieve fishable, swimmable water quality standards in Ballona Creek
	Improve water quality in Santa Monica Bay
Maintain Flood Protection	Implement incentives to encourage new and existing developments to detain stormwater onsite to reduce runoff
	Implement a plan to utilize nonstructural flood protection projects to the maximum extent feasible
	Reduce the volume and velocity of stormwater runoff
Restore Natural Hydrologic Function to Ballona Creek and Tributaries Where Feasible	Expand water conservation programs
	Extend the distribution and range of uses of reclaimed water
	Maximize onsite collection of stormwater for irrigation and percolation
	Establish a network of stormwater detention sites
	Expand groundwater recharge facilities
Optimize Water Resources to Reduce Dependence on Imported Water	Restore tidal flushing to lagoons and wetlands where consistent with flood protection objectives
	Restore natural hydrologic conditions in stream channels where feasible
Improve Aquatic, Estuarine, and Riparian Habitat Quality and Quantity	Improve aquatic, estuarine and salt marsh habitat in the Ballona Creek estuary system, including the Ballona Wetlands, Ballona Lagoon, Playa del Rey Lagoon, and associated water bodies, by restoring tidal flushing, removal of invasive species, and restoration of native habitat
	Restore riparian habitat along a section of a tributary stream
	Establish self-sustaining populations of key indicator species in the Ballona Wetlands and the associated estuary system
	Establish self-sustaining populations of key indicator riparian species along tributaries
	Restore riparian habitat along Ballona Creek where feasible
	Daylight tributary streams and restore riparian habitat wherever feasible

Ballona Creek Watershed Management Plan Objectives

Goals	Objectives
LAND	
Improve Terrestrial Habitat Quality, Quantity and Connectivity	Restore habitat wherever feasible on publicly owned land in the Baldwin Hills, the Santa Monica Mountains and the Hollywood Hills, including removal of invasive species and restoration of native upland habitats, where consistent with use Expand protection of high-quality habitat and ecologically-significant areas Establish self-sustaining populations of key indicator riparian species tributary streams Develop and implement habitat monitoring programs Maintain, restore and enhance wildlife corridors as continuous linkages from the Santa Monica Mountains to Baldwin Hills, Ballona Wetlands and Santa Monica Bay
Improve Access to Open Space and Recreation for All Communities	Increase public open space by targeted, prioritized programs of land acquisition Coordinate open space planning, land acquisition and management among jurisdictions Accommodate a range of active and passive recreational uses Improve access to open space based on population density, distance and travel time for underserved communities Connect open spaces to transit access points Connect waterway projects to adjacent communities
Improve Pedestrian and Bicycle Access and Safety	Provide and maintain bicycle, pedestrian and equestrian trail systems along waterways and within the watershed to link public open space Provide for public safety and security along pedestrian and bicycle routes
Practice Stewardship of the Landscape	Adopt requirements for the use of native, regionally-adapted and drought-tolerant plants in all public sector projects, where consistent with use Provide incentives for use of native, regionally-adapted and drought-tolerant plants in private sector projects Encourage identification, preservation and restoration of historic sites and cultural landscapes

Ballona Creek Watershed Management Plan Objectives

Goals	*Objectives*
PLANNING	
Coordinate Watershed Planning Across Jurisdictions and Boundaries	Integrate watershed planning with water supply, natural resource, land use, and transportation plans
Implement Multi-Objective Planning and Projects	Employ comprehensive cost-benefit analysis to evaluate multiple-objective projects Leverage planned single-purpose infrastructure projects by incorporating multiple objectives and partnerships Provide incentives to promote sustainable, multiple-objective private sector projects Incorporate sustainability objectives and practices in all projects
Use Science as a Basis for Planning	Base plans and projects on scientifically-derived principles, practices and priorities Utilize applied scientific research to guide public policy
Involve the Public through Outreach and Education	Conduct public educational and outreach programs to promote watershed restoration. Establish a process for project participation by stakeholder representatives and the public. Incorporate appropriate interpretive signage and educational elements and facilities in watershed restoration projects.
Utilize the Plan in an Ongoing Management Process	Periodically assess progress towards meeting Watershed Plan objectives and revise as appropriate Develop benchmarks to assess watershed status by a regular monitoring process
Realize the Potential of Watershed Restoration for Sustainable Economic Development	Recycle underused sites along Ballona Creek as frontage for new, sustainable mixed-use development. Encourage compatible residential, commercial, and service uses adjacent to rehabilitated creek.

CALLEGUAS CREEK

Watershed Management Plan

A COOPERATIVE STRATEGY FOR RESOURCE MANAGEMENT & PROTECTION

PHASE I REPORT

November 10, 2004

1.0 INTRODUCTION

2.0 ACTION RECOMMENDATIONS

3.0 PAST WORK PRODUCTS

4.0 WATERSHED OVERVIEW

5.0 WATERSHED DEFINITIONS

CHAPTER 1

Introduction

1.1 INTRODUCTION AND OVERVIEW

Started in 1996, the Calleguas Creek Watershed Management Plan (WMP or plan) is a comprehensive, stakeholder driven effort to develop a resources management and protection program and strategy for the 341-square mile Calleguas Creek Watershed in southeastern Ventura County. Watershed stakeholders initiated the WMP in response to a clear need to work cooperatively and responsibly to develop a comprehensive plan that would guarantee the long-term health of natural resources in the watershed. Led by a broadly representative Steering Committee, the WMP has completed its first phase, the development of action recommendations and technical tools to address coordinated environmental and resource management by public agencies and private sector participants. Phase II, which is currently underway, focuses on how responsible parties in the watershed will act collectively to address significant water quality improvements and meet the mandatory standards of the federal Clean Water Act and California Porter-Cologne Act.

This document is a compilation and description of the work and process which has led to the completion of Phase I.

The Calleguas Creek WMP is designed to:
- Take a comprehensive approach involving all major stakeholder groups;
- Develop a common vision for the future;
- Create a permanent forum and structure for co-operative decision-making;
- Develop an in-depth understanding of current conditions and identify resource management needs;
- Facilitate comprehensive natural resource management, protection and enhancement;
- Coordinate public facility siting and development;
- Provide constructive guidelines for private sector actions;
- Meet required water quality standards through effective solutions; and
- Maintain a high quality of life while accommodating forecast growth.

In developing the WMP, the Steering Committee has also acknowledged that:
- A program of coordinated actions specifically designed for the Calleguas Creek Watershed will best meet its needs;
- A locally developed plan is most effective for watershed protection;
- A cooperative planning structure must involve locally-elected policy makers and a new entity should not be required for implementation; and
- A comprehensive and cooperative approach provides the best opportunity to invest public resources and effectively achieve objectives.

This Phase I Final Report helps meet these objectives by documenting the development of two major components, Action Recommendations and WMP Tools, which are integrated into the WMP.

Action Recommendations:
These watershed-wide recommendations have been developed by the functional WMP Subcommittees using common data and information, with a focus on complimentary implementation. Phase I Action Recommendations include six key areas:
- Water Resources and Water Quality;
- Habitat and Recreation;
- Flood Protection and Sediment Management;
- Agriculture;
- Land Use; and
- Public Outreach and Education.

Chapter 2 describes the Action Recommendations in detail, addressing their intent, purpose and development.

Watershed Management Planning Tools:
Since 1996, the WMP, in coordination with related projects, has assembled a large body of baseline data, maps, strategic plans, resource documents, and evaluation models. These comprehensive planning tools go well beyond what has existed in the past and are intended to help evaluate management options and inform public policy and private sector decision-making, particularly to:
- Encourage watershed-wide resource management planning;
- Enable watershed-wide public facility planning;

Appendix B

Comments on the Draft Report and Responses

From: Shirley Birosik [SBIROSIK@waterboards.ca.gov]
Sent: Wednesday, December 07, 2011 10:42 AM
To: Mark Horne
Cc: Zia.Hosseinipour@ventura.org
Subject: comments on the draft Ventura River Watershed Protection Plan Report

I have just a few comments.

On Page 2-44 there is a discussion of City of Ventura's Sanitary Survey Update from 2005. There is a more recent update from 2010 available. The sanitary surveys conducted by the Casitas Municipal Water District (covering lands draining to Lake Casitas) should be mentioned also. The most recent one was adopted in 2011.

Page 2-45: The current 303d list is from 2010 (although originally intended to be released in 2008). Some impairments are missing from Table 2.7-2 (those for Matilija Creek, Matilija Reservoir, and Lake Casitas). See http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml.

On Page 5-3, second paragraph under Lessons Learned, as I mentioned at a recent Ventura River Watershed Council meeting, the Ballona Creek Watershed Task Force is meeting once again after taking time off to refocus.

Shirley A. Birosik
Watershed Coordinator
CA Regional Water Quality Control Board, Los Angeles Region
320 W. 4th St., Suite 200
Los Angeles, CA 90013
213-576-6679
sbirosik@waterboards.ca.gov

Responses to comments from Shirley A. Birosik, dated December 7, 2011

The discussion of the Sanitary Surveys (in Section 2.7) has been updated to incorporate the new information from the Ventura and Casitas 2011 surveys.

The water quality impairments included in Table 2.7.2 has been updated with the more recent list (adopted in 2011).

The text in Section 5.3.1.3 has been revised to acknowledge that the Ballona Creek Task Force has recently begun to meet again.

Comments received during the presentation of the Draft Report to the Ventura River Watershed Council, December 13, 2011, and responses to those comments (which were not attributed to specific individuals).

Topic/ Comment	Response
Water Demand	
Using a one year snapshot (2010) is not the same as an "average" year for water demand, given the variation in water year types, as well as when precipitation occurs and the type of rain events. In particular, water use for agriculture varies greatly.	Water demand estimates in Urban Water Management Plans are typically provided in five year increments for three water year types: average, dry year, and multiple (or critically) dry years. The data incorporated into the Draft Report was average year demand for 2010, to the extent that information was available. Data for dry or multiple dry years was not available from other available sources, and thus estimation of water demand for those water year types was not feasible.
Do the numbers for water demand in Ventura: 1) include water provided to petroleum operations or 2) double count water supplied by Casitas.	The estimate of M&I water demand in the City of Ventura in Table 4-1 of the Draft Report did not include water provided to petroleum operations. Tables 4-1 and 4-3 in the Final Report have been revised accordingly. As Table 4-1 is an estimate of water demand, it does not account for water supplied by Casitas to the City of Ventura.
Groundwater extraction values for the Upper Ojai Basin (of 700 AFY) are available from DWR Bulletin 118.	The estimate of agricultural demand have been revised (in Tables 4-2 and 4-3) to include this additional information.
The combined estimate for agriculture and urban water demand are very similar to what Casitas calculated in 1990. The numbers look about right.	Comment noted.
Water Budget	
There may not be a lot of data on groundwater, however you can "back in" to the water budget numbers based on storage in reservoirs. Some maps and other reports could be included in the report.	An map of Ventura River Watershed Groundwater Basin and Surface Water Reservoirs was provided at the meeting (and is attached to the comment letter from Bill O'Brien in this Appendix). This map provides information that is similar to Figure 2.6-6 in the Draft Report.

Topic/ Comment	Response
The amount of water that evaporates from Lake Casitas should be included in the report. That information is available in Casitas' Urban Water Management Plan and the annual Casitas Hydrology reports.	The discussion of the Water Budget in Section 4.3 was revised to include an estimate of annual loss from evaporation and rainfall from Lake Casitas (of 2,630 AF).
Data Gaps	
The HSPF model needs ground-truthing and additional data to allow for the reduction in the size of the cells.	Comment noted. The discussion of data gaps for the HSPF suggests specific locations where additional data would be useful.
Fox Canyon GMA has produced estimates of water use for 22 crops and water year type, and this could be used to estimate agricultural water demand in the Ventura River watershed.	The discussion of data gaps in Section 6.3 will be revised to acknowledge the potential to use the agricultural water use data developed by the Fox Canyon GMA.
Report Scope and Purpose	
The report needs to clearly state the purpose and note that the scope is very limited; the last sentence in the introduction has the "why" statement – this should be moved to the beginning of the introduction and expanded.	The introduction to the Report will be revised.
The report should be more general, it is not a deliverable specifically for the VCWPD, as it is going to the State Board.	The introduction to the Report will be revised to acknowledge it fulfills a requirement of a grant from the State Water Resources Control Board.
Add a caveat in the introduction noting that the report is not a comprehensive assessment of the watershed and focuses on water supply. This is especially important since the report is going to the State Board, and they won't understand the limitations of the VCWPD Scope of Work.	The introduction to the Report was revised to insert this acknowledgement.
Water supply section needs to include an overview – and should note that the Ventura River watershed does not receive any imported water.	The text of the introduction to Chapter 4 (Water Demand and Water Budget) was revised.
The summary of V-1 projects is written in terms that are too technical; it needs an introduction that explains the section in lay person terms.	The initial text on each of the V-1 projects was to provide a short overview of each project.

Topic/ Comment	Response
Corrections or Clarifications	
The maximum credible earthquake for Red Mountain is incorrect. Based on recent research, that value should be 7.5.	The text in Section 2.4.1 was revised to modify the maximum credible earthquake from 6.8 to 7.0, per the Bureau of Reclamation's 2010 EIR/EIR on the Lake Casitas Management Plan. No other sources could be identified that confirmed the suggested value of 7.5.
The County built Matilija Dam, not the Corps.	The text in Section 2.9.3.1 of the report was revised.
The portion of the Matilija Dam removal project that the Corps can't do is related to the notching, the rest of the proposed work is within the Corps' scope.	The recommendation concerning moving forward with the Matilija Dam Ecosystem Restoration project (in Section 8.1.7) was revised.
Suggested Additions to Report	
Land use section needs to be beefed up and a habitat section added.	As noted in the Introduction (Chapter 1), the report relied on available information from reports produced for the V-1 projects and the Appendices to the in-progress Ventura River Multi-Species Habitat Conservation Plan. Those source documents did not include an extensive section on Land Use. As noted in the discussion of Data Gaps (in Section 6.3, limited information on habitat in the watershed was available from the referenced sources. We concur that additional information on Land Use and Habitat would be useful for the development of a watershed management plan.
Include an overall map with roads and creeks identified, as the existing maps don't identify those features	Several of the maps do provide identifying information. However, the report relied on existing graphics from available reports, which were not in a format that could be modified.
Each major section needs an introduction that highlights the themes/big picture for the section	The introduction to the Report (in Section 1) was revised to provide an overview of the report.
The report should identify themes/synopsis or a 3-5 page executive summary. The IRWMP has general information on the watershed that could be added.	The introduction to the Report (in Section 1) was to incorporate more summary information on the content of the document. Since Chapter 2 provides a summary of watershed characteristics, adding similar information to Chapter 1 was deemed too redundant.

Topic/ Comment	Response
There is not much discussion of what is going on in USFS lands and how that affects the watershed – e.g. septic tanks in the upper watershed.	As noted in the discussion of data gaps, information from the Los Padres National Forest Management Plan was utilized in the report, but that Plan provides very little information related to the Ventura River Watershed, and the information is focused on the management of the forest lands.
Disposition of Comments	
Suggest creating a matrix of comments received and response to comments to include with the document.	Oral comments from the meeting are summarized and responded to herein. Written comments are responded to individually in this Appendix.
Provide all comments to the State Board so they see what comments were made.	This section summarizes oral comments received at the meeting. Copies of all written comments are included in this Appendix.

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January 11, 2012

Zia Hosseinpour
Ventura County Watershed Protection District
800 South Victoria Ave.
Ventura, CA 93009-1600

Mark Horne
Cardno ENTRIX
201 N. Calle Cesar Chavez, Suite 203
Santa Barbara, CA 93103

RE: Ventura River Watershed Protection Plan Report – Draft Report

The City of Ventura has completed a review of the draft report of the Ventura River Watershed Protection Plan (dated December 2011). Our comments are noted below:

General Comments:

In general we feel the report is disjointed and incorporates information from various reports into a cut and paste document. This has contributed to conflicting data being included in the report. In addition, there is information that is incorporated into the report that is outdated and better not included. Therefore, we recommend the report be revised to incorporate current information provided in the City of Ventura's March 2011 Water Master Plan, 2010 Urban Water Management Plan and 2010 Ventura River, San Antonio Creek Watershed Sanitary Survey Update and perhaps other current agency annual reports that provide water production data (i.e. Ojai Groundwater Management Agency).

In addition the report looks at the City's water usage within the watershed to calculate a water balance for the watershed, which does not take into consideration that the Ventura River is just one of several sources utilized by Ventura Water customers. Ventura has been successful in utilizing multiple sources of water supply to create a reliable water system that relies on conjunctive use. Therefore, the report miss represents the City's water rights by restricting usage of our Ventura River water to only those present customers within the watershed. Therefore, the report needs to identify that the City's appropriate water rights are used conjunctively to provide service to all our customers.

501 Poli Street • P.O. Box 99 • Ventura, California 93002-0099 • 805.667.6500

Chapter 8 of the draft report, "Future Actions to Improve Water Sustainability and Ecosystem Functions" provides a list of recommended actions, which includes the development of a Ventura River Groundwater Management Plan. As noted in the list of recommended actions there are various water resource data gaps, which limit the potential for assessment of long-term trends in groundwater level and the development of a water budget. Therefore, we support the recommendation to develop a technical advisory group to assess and prioritize data gaps that need to be evaluated prior to moving forward with the development of a Groundwater Management Plan for the Ventura River Watershed.

Report Comments:

We are attaching Hopkins Groundwater Consultants Letter to the City dated January 10, 2012, that addresses our concerns (Attachment A).

Text Edits:

In addition, we have attached a few pages with revisions to the text for incorporation into the report (Attachment B).

We request that our comment letter be included in an appendix to the final report.

If you should have further questions please contact me at (805) 677-4503.

Sincerely,

Shana Epstein
General Manager, Ventura Water

cc: Ariel Calonne, City Attorney
Susan Rungren, Principal Engineer
Curtis Hopkins, Hopkins Groundwater Consultants

Attachments: A - Letter dated January 10, 2012, from Hopkins Groundwater Consultants to City

B - Mark-up copies of pages from *Draft Ventura River Watershed Protection Plan Report*

Attachment A –

Letter dated January 10, 2012, from Hopkins Groundwater Consultants to City

HOPKINS
GROUNDWATER
CONSULTANTS, INC.
THE WATER RESOURCE SPECIALISTS

January 10, 2012
Project No. 01-009-10

City of San Buenaventura
Ventura Water
Post Office Box 99
Ventura, California 93002-0099

Attention: Ms. Shana Epstein
General Manager Ventura Water

Subject: Review Comments on Ventura River Watershed Protection Plan Draft Report, Dated December 2011.

Dear Ms. Epstein:

As requested, Hopkins Groundwater Consultants, Inc. (Hopkins) has conducted a cursory review of the Ventura River Watershed Protection Plan Draft Report. Based on our review findings, we have developed the comments in this letter about the report contents and recommend that the City of San Buenaventura (City) consider requesting that the Ventura County Watershed Protection District (District) consider potential modifications or clarifications.

We recognize that the report is intended to be a generalized summary of the Ventura River watershed conditions that were obtained from existing, readily available documents. However, in light of the significant data gaps identified in this report and previous reports referenced (see report section 6), we question whether this compilation provides sufficient relevant information to develop a comprehensive and integrated watershed management plan.

It is our understanding that the report is intended to satisfy the fourth and final bullet of tasks that Project V-1 was proposed to include (i.e., the Ventura River Watershed Protection *and Supply* Plan [see page 1-1]). The supply aspect of the originally proposed plan was removed in title and the water demand was subsequently summarized in a confusing manner (see report section 4.2). The water demand does not appear to represent the City's historical demand of the water supply obtained from within the watershed. The discussion instead focused on grossly estimating the per capita water use within the watershed (which ignores industrial uses), not the total historical diversions from within the watershed as documented by the City and reported to the State.

The recommendations for the watershed management plan summarized in report section 5.4 should likely include a bullet that discusses; Identifying and quantifying established and permitted legal surface water diversion and groundwater pumping rights within the watershed.

P.O. Box 3596, Ventura, California 93006 Phone: (805) 653-5306 e-mail: chop4@earthlink.net

We believe the report should subsequently identify the City's efforts documented in the Foster Park Wellfield Design Study (Hopkins, 2007) and include the City's proposed diversion strategy in the report section located on page 7-4 titled *Implement Integrated Water Resource Management Practices*. If regulatory agencies were to approve, the City intends to completely abandon direct diversion of surface water flows and locate additional well facilities in the Foster Park area. The new facilities would allow a better conjunctive use of this supply during the rainy season when flows are high and subsequently a controlled diversion of water as flow diminishes in the river. This strategy is intended bolster the historically sustainable yield of the lowest reach of the Upper Ventura River Groundwater Basin in a manner that is environmentally responsible.

The report appropriately indicated the intentions and approach to developing a groundwater management plan; however, typical groundwater management plans are developed and implemented by a groundwater management agency comprised of historical groundwater users with legal authority provided by the State. It is unclear what legal entity will collect data, conduct study, and be accountable for the implementation of the plan when developed.

We trust the summary of the draft report review findings is sufficient for the City's administrative needs. If you have questions or need any additional information, please give us a call.

Sincerely,
HOPKINS GROUNDWATER CONSULTANTS, INC.

Curtis J. Hopkins
Principal Hydrogeologist
Certified Engineering Geologist EG 1800
Certified Hydrogeologist HG 114

Attachment:

References

Cardno Entrix (2011), *Ventura River Watershed Protection Plan Draft Report,* prepared for the Ventura County Watershed Protection District, Dated December.

Hopkins Groundwater Consultants, Inc. (Hopkins, 2007), *Preliminary Hydrogeological Study, Foster Park Wellfield Design Study, Ventura, California,* prepared for the City of San Buenaventura, Dated December.

Attachment B –

Mark-up copies of pages from *Draft Ventura River Watershed Protection Plan Report*

Cardno ENTRIX

Shaping the Future

DRAFT

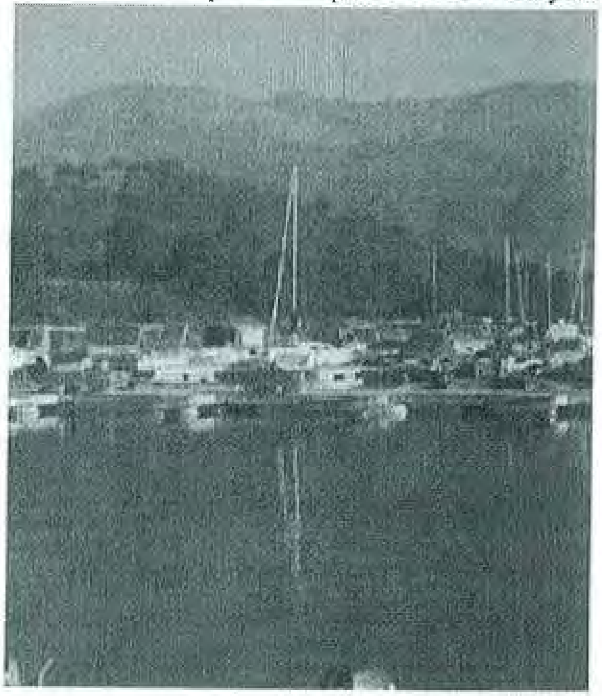
Ventura River Watershed Protection Plan Report

December, 2011

Prepared for
Ventura County Watershed Protection District

Several multiple-use trails serve bicyclists, equestrians, and pedestrians in the watershed. The Ojai Valley Trail follows the abandoned Southern Pacific Railroad right-of-way and is located along the west side of State Route 33 from Ojai to northern Foster Park. In the City of Ventura, the Omer Raines Trail parallels the Ventura River and terminates at Main Street. A Class I trail, following the Southern Pacific Railroad casement connects the Ojai Valley Trail with the Omer Raines Trail. The City of Ventura owns and ~~manages~~ the Ventura River Trail, a multi-purpose trail that extends from Foster Park to the beach. maintains

Lake Casitas is open to the public for non-body contact recreational activities. All recreational activities are operated by Casitas Municipal Water District (Casitas) or by concessionaries.



The Recreation Area encompasses approximately 4,097 acres and consists primarily of open space. The recreational facilities are located on approximately 400 acres scattered about the perimeter of the lake. Existing recreational facilities include camping, picnicking, motor boating, sailing, canoeing, and fishing. Lake Casitas hosted the 1984 Olympic Rowing and Canoeing Events and is currently the home of the Lake Casitas Rowing Association which provides recreational and competitive rowing training to youth and adults in the community. The lake is also used by bird watchers to view the many migratory birds that use Lake Casitas as they pass through the Pacific flyway. Facilities include stores, campgrounds, RV campgrounds, showers, restrooms, picnic areas, boat ramps, water playground, a radio-controlled airplane landing strip, and boat and trailer storage.

Lake Casitas is famous for its record fish catches. Fishing takes place from docks, boats, and shore. Lake Casitas contains a warmwater fishery that includes bass (primarily large mouth), catfish, sunfish, and crappie. These fish are non-native and were introduced when the lake was formed, but now are self-sustaining populations. Both the California Department of Fish and Game (CDFG) and Casitas also stock the lake annually with catchable size rainbow trout. Lake Casitas has also been stocked on an irregular basis with crappie and other panfish.

The Ventura County Parks Department maintains three regional parks (Camp Comfort, Soule Park, and Foster Park) located adjacent to waterways of the Ventura River. Camp Comfort Regional Park is situated adjacent to San Antonio Creek. Soule Park recreation area consists of a golf course and a public park. The confluence of San Antonio and Thacher creeks occurs within Soule Park, and the Ventura River runs through Foster Park. Activities at all parks include picnicking and playground areas and services such as public restrooms. Park users also wade in San Antonio Creek at Camp Comfort and in the Ventura River at Foster Park. Soule Park includes baseball and equestrian facilities as well as a public golf course. Water for golf course

2.3.1.1 Mountainous Uplands

The mountainous uplands are the primary water and sediment production areas, with few or no alluvial deposits and steep streambed gradients. The major sub-basins with significant uplands include Matilija, North Fork Matilija, Coyote, Santa Ana, and San Antonio creeks (Tables 2.3-1 and 2.3-2). This is also the zone in which two major water supply and flood control facilities are located (Matilija Dam and Casitas Dam).

Table 2.3-1 Major Ventura River Watershed Sub-Basins and Water Facilities

Sub-Basin	Unit Area (sq. mi.)	Percent of Area at Foster Park (%)	Storage and Diversion Facilities	Present Capacity
Uplands: Headwaters/Tributaries				
Matilija Creek	55	29.3	Matilija Dam	500[a] acre-feet (AF)
North Fork Matilija Creek	16	8.5		
San Antonio Creek (includes Ojai Valley)	51	27.1		
Coyote and Santa Ana Creeks	41	21.8	Casitas Dam	254,000 AF
Alluvial Valleys: Mainstem				
Upper Ventura River	74[b]	39.4	Robles Dam	900 AF/day
Ventura River near Ventura at Foster Park	18[illegible]	100.0	Foster Park*** ?	Surface: 21.4AF/day Sub-surface: 11.1 AF/day
Ventura River below Foster Park	100			
Total	228			

a. Estimated by Reclamation (2000)
b. Includes area of all upstream sub-basins
c. Average daily capacity, exclusive of Nyo well field. Maximum production is effectively limited by the 13 mgd (20 cfs) capacity of the water treatment plant.

Source: ENTRIX and Woodward Clyde Consultants 1997 and Reclamation 2000

c footnote does not make sense

Cleanup foot notes

Table 2.3-2 Drainage Area of Sub-Watersheds in the Ventura River Watershed

Local Area Watershed Name	Drainage Area (mi^2)	Maximum Length of Watershed (ft)	Minimum Elevation of Watershed (ft)	Maximum Elevation of Watershed (ft)	Mean Annual Precipitation (inches)
Matilija at Matilija Dam	54.6	83,363	1,009.29	5456.77	23.5
North Fork Ventura River-Matilija	16.2	40,554	1009.29	5006.72	22.1
Ventura River D/S of Willis Canyon	7.4	22,090	696.87	4,278.56	20.2
Ventura River at Live Oak Creek	11.6	45,685	290.61	2,310.04	17.8
San Antonio Creek	51.0	79,331	290.41	5.410.69	18.3
Santa Ana Creek at Lake Casitas	9.5	38,211	528.60	4,645.89	18.7
Coyote Creek above Lake Casitas	13.4	36,127	560.88	4,769.48	21.1
Drainage area that includes Lake Casitas	15.3	31,470	514.96	2,342.64	18.2
Ventura River Subarea to Foster Park	9.3	25,313	195.36	1,302.82	17.3
Cañada Larga Subarea to Foster Park	19.3	50,752	195.78	2,788.00	17.9

Table 2.3-2 Drainage Area of Sub-Watersheds in the Ventura River Watershed

Local Area Watershed Name	Drainage Area (mi²)	Maximum Length of Watershed (ft)	Minimum Elevation of Watershed (ft)	Maximum Elevation of Watershed (ft)	Mean Annual Precipitation (inches)
Lower Ventura River	15.5	35,470	0.00	2,117.63	16.9
Entire Ventura River Watershed	228	—	0.0	5,456.77	19.9

Source: U.S. Army Corps of Engineers (USACE) 2004

Approximately 80 percent of the watershed is composed of uplands of hill slopes and ridges with surface geology of Tertiary sedimentary rocks (3 million to 70 million years old). The bedrock units of the Tertiary sedimentary rocks (i.e., well-cemented sandstones, siltstones, conglomerates, and shales) have been severely deformed by folding and faulting, and have low permeability relative to the unconsolidated alluvial deposits in the main valleys (Reclamation 2003).

2.3.1.2 *Alluvial Valleys*

The alluvial valleys are primarily a zone of storage and transfer of water and sediment and include the mainstem river, floodplain, and valley bottom downstream of the confluence of Matilija and North Fork Matilija creeks and the Ojai Valley (or the San Antonio Creek sub-basin). The upper portion of the Ventura River mainstem valley (upstream of Foster Park) is the reach of the river with groundwater production and surface diversions.

The alluvial valleys are underlain by relatively shallow deposits, ranging in age from 10,000 to 1 million years old. The Ventura River has slowly migrated to the west during the late Quaternary Period, leaving a series of terraces marking former channel and floodplain locations (Putnam 1942 and Rockwell et al. 1984, as cited in Keller and Capelli 1992).

The alluvial deposits continue to be affected by active regional tectonic forces that tilt and bend sediments and create vertical and horizontal offsets (faults), affecting subsurface water flow and water levels. The alluvial valley fills constitute the major groundwater aquifers, and the major groundwater basins of the Ventura River watershed are located in these valleys and include the Ojai Valley basin, the Upper Ventura River basin (above Foster Park), and the Lower Ventura River basin (Fugro West 1996). In addition, minor groundwater basins occur in the Upper Ojai Valley (along Lion Creek) and along lower San Antonio Creek (Turner 1971, as cited in EDAW et al. 1981).

2.3.1.3 *Lagoon/Delta*

The Ventura River lagoon encompasses approximately 3.7 acres between the shoreline and a few hundred yards upstream of the U.S. Highway 101 Bridge. The lagoon is separated from the Pacific Ocean by a sand/cobble bar during the dry season and opens and closes in response to storms and flow changes throughout the year. When full, the lagoon covers approximately 1.5 surface hectares and ranges in depth from 0.6 to 2.4 meters. The river lagoon includes the shifting channels and depositional environments at the mouth of the river, occurring in an arc-shaped delta that extends approximately 1 mile upstream from the ocean and is 2 miles wide at the coast. An estuary at the second mouth exists to the west of the main lagoon (CRWQCB-LA 2002).

Some areas of the watershed have not burned for many years, such as the area around Lake Casitas and parts of the San Antonio Creek basin. These locations may be susceptible to intense damage from future fires due to accumulated fuel loads (Chubb 1997). By reducing or destroying vegetative cover and altering soil characteristics, fires may result in conditions that can significantly increase runoff and erosion when winter rains begin to fall. These conditions may result in a debris flow (also referred to as mud flow) – a slurry of water, sediment, and rock that converges in a stream channel (URS 2005).

2.6 Hydrology

2.6.1 Historical Context

Although few records exist prior to the 20th century, a review of historical maps and documents suggests that the historical hydrology of the Ventura River was a result of the form of the river channel and the associated geology. In the reach of the river within Matilija Canyon, flows were perennial. As the river entered the Ojai Valley and the channel broadened, surface flows became intermittent. At the confluence with San Antonio Creek, and from Foster Park to the mouth of the river, flows were perennial (SFEI, 2011).

2.6.2 Surface Water

Flow conditions in the mainstem of the Ventura River and tributary watersheds are naturally variable depending upon precipitation (rainfall and snowmelt). About 80 percent of the time, there is no significant surface flow in the Ventura River above the confluence with San Antonio Creek. However, there is generally year-round flow in the lower reaches of San Antonio Creek. During the wet season, the surface flows are "flashy," with sudden rises in discharge immediately following the onset of precipitation, and relatively rapid declines in streamflow after precipitation decreases (USACE 2004).

Under summer low-flow conditions, surface streamflow at various locations in the watershed is governed by a number of factors, including precipitation input, spring discharge, groundwater levels, the effects of water diversions, water storage and water supply releases, treated wastewater discharge, and groundwater extraction. Some reaches of the mainstem Ventura River tend to go dry on a yearly basis. This typically includes the Ventura River reach between Robles Fish Passage Facility and the upstream end of the Casitas Springs/Foster Park reach between the confluence of San Antonio Creek and Foster Park. The Casitas Springs/Foster Park reach and Ventura River downstream from the OVSD Wastewater Treatment Plant to the lagoon typically retains flows year round. This section of the Ventura River has perennial flows, even during drought years, due to a natural bedrock barrier that forces subsurface flow to the surface. The river channel occurs as a wide floodplain and during high flows is "characterized by a typical pool riffle continuum found in low gradient streams." Vegetation such as watercress and water veronica is consistent with the spring-fed nature of this reach (Moore 1980).

← we have seen the river dry. during drought years.

San Antonio Creek typically goes dry upstream from Soule Park across the Ojai Valley, but is typically perennial downstream to the confluence with the Ventura River. North Fork Matilija Creek retains perennial surface flows except during long periods of severe drought (ENTRIX 2003). Along the mainstem, surface flows dry up in locations between the Robles Fish Passage Facility and the confluence of San Antonio Creek. However, small summer flows are maintained upstream of the Robles Fish Passage Facility; in the Casitas Springs/Foster Park reach, between Foster Park and the confluence of San Antonio Creek; and downstream of the OVSD Wastewater

Treatment Plant (ENTRIX and Woodward Clyde Consultants 1997). The following background information summarizes the general hydrology of the Ventura River watershed.

From the Matilija Creek headwaters to Camino Cielo, the Ventura River is perennial, supported in part from releases from Matilija Dam. The flow is intermittent from Camino Cielo to the confluence with San Antonio Creek with the reach below the Robles Fish Passage Facility typically going subsurface during the summer months (ENTRIX 2001). Historically, there has been little or no surface flow in the river in the summer from Hollingsworth Ranch (8 miles above the lagoon) to the former Soper's Ranch (14 miles inland). There is a geologic discontinuity at Casitas Springs that causes groundwater to rise and feed a perennial stretch of the surface flow below San Antonio Creek (CRWQCB-LA 2002). Surface flows in this reach come from San Antonio Creek, Live Oaks Acres Creek, and small springs and rising groundwater. Between the confluence with San Antonio Creek and Foster Park, flow is perennial, with some disruption at Foster Park by the groundwater extraction. The river has a perennial flow to the lagoon due to rising groundwater and water treatment plant discharges.

2.6.2.1 *Surface Flow Conditions*

The factors controlling surface streamflow differ considerably during the high-flow season ~~and~~ or wet years from those that occur during low-flow seasons or dry years. The following summary of historical conditions presents separate discussions of high and low flows to help clarify the relationship between streamflow conditions and various water resource developments and operations. Several stream gages are located in the Ventura River watershed, and some have a record extending as far back as 1927 (Table 2.6-1). Originally, the U.S. Geological Survey (USGS) operated them all, but starting in the 1980s, the District and Casitas have operated several gages. The operation of some gages has been discontinued for various reasons. The gage above Matilija Dam (11114500) was destroyed in the 1969 flood. The records for gages above Casitas Lake (11117600 and 11117800) are not considered reliable for high flows after 1988 because Casitas took over their operation at that time and was not concerned with recording high flows in this area. The gage locations are shown in Figure 2.6-1 along with their periods of record.

Table 2.6-1 Stream Gages in the Ventura River Watershed

Description	USGS Gage Number	Drainage Area (mi^2)	Period of Record	Data Source
Matilija Creek U/S Reservoir near Matilija Hot Springs	11114500	50.7	1948-1969 (destroyed)	USGS
Matilija Creek at Matilija Hot Springs	11115500	54.7	1927-present	USGS and Casitas
North Fork Matilija Creek at Matilija Hot Springs	11116000	15.6	1928-present	USGS and District
Ventura River near Ojai	11116500	70.7	1911-1984 (not maintained)	USGS
Ventura River near Meiners Oaks	11116550	76.4	1959-present	USGS and Casitas
San Antonio Creek near Ojai	11117000	33.7	1927-1932	USGS
San Antonio Creek at Casitas Springs	11117500	51.2	1949-present	USGS and District
Coyote Creek near Oak View	11117800	9.11	1958-present (not reliable)	USGS and Casitas
Coyote Creek near Ventura	11118000	41.2	1927-1982	USGS and Casitas

Table 2.6-1 Stream Gages in the Ventura River Watershed

Description	USGS Gage Number	Drainage Area (mi²)	Period of Record	Data Source
Ventura River Diversion near Ventura	11118400	–	1969-present	USGS
Ventura River near Ventura	11118500/ 11118501	188	1929-present, 1932-present, respectively	USGS
Ventura River at Santa Ana Blvd.	Flood warning gage	–	2002-present	District
Thacher Creek at Boardman	Flood warning gage	–	2002-present	District
Matilija Creek upstream of Reservoir	11114495	47.8	2002-present	USGS

Source: District 2007; USGS 2007; Casitas, no date

Description changes for Tables 2.3-1, 2.3-2, 2.6-1 + 2.6-2. Need to be consistent in data + descriptions.

2.6.2.2 River and Tributary Runoff Production

The production of runoff in various tributaries is generally related to sub-basin area, peak elevations, and variations in vegetation and soil conditions, as well as local storm patterns. Runoff volumes, hydrograph timing, and sediment yield over the period of record has been greatly affected by interaction of fires and floods (refer to Section 2.5, Fire Regime).

Long-Term Averages

The long-term average runoff production for the gauged tributaries and the Ventura River is presented in Table 2.6-2. Matilija and San Antonio creek sub-basins have the largest average annual runoff volumes, with Matilija Creek being the single most important sub-basin for total volume. North Fork Matilija Creek and Matilija Creek are the major water production areas, with long-term average runoff of approximately 500 AF per square mile of watershed area. San Antonio Creek has the lowest runoff production per unit area, but has a larger watershed than either Coyote or Santa Ana creeks. Therefore, the average annual runoff produced from the San Antonio Creek basin is approximately equal in volume to that from both the Coyote and Santa Ana sub-basins upstream of Lake Casitas.

Water Year Types

Annual unimpaired runoff for the Ventura River watershed between 1930 and 2005 varies greatly, with several extremely high years of runoff much higher than the mean value (Table 2.6-3; Figure 2.6-2). The totals range from a low of 1,602 AF in water year (WY) 1961 to a maximum of 277,300 AF in WY 1995. The median annual unimpaired runoff, 18,116 AF, is much lower than the mean due to the statistical effect of a few extremely large runoff years.

The wide range of streamflows from year to year is not unusual for a semi-arid setting, but has important implications as a natural limitation to both the native fisheries resources and water supply management. Over typical planning timeframes (20 to 50 years), such variability creates limitations to water supply management and native fisheries resources. However, when viewed from longer time spans, the conditions are less of a limiting factor than an evolutionary pressure affecting the traits of native fishes. The entire historical record has been analyzed and categorized into WY types. Standard hydrologic methods were used to rank the years and analyze the percent of years with certain ranges of values creating five classes: wet, above normal, normal, below normal and dry. The WY type was determined using the unimpaired runoff for the Ventura River, near Ventura gage (combined record, USGS #8501) (Table 2.6-3).

These water years need to be defined as to what the range for each class means.

Table 2.6-3 Water Year Types for the Ventura River Basin Based on Unimpaired Runoff

Water Year	Ventura River Runoff** Annual Volume (AF)	Ventura River Runoff** Water Year Type*	Water Year	Ventura River Runoff** Annual Volume (AF)	Ventura River Runoff** Water Year Type*
1939	24,773	Normal	1976	7,731	Below Normal
1940	16,807	Normal	1977	6,558	Dry
1941	262,031	Wet	1978	242,412	Wet
1942	27,751	Above Normal	1979	37,661	Above Normal
1943	142,573	Wet	1980	137,703	Wet
1944	81,338	Wet	1981	14,888	Normal
1945	37,087	Above Normal	1982	10,121	Below Normal
1946	30,919	Above Normal	1983	221,222	Wet
1947	19,268	Normal	1984	34,373	Above Normal
Matilija Dam began storing water in water year 1948			1985	8,820	Below Normal
1948	4,473	Dry	1986	52,680	Above Normal
1949	4,308	Dry	1987	10,523	Below Normal
1950	7,863	Below Normal	1988	12,087	Below Normal
1951	3,574	Dry	1989	7,011	Dry
1952	130,918	Wet	1990	3,672	Dry
1953	14,112	Normal	1991	23,967	Normal
1954	14,102	Below Normal	1992	61,637	Above Normal
1955	4,909	Dry	1993	101,855	Wet
1956	14,972	Normal	1994	3,683	Dry
1957	5,804	Dry	1995	277300	Wet
1958	165,177	Wet	1996	13009	Below Normal
Casitas Dam, Robles Diversion began functioning in water year 1959			1997	19513	Normal
1959	10,847	Below Normal	1998	264364	Wet
1960	4,238	Dry	1999	12141	Below Normal
1961	1,602	Dry	2000	18068	Normal
1962	64,884	Above Normal	2001	73788	Wet
1963	7,087	Dry	2002	7299	Below Normal
1964	3,960	Dry	2003	15466	Normal
1965	6,155	Dry	2004	9901	Below Normal
1966	42,424	Above Normal	2005	235817	Wet

*Water Year Type is defined as the surface-water supply for the 12 month period October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1990, is called "water year 1990."

Please define water year types.

need, to make easier to read

Low Flows

Under summer low flow or drought conditions, surface streamflow at various locations in the watershed are governed by a complex interaction of precipitation input; discharge from springs; groundwater levels; the effects of water diversions, water storage, water supply releases, and treated wastewater discharge and groundwater extraction.

It is not unusual for streams in Southern California that are rainfed, and lack groundwater support, to dry up in summer months, in both average and below average precipitation years. In the Ventura River watershed, however, several of the smaller tributaries, and even the mainstem, have short perennial reaches that are fed by springs and/or the perched groundwater over shallow bedrock. Perennial flows are present in San Antonio Creek, and in the Casitas Springs/Foster Park reach, defined as the portion upstream of, and including, Foster Park and including lower San Antonio Creek from SR 33 to its confluence with the Ventura River. The presence of year-round flow in this reach of the river is due to high groundwater levels in the shallow alluvium over bedrock, which is artificially raised at Foster Park by the City's subsurface dam (URS Corporation 2003).

Small summer streamflows maintained by springs were documented by both Reclamation (1954) and EDAW et al. (1981) in the upper reaches of the larger sub-basins. EDAW reported typical summer base flows of 1 to 2 cfs in North Fork Matilija Creek, 1 to 3 cfs in Matilija Creek, and less than 0.5 cfs in San Antonio Creek and Coyote Creek below Casitas Dam. Since the 1960s, effluent discharge from the OVSD Wastewater Treatment Plant provides summer flows of approximately 1.9 cfs (2002 data) from the OVSD Wastewater Treatment Plant downstream to the lagoon.

2.6.3 Groundwater

Groundwater has been an important water source for irrigation and municipal supplies in the Ventura River watershed for many decades. In general, groundwater in the Ventura River system occurs under unconfined conditions. However, in some localized areas (where fine-grained overbank deposits form a relatively low permeability cap over old channel deposits with higher permeability), semi-confined conditions may exist, especially during periods of high water levels (Fugro 2002). The primary source of recharge to the alluvial aquifer system is direct infiltration of surface flows. Two other sources of recharge include direct infiltration of precipitation, and downvalley underflow through alluvial sediments.

The Ventura River system is composed of five major groundwater basins: the Upper Ojai basin; the Ojai basin; the Upper Ventura River basin; the Lower Ventura River basin; and the San Antonio Creek basin (ENTRIX 2001c). Of primary importance to this report are the Upper Ventura River, Ojai, and San Antonio Creek basins because local agencies operate and maintain water supply facilities in these areas (Figure 2.6-6). A description of the major groundwater basins is provided below.

2.6.3.1 *Groundwater Basins*

Upper Ventura River Basin

The Upper Ventura River Basin has a partial downslope along the Arroyo Parida fault to the north (ENTRIX 2001b). The upper basin extends from the confluence of Matilija Creek and North Fork Matilija Creek (RM 16.2) to the City's subsurface dam at Foster Park (RM 5.9), which delineates the boundary between the Upper and Lower Ventura River groundwater basins. The basin is believed to have a capacity of approximately 14,000 AF when full (USACE 2004). The boundary between the Ojai Basin and the Upper Ventura River Basin is situated between Camp Comfort to the south and Arbolada to the north. The depth to bedrock decreases in the vicinity of this boundary resulting in a decrease in thickness of the aquifer materials.

The Upper Ventura River is underlain by alluvial deposits with a maximum thickness of approximately 200 feet and an average thickness of 60 to 100 feet. A natural subsurface obstruction blocks subsurface flow below the Ventura River just above San Antonio Creek causing groundwater to rise as springs. Therefore, the groundwater beneath the Ventura River is divided into an upper cell and a lower cell (Reclamation 2003).

The thickness of aquifer materials is generally shallow, but varies along the river due to the geologic structure of the basin (variations in the depth to bedrock and faulting). Along the Upper Ventura River, the water-bearing units increase in thickness downstream of the confluence of Matilija and North Fork Matilija creeks, attaining a maximum thickness of approximately 200 feet on the north (down dropped) side of the Arroyo Parida-Santa Ana fault (Figures 2.6-7 and 2.6-8). Downstream of the Santa Ana fault, in the Mira Monte area, the alluvium thickness is controlled by the folded bedrock surfaces and is approximately 65 feet thick. In the Foster Park area, north of the subsurface dam and in the vicinity of the City's Nye Wells, the aquifer materials are 45 to 60 feet thick, providing a saturated thickness ranging from 35 to 45 feet (Fugro West 2002). The total storage capacity of about 14,000 AF typically empties during a 1 to 3-year critical dry period. The dominant source of recharge is direct infiltration or precipitation and percolation from local streambeds (ENTRIX and Woodward Clyde Consultants 1997).

→ See Paragraph I, under general comments of our comment letter.

Ojai Groundwater Basin

The Ojai Groundwater Basin (Ojai Basin) is located within the Ventura River watershed, within the western portion of Ventura County, California. The Basin is bordered by the Topa Topa Mountains and Santa Ynez Mountain Range on the north and east, Black Mountains on the south, and the Upper Ventura River Groundwater Basin to the west. Ground surface elevations across the alluvial surface of the Basin range from over 1,300 feet above mean sea level (amsl) at the northeastern portion of the Basin, to approximately 700 feet amsl. The drainage area for the basin comprises 36 square miles and rises to elevations over 4,500 feet amsl. The alluvial groundwater Basin is 10.7 square miles (Kear 2005, as cited in Daniel B. Stephens & Associates [DBS&A 2010b]). A large fraction of land within the basin is dedicated to orchards, with the remaining area composed of residential, pasture, commercial and vacant land uses. Municipal and agricultural water requirements of the basin have historically been supplied by both surface water and groundwater sources.

The Ojai Basin is composed of alluvium deposits within a structural depression, and the lateral boundaries of the basin are defined by the contact between the alluvial deposits and the underlying sedimentary rocks (SGD 1992, as cited in DBS&A 2010b). The alluvial aquifer consists of undifferentiated and poorly consolidated deposits of clay, sand, gravel, and boulders. Confining clay units exist within the alluvium, and Kear (2005, as cited in DBS&A 2010b) reported that the units are thickest in the southern portion of the basin.

see paragraph 1 of General Comments in attached City Comment Letter.

Additionally, the City of Ventura collects water quality samples at 11 sites located throughout the watershed. Since 2002, the City has monitored water quality along the Ventura River and San Antonio Creek at these sites for *Cyptosporidium*, *Giardia*, bacteria, nutrients, bromide, total organic carbons, chloride, and conductivity.

The Ventura River and San Antonio Creek Watershed Sanitary Survey 2005 Update (Kennedy/Jenks 2006) reviewed water quality sampling in the Ventura River and San Antonio Creek watersheds. The survey mapped and discussed overlap in sampling sites and constituents among the City of Ventura's, OVSD's, and Ventura County Stormwater Monitoring programs, the Ventura River Stream Team water quality monitoring program, and planned agricultural lands monitoring (associated with the Regional Board's Agricultural Waiver program) due to begin in fall 2006. The report recommended consolidation of the monitoring programs with data stored in a central NPDES database maintained by the District (Kennedy/Jenks 2006).

The Sanitary Survey Update cites the 2005 County Storm Water Monitoring Report in a summary of water quality conditions from 2001 to 2004 with the statement:

"These results [of the water quality monitoring] indicated that water quality in the watershed remained relatively stable during this four year period."

The Sanitary Survey Update notes that *Giardia* and *Cyptosporidium* were below detection limits in the City of Ventura's water sampling program during the 2000 to 2005 period and that general mineral, physical, radionuclide and inorganic chemicals stayed within historical ranges (Kennedy/Jenks 2006). The Sanitary Survey Update also notes actions since 2000 that have reduced the risk of contamination including:

- New OVSD siphons that reduce the risk of spilling untreated wastewater.
- Horse manure public awareness program.
- Successful operation of the permanent Household Hazardous Waste Collection Facility.
- Improvements to the City's Avenue Water Treatment Plant.

2.7.1 Summary of Water Quality Conditions in the Subwatersheds

Above Foster Park, surface water quality in the Ventura River is controlled in large part by the tributary water quality. In the upper tributaries, boron is contributed by hot springs in the Santa Ynez Mountains. Boron can be as high as 6.5 ppm in Matilija Creek above the reservoir during low flow conditions. The high boron is diluted in the reservoir so that water downstream is of higher quality. Turbidity in the watershed can rise as high as 600 turbidity units following storms (Casitas and City of Ventura, 1984).

Uncontrolled stockpiling and storage of horse manure has been observed at some locations within the watershed which could lead to nutrient loading and coliform problems (URS 2002). Organic chemical analysis of raw water by the City of Ventura in 1997 and 1999 did not find organic chemicals at detectable levels (URS 2002). The excessive growth of vascular plants, particularly the non-native water primrose, is prevalent in the lower Ventura River. Below the discharge point from the Ojai Valley Wastewater Treatment Plant, DO generally remains above 7.0 mg/l, but seasonally in the late summer and early fall DO levels fall. With the first major winter or spring storms and corresponding increased flows in the Ventura River, the DO levels tend to return to desirable levels. Actually, DO levels in the river have improved dramatically to about 11 mg/l. Nitrate levels continue to be considerable in San Antonio Creek, which drains much of the Ojai area. According to the Ventura Stream Team, slightly elevated levels of nitrate are also seen in the lower river.

2.7.2 Impaired Water Bodies in the Ventura River Watershed

The Clean Water Act requires each state to assess the status of water quality in the state (Section 305(b)) and provide a list of impaired water bodies (Section 303(d)) to the U.S. Environmental Protection Agency (USEPA) every 2 years. Impaired water bodies are those that have been determined to not achieve designated beneficial uses. A finding of impairment is made through use of decision rules specified in the State Board Listing Policy, which considers data on chemical-specific water quality standards; bacterial water quality standards; health advisories; bioaccumulation of chemicals in aquatic life tissues; nuisances such as trash, odor, and foam; nutrients; water and sediment toxicity; adverse biological response; and degradation of aquatic life populations and communities. For water quality limited segments included on the 303(d) list, the state is required to develop a Total Maximum Daily Load (TMDL) or take other action to address the impairment. The 2008 update to the Section 303(d) list (CRWQCB-LA 2009, Appendix F) identifies a number of waterbody segments in the Ventura River watershed as water quality limited and requiring a TMDL. These listings are shown in Table 2.7-2. A TMDL for trash has already been developed for the Ventura River Estuary (Tetra Tech 2009b).

Table 2.7-2 2008 Section 303(d) List of Water Quality Limited Sections in the Ventura River Watershed Requiring Development of a TMDL

Waterbody Name	CALWATER Watershed	Estimated Size Affected	Pollutant(s)
Cañada Larga (Ventura River watershed)	40210010	8.01 miles	Fecal coliform Low DO TDS
San Antonio Creek (tributary to Ventura River Reach 4)	40220023	9.79 miles	Indicator bacteria Nitrogen TDS
Ventura River Estuary	40210011	0.2 miles	Algae Eutrophic Total coliform
Ventura River Reach 1 and 2 (Estuary to Weldon Canyon)	40210011	4.49 miles	Algae
Ventura River Reach 3 (Weldon Canyon to Confl. w/ Coyote Cr.)	40210011	2.82 miles	Indicator bacteria Pumping Water diversion
Ventura River Reach 4 (Coyote Cr. to Camino Cielo Rd.)	40220021	19.22 miles	Pumping Water diversion

Source: Tetra Tech 2009b

2.9.2 Diversion Structures

Four major on-stream diversion structures and conveyances have been identified in the Ventura River watershed (Figure 2.9-3). Three canals are represented spatially in the GIS; the fourth (Foster Park) is shown only as a point. Water stored in Casitas Reservoir is in large part derived from the Ventura River via the Robles Diversion Dam and the Casitas-Robles Canal (Tetra Tech 2008a).

See Paragraph 1, General comments of attached comment letter

The Foster Park Diversion supplies water to the City of Ventura. The diversion is apparently via a pipe embedded in the alluvium, and so may include both surface and shallow subsurface flow – but these flow types are difficult to separate in this stretch of the river, which has high storage capacity in the alluvium. Daily gauged flows for the Foster Park Diversion have been obtained for 1932 to 2006. It is not known if later flows are available, or if the diversion has ceased. Little is known at present about the other two mapped diversions – Live Oak and Rancho Matilija. No gauging data or other information has been provided or located to date (Tetra Tech 2008a).

2.9.3 Water Supply and Use

Surface water and groundwater diversions have been developed for use along the Ventura River for over 200 years. As of 1981, approximately 45 known entities withdrew water from the Ventura River system (EDAW et al. 1981). These entities include irrigators, domestic users, industrial users, and water purveyors or suppliers.

2.9.3.1 Matilija Dam

Matilija Dam was constructed in 1946 to 1947 by the US Army Corps of Engineers, Los Angeles District to provide water storage for agricultural needs and for limited flood control. The structure is a concrete arch dam with an average height of 190 feet and a crest length of 616 feet, located approximately 0.6 miles upstream of the confluence of Matilija Creek and North Fork Matilija Creek. The original storage capacity of the dam and reservoir was 7,020 AF, but structural modifications to address concrete deterioration and siltation since 1947 have reduced the water storage capacity to less than 500 AF at present. Matilija's current operations are primarily for optimizing diversions at the Robles Diversion Dam, using a release valve with a maximum capacity of 250 cfs (Reclamation 2000).

In July 2004, the District and the USACE – Los Angeles District completed the public draft of The Matilija Dam Ecosystem Restoration Feasibility Study, a study of the feasibility of removing Matilija Dam and restoring the ecosystem above and below the dam location. The report presents the findings of the alternatives analysis and the selection of a recommended preferred alternative. The study focuses on ecosystem restoration in the Ventura River watershed to benefit native fish and wildlife (including the federally listed endangered southern steelhead trout) of the Ventura River and Matilija Creek in the vicinity of Matilija Dam, and improvement to the natural hydrologic and sediment transport regime to support coastal beach sand replenishment from the Ventura River. In September 2004, the Final Environmental Impact Report/Environmental Impact Statement for this project was completed (USACE 2004).

In 2005, the Project Management Plan was developed specifically for the Matilija Dam Ecosystem Restoration Project, Preconstruction Engineering and Design Phase for the purpose of setting forth the management strategy to be employed by both the USACE – Los Angeles District and the District (Sponsor/Partner/Non-Federal Interest). Currently, grant applications and congressional funding is being sought to fund project components outlined in the feasibility study.

2.9.3.2 Casitas Dam

Casitas Dam was constructed in 1959 and is located approximately 2.5 miles upstream of the Ventura River on Coyote and Santa Ana creeks (near RM 6.2). Lake Casitas has a maximum storage capacity of 254,000 AF and is supplied by inflow from the Robles Diversion via the Robles-Casitas canal in addition to watershed runoff from the Coyote and Santa Ana basins.

2.9.3.3 Robles Fish Passage Facility

The Robles Diversion Dam was first built in 1958 and is located approximately 1.5 miles downstream of the confluence of Matilija Creek and North Fork Matilija Creek (RM 14). Since 1960, the diversion has been used to transfer water to Lake Casitas via a canal. The surface water diversions primarily occur in January, February, and March, and the mean monthly diversions during these months range from 2,183 to 3,489 AF (Reclamation 2003). The annual total diversion volume varies with available runoff and storage capacity remaining in Casitas Reservoir, averaging 13,095 acre-feet per year (AFY), with a median diversion volume of 6,335 AFY (Reclamation 2003). In dry years, there are often almost no diversions.

Since 2003, the Diversion Dam has been referred to as the Robles Fish Passage Facility due to the construction of a fish ladder at the facility. Prior to construction, The National Oceanic and Atmospheric Administration Marine Fisheries Service (NOAA Fisheries) issued a Biological Opinion on southern steelhead for the construction, operations and maintenance of the Robles facility (NOAA Fisheries 2003).

2.9.3.4 Foster Park Surface Diversion and Subsurface Dam

See paragraph 1, General Comments - See City's 2011 water master Plan.

The City of Ventura's water supply facilities at Foster Park consist of a surface and subsurface water collection system. These facilities operate in conjunction with an underground dam (a weir that is 973 feet long and maximum of 65 feet deep and stops short by 300 feet from extending the full breadth of both streams) that was constructed between 1906 and 1908 at the confluence of Coyote Creek and the Ventura River. The underground dam and confining bedrock surfaces increase groundwater levels in the vicinity of Foster Park to produce enhanced surface flows. These flows are captured by a surface diversion and a subsurface collector system consisting of two perforated concrete pipes situated on the upstream side of the dam. Since 2001, the City of Ventura has not used the surface water diversion, although it maintains the structures for possible use in the future (Kennedy/Jenks 2006). The subsurface diversion has produced water consistently and reliably despite heavy storm water flows.

2.9.3.5 Groundwater Wells

Several public and private groundwater supply wells are located within the Upper Ventura River basin in the vicinity of the mainstem of the river. The largest groundwater extraction entities are

Meiners Oaks County Water District (CWD), Casitas Springs Mutual Water Company, the Ventura River CWD, and the City of Ventura. Meiners Oaks CWD operates two wells located approximately 1 mile downstream of Matilija Dam and two wells in the vicinity of Meiners Oaks, one of which is adjacent to Rice Road. Meiners Oaks CWD produces approximately 1,150 AF of water per year from these wells. The Ventura River CWD operates three wells located between Meiners Oaks and the SR 150 crossing. The Ventura River CWD produces approximately 1,320 AF of water per year from these wells. Casitas Springs Mutual Water Company operates at least one water supply well north of the City's property at Foster Park. The location and annual production from that well is unknown (URS Corporation 2003). The City of Ventura operates four wells located in the Foster Park area. The City of Ventura produces approximately 4,000 AFY from these wells. (ENTRIX and Woodward Clyde Consultants 1997; Ventura County Water Purveyors' database 2000; updated by City of Ventura 2006). Production from the City's Foster Park facilities varies greatly from year to year due to effects of weather, local hydrology, the storage capacity of the Ventura River alluvium, and upstream diversions (URS Corporation 2003). The City's wells and pipelines are subject to damage by erosion from heavy storm flows.

More than 300 wells have been installed along the Ventura River and its tributaries, extracting groundwater from the Ventura River Alluvial Basin, outside of the Ojai Basin. Records of groundwater wells were examined at the Ventura County Public Works Agency, Water and Environmental (W&E) Division. A summary of the wells recorded and mapped is provided in Table 2.9-2. Data are unavailable for most wells. However, based on the limited data, it appears that most of the wells are shallow (less than 200 feet), drilled for domestic use, and potentially intact. The available data do not indicate how many wells are still in operation. A large number of the wells appear to have been installed during the 1986 to 1991 drought period. Because the vast majority of the wells are private, there is no monitoring of extractions and, therefore, no estimate of annual private pumping from the alluvial basin.

Table 2.9-2 Summary of Wells Adjacent to the Ventura River Mainstem and Tributaries

	No. of Wells				Type of Well			
Area	Active	Inactive or Abandoned	Unknown	Total	Domestic or Municipal	Irrigation	Unknown	Total
A. Estuary area, including Seaside and Emma Wood Parks	?	?	7	7	?	?	7	7
B. Lower river, between Main Street bridge and Foster Park	2	1	7	10	5	?	5	10
*→ C. Foster Park area	?	1	22	23	3	?	20	23
D. Coyote Creek below the dam	?	?	6	6	1	?	5	6
E. Casitas Springs area	?	?	9	9	1	1	7	9
F. San Antonio Creek, below Soule Park	?	1	49	50	4	1	45	50
G. Santa Ana Creek watershed above Lake Casitas	?	?	18	18	10	?	8	18
H. Oak View, Live Oak Acres, and western Mira Monte	?	1	139	140	10	2	128	140

* See paragraph 1 of General comments from attached comment letter - See City Water Master Plan March 2011

Canyon. Water users in the Ventura River watershed have no access to imported water and are therefore dependent upon maintaining an adequate supply of usable quality local water resources. For this reason, protection of local groundwater is vital, and an adequate understanding of groundwater storage volume and water quality trends is necessary. This report presents a groundwater budget for the sub-basins and an approach to a groundwater management plan (GWMP), as the first steps in planning for long-term protection.

The general approach for the groundwater budget is to estimate, based on available data and hydrogeologic analyses, the magnitude of all groundwater inputs and outputs within each of the sub-basins. Inputs include infiltration from precipitation, infiltration from irrigation, surface water recharge to groundwater, recharge from domestic septic systems, inflow from bedrock to the alluvial aquifer, and groundwater inflow from upgradient sub-basins. Groundwater outputs include municipal groundwater extractions, domestic groundwater extractions, agricultural groundwater extractions, industrial groundwater extractions, groundwater discharge to surface water, groundwater outflow, and groundwater consumption by riparian vegetation.

The resulting budget provides an estimate of the net gain or loss of the volume of groundwater in storage within the sub-basins per year. For the Upper Sub-Basin, a net gain of 1,466 AFY (Table 3.4-1) is estimated for the budgeted time period (WY 1997 through 2007). The primary inputs to groundwater in this sub-basin are infiltration and surface water recharge from Lake Casitas and the Ventura River, while the primary outputs are municipal and agricultural extractions. The estimated net gain in groundwater storage is relatively small and is consistent with long-term hydrographs of wells within the Upper Sub-Basin that indicate stable groundwater levels with 5 to 10-year rise and decline cycles. See Paragraph I- General Comments to attached comment letter.

Table 3.4-1 Groundwater Balance Upper Ventura Sub-basin

Category	Parameter	Upper West (AFY)	Upper East (AFY)	Upper (Combined)[a] (AFY)
Groundwater Inputs	Infiltration from precipitation	893	4,181	5,073
	Infiltration from irrigation	222	2,891	3,113
	Net surface water to groundwater	2,003	2,290	4,293
	Septic system recharge	18	120	139
	Bedrock to alluvial [b]			113
Groundwater Outputs	Extractions (domestic)	1	16	17
	Extractions (municipal)	0	7,385	7,385
	Extractions (agricultural)	0	1,898	1,898
	Groundwater outflow to Lower Sub-basin [b]			535
	Consumption by riparian vegetation [b]			1,430
			Final Balance [c]	+1,466

Notes:
a: Numbers may not add exactly because of rounding
b: Values not calculated independently for East and West Sub-basins
c: Sum of groundwater inputs minus sum of groundwater outputs
Source: Daniel B. Stephens & Associates 2010

For the Lower Sub-Basin, a net loss of 2,423 AFY (Table 3.4-2) is estimated for the budgeted time period. The primary inputs are infiltration and inflow from the Upper Sub-Basin, while the primary outputs groundwater discharge to surface water and discharge to the Pacific Ocean. There are currently no water levels monitored by Ventura County within the Lower Sub-Basin for comparison to the budget. See Paragraph I- General comments to attached comment Letter.

Table 3.4-2 Groundwater Balance Lower Ventura Sub-basin

Category	Parameter	AFY[a]
Groundwater Inputs	Infiltration from precipitation	616
	Infiltration from irrigation	655
	Net surface water to groundwater	5
	Septic system recharge	319
	Bedrock to alluvial [b]	535
Groundwater Outputs	Extractions (domestic)	1,254
	Extractions (municipal)	1
	Extractions (agricultural)	522
	Groundwater outflow to Lower Sub-basin [b]	2,412
	Consumption by riparian vegetation [b]	365
	Final Balance [b]	-2,423

Notes:
a: Numbers may not add exactly because of rounding
b: Sum of groundwater inputs minus sum of groundwater outputs
Source: Daniel B. Stephens & Associates 2010

The intention of a GWMP is to provide a framework to manage groundwater to ensure a long-term, sustainable, reliable, good-quality water supply suitable to the political, legal, institutional, hydrogeologic, and economic conditions and constraints that exist in a groundwater basin. This report presents an approach to development of a GWMP for the sub-basins, including specifications for public participation, interagency involvement, coordination with the Ventura River Watershed Council, literature review and technical analysis, establishment of management objectives, and development of a monitoring program. The following outline provides an approach to development of a GWMP.

Component 1. Develop a map showing the area of the Basin, with the area that will be subject to the GWMP, as well as the boundaries of other local agencies that overlie any portion of the Basin. As a delineated groundwater basin with two delineated groundwater sub-basins, maps of the basins have been developed by both state and county agencies.

Component 2. Provide a written statement to the public describing the manner in which interested parties may participate in development of the GWMP. The statement should be provided to the public via local newspapers and/or other media, with distribution throughout the Basin. Documentation of public notification will be included in the GWMP.

See Paragraph 1, General Comments of this attached comment letter.

Chapter 4

Water Demand and Water Budget

4.1 Introduction

This section provides a summary and analysis of water supply and demand determinations for the overall Ventura River watershed. Data collected from various previous investigations has been compiled and presented in a form to illustrate both the level of understanding of water supply and demand and the types of data that will need to be addressed to improve the accuracy of a water budget for the watershed.

Wholesale and retailed water service within the watershed is provided by:

- Casitas (Municipal Water District) provides service within a 150-square mile area that includes the Ojai Valley and much of the lower Ventura River watershed. Casitas operates and maintains the Casitas Dam, Robles Diversion, and Robles-Casitas Canal (collectively referred to as the Ventura River Project) under contract with the U.S. Bureau of Reclamation to supply surface water from the Ventura River and Coyote Creek. Additionally, Casitas operates a single groundwater well in Mira Monte. Casitas provides water to retail customers, as well as several other public and private retail water operations.
- Golden State Water Company (Golden State) provides service to an area that is approximately the limits of the City of Ojai. Golden State relies on groundwater extractions from the Ojai Basin and supplements the groundwater supply with additional water from Casitas' service connections.
- Hermitage Mutual Water Company provides service to a limited area in the foothills north of the Ojai Valley. It relies on wells in the Ojai Basin and a supplemental connection to Casitas.
- Meiners Oaks Water District provides service in Meiners Oaks. It relies primarily on two wells in the Ventura River and has relied on Casitas only during infrequent system emergencies.
- Senior Canyon Mutual Water Company provides service in the east end of the Ojai Valley. It relies on three wells in the Ojai Basin and surface water diversions, with Casitas as a secondary source of water to buffer peak demands and as a drought contingency supply.
- Siete Robles Mutual Water Company services a single housing development located southeast of the City of Ojai. It relies on a well in the Ojai Basin and one service connection to Casitas that is used occasionally.
- Sisar Mutual Water Company provides service in the northeast area of the Upper Ojai Valley. It relies on groundwater wells and on a connection to Casitas as an emergency water source.
- Tico Mutual Water Company provides service in Mira Monte. It relies on one well in the Mira Monte area and one 2-inch service connection to Casitas as a backup supply.

See Paragraph 3 of General Comments from attached Comment Letter.

Chapter 6

Data Gaps

Data gaps have been identified for both the HSPF model and the groundwater budget; these data gaps and recommendations to fill them are described below.

6.1 HSPF Model

6.1.1 Study Limitations

The Calibration and Validation Baseline Report (Tetra Tech 2009a) identified the following areas where the HSPF model might be further improved:

- There is uncertainty regarding the model's ability to accurately predict high flow peaks at the North Fork Matilija and Happy Valley Drain stream gages. Some improvement could likely be attained by refining the channel hydraulic representation through development of HEC-RAS models for these subwatersheds, which would require assembly of additional information on channel dimensions and structures. Note that as part of the Federal Emergency Management Agency (FEMA) Cooperating Technical Partners (CTP) Program for Happy Valley Drain, a HEC-RAS model was developed and is available for further refinement of HSPF in this area (District 2011b).
- Simulation of event peaks in Happy Valley Drain also was identified as being particularly problematic. The hydrology in this area is complex, including a diversion and a concrete channel. The report noted that detailed survey and small scale modeling of this area might reveal ways in which the model representation could be improved. This also was done as part of the FEMA CTP for Happy Valley Drain.
- Model fit to the Santa Ana and Coyote Creek gages is uncertain due to the lack of information on gage accuracy and bias. New rating tables have apparently not been developed for these gages in a number of years, and adjustments are likely needed to reflect changes in channel dimensions. Measurements to develop a current-day rating curve would assist in interpretation of records from earlier in this decade.
- As noted above, the quality of gage records for Coyote Creek and Santa Ana Creek is uncertain. These gages are useful for providing a broad basis to evaluate model performance. Tetra Tech suggests that field measurements be made on a regular schedule (at least annually) to provide a basis for calibrating and adjusting the Coyote Creek and Santa Ana Creek rating tables.
- No current gauging exists in the southernmost portion of the watershed, downstream of Foster Park. As a result, this portion of the model cannot be directly calibrated. Tetra Tech suggests that a mainstem gage should be installed at an appropriate location near the outlet of the Ventura River. In addition, the Canada Larga peak flow gage should be operated to provide continuous flow records.
- The present-day precipitation monitoring network appears to provide generally good coverage of the watershed. However, quality assurance can likely be improved for the high

1. Consider Density, as higher density development consumes less land and produces less impervious cover per capita than low density development.

2. Identify and Preserve Contiguous Open Space and look for opportunities to link open space preservation with regional open space preservation efforts.

3. Make use of Previously Developed Sites, as this reduces the need for greenfield development, and makes use of existing infrastructure.

4. Locate Development within Close Proximity to Mass Transit to reduce the number of automobile trips, and lessen the water quality impacts associated with transportation.

Design criteria at the Site scale include:

5. Maintain and Restore Natural Flowpaths for Runoff to reduce the amount of clearing and grading and maintain the pre-development hydrology's time of concentration.

6. Maximize Use of Existing Impervious Cover to reduce runoff at a watershed scale.

7. Design Public Spaces and Common Areas to Minimize Stormwater Runoff.

8. Compact Project Design to reduce the amount of impervious cover per capita and increase walkability, and decrease water quality impacts associated with transportation.

9. Encourage Use of Multiple Modes of Transportation.

Implement Integrated Water Resource Management Practices

Integrated Water Resource Management (IWRM) is a process which promotes the coordinated development and management of water, land, and related resources. Many of the concepts of IWRM are documented in the County's IRWMP, a product of an intensive stakeholder process, and address multiple water resource management goals. These practices include:

1. Conserve and Augment Water Supplies: Identify and evaluate the opportunities to recharge groundwater and increase water use efficiency. This can be accomplished through infiltration of stormwater runoff and selection of drought-tolerant landscaping. Additional wells at Foster Park to capture high river flows.

2. Protect People, Property and the Environment from Adverse Flooding Impacts: Identify opportunities to utilize BMPs that provide both water quality and water quantity benefits. Provide and maintain setbacks from streams and rivers.

3. Protect and Restore Habitat and Ecosystems in Watersheds: Implement the practices identified in Protect and Restore Natural Areas to integrate habitat and stormwater goals. Landscaping selection for stormwater management practices may also further encourage and attract wildlife.

4. Provide Water-related Recreational, Public Access and Educational Opportunities: Integrate recreation and stormwater management by creating multi-functional BMPs and designing

Table 7-1 Best Management Practices for Construction and Maintenance Activities

Category	Specific Practice(s)
	Where technically feasible, vehicles and heavy equipment shall not be driven or equipment operated in water covered portions of the stream channel, or where wetland vegetation, riparian vegetation, or aquatic organisms may be destroyed, except as necessary to complete the authorized work. When technically feasible, restrict construction activities to scoured areas or to areas dominated by non-native vegetation to avoid damaging native trees and shrubs.
	Where technically feasible, the use of heavy equipment shall be avoided in a channel bottom with rocky or cobbled substrate. Instead, manual labor should be used whenever practical. If manual labor in rocky substrate is not feasible, a rubber tire loader/backhoe is the preferred vehicle by the Services and the amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized
	Access to the work site shall be via existing roads and access ramps, unless otherwise specified or approved by the Services. If no ramps are available in the immediate area, a ramp should be constructed in the footprint of the project. Any temporary ramp shall be removed upon completion of the project. Where feasible, ramps should be graded within the elevated bank area, down to but not in the channel bottom.
	Vehicles may be driven on the streambed to traverse the distance to the work site from the access point, and in the immediate vicinity of the work area, and only as necessary to accomplish the authorized work.
	When temporary access is removed, remaining disturbed soil shall be stabilized and seeded with appropriate native seed mix immediately after work completion. If a stream's low flow channel, bed or banks have been altered during operations, channel topography and geometry shall be restored to pre-project conditions to the extent possible, without creating future erosion problems.
Fill and Spoil	Fill shall be limited to the minimal amount necessary to accomplish the activities. Fill construction materials, other than on-site alluvium, shall consist of clean silt-free gravel or river rock.
	Rock riprap may be used to repair eroded slopes that previously contained riprap, allowing for in-kind replacement or repair of existing facilities. Material for backfilling an eroded slope area may be obtained from onsite alluvium.
	Where feasible, to facilitate recovery of vegetation and provide additional protection from erosion on ungrouted riprap banks, the Operator shall place branches from willow trees into the open toe-trench and within the wick zone of the shaped sideslope, prior to placing the filter rock and unconcreted armor rock.
	Spoil storage sites shall not be located within a stream, where spoil can be washed back into a stream, or where it will cover aquatic or riparian vegetation. Upslope erosion control BMPs (i.e., blankets/geotextile fabrics, coir fabric/netting, mulching, planting, silt mat, etc.) shall be used to protect and stabilize stockpiles and exposed soils to prevent movement of materials. Avoid placing temporary spoil stockpiles at the top of unstable slopes or at the edges of slopes. Remove temporary stockpiles to permanent disposal locations before the rainy season or, if work is conducted during the rainy season, as soon as feasible and before the next rain storm.

7.4.5 Measures Recommended by the Draft Southern California Steelhead Recovery Plan

In July 2009 the National Marine Fisheries Service (NMFS) released the draft Recovery Plan for the endangered Southern Steelhead (NMFS 2009). Recommendations for the recovery of this Distinct Population Segment for the Ventura River watershed include a number of best management practices and actions that in the view of the NMFS would lead to the recovery of the species in Southern California. Inclusion of these recovery actions can help assure that projects defined within the watershed management plan are consistent with the requirements for the federal endangered species act. Recovery actions (from Table 8-6 in NMFS 2009) include:

- Conduct hydrological analysis(groundwater)

See Paragraph 3 of General Comments of attached Comment letter.

Chapter 8

Future Actions to Improve Water Sustainability and Ecosystem Functions

8.1 Recommended Actions

The following recommended actions are provided to improve the sustainability of water resources and improve ecosystem functions.

8.1.1 Watershed Management Plan

Based on lessons learned from review of other applicable plans, the recommendations (in Chapter 5) are summarized as follows:

- Identify the intended audience and provide appropriate content
- Engage watershed stakeholders
- Clearly define and state the plan's goals and objectives
- Focus the scope of the plan
- Focus on issues where stakeholders can make a meaningful difference
- Work with regulatory programs
- Prioritize projects that can meet the plan's objectives
- Identify mechanisms and a process to gauge progress towards plan implementation

8.1.2 Stakeholder Involvement

The creation of the Ventura River Watershed Council provided a forum for discussion of issues at the watershed scale. In addition, the implementation of the "Watershed U" expanded awareness of watershed issues and generated substantial interest in how individual actions could improve watershed conditions. To enhance and extend stakeholder involvement:

- Continue meetings of the Watershed Council and consider extending invitations to relevant organizations or entities that have not participated regularly;
- Improve and regularly update the Watershed Council's webpage, to provide a consistent source of meeting notices, agendas, and other relevant information and consider providing links to relevant information for other organizations and groups involved in watershed restoration.
- Build upon stakeholder interest by publicizing meetings and workshops that provide useful information for residents and land-owners, such as: water conservation, stormwater management, or watershed-friendly gardening.

Responses to comments from Shana Epstein, dated January 11, 2012

As noted in the introduction, a major focus of the report is to summarize available information provided from existing reports, and as such does include substantial material from other reports. The City's 2010 Urban Water Management Plan was used as a source document for the Draft Report and the final report has been updated to incorporate information from the 2011 Sanitary Survey. The referenced 2011 Water Master Plan could not be located online and thus is not utilized as a source document.

The report provided an estimate of water demand within the watershed. As the service boundaries of Ventura Water extend outside of the watershed, the inclusion of the demand for the entire service area would have over-estimated water demand. To account for water demand within the watershed boundary, the report pro-rated water demand based on 2010 census data for the residential population that resides within the watershed. Cardno ENTRIX acknowledges that the pro-rated demand calculation is only an estimate, and should not be inferred as an attempt to misrepresent water rights, characterize water sources, or the appropriate utilization of those services within the service boundary of Ventura Water.

In response to the marked-up pages from the Draft Report, the Ventura Water Master Plan (RBF 2011) was reviewed, and several revisions were made to the text and tables in this Final Report.

Responses to comment letter (attached to letter from Shana Kaplan) from Hopkins Groundwater Consultants, dated January 10, 2012

As noted in the introduction, a major focus of the report is to summarize available information provided from existing reports, not to provide a foundation for a comprehensive watershed management plan.

The estimate of water demand did not address water supply, and thus does not include any data with respect to current or historical diversions from the Ventura River. The pro-rated estimate was derived from the water demand information provided in Table 2-5[2] of the 2010 Urban Water Management Plan for the City of Ventura, which included the following demand categories: Single-Family, Multi-Family, Commercial, Industrial, Government/Institutional, and Landscape. Thus, industrial water use (and several other categories) were included the estimate. Note that per an oral comment received on December 13, 2011, the estimate in of water demand in this report has been revised to add water demand associated with Petroleum Recovery Operations.

The recommendations provided in Section 5.4 (Recommendations for Ventura River Watershed Management Plan) were based on a review of the applicable watershed management plans that were summarized in Chapter 5, and are intended to address the scope, content, and approach to development of a plan, and were not intended to serve as limitations on information that could be helpful in the preparation of a plan.

[2] Instead of Table 2-1 as cited in the Draft Report.

The suggestion to implement Integrated Water Resource Management (on Page 7-4 of the Draft Report) was derived from the Ventura County Technical Guidance Manual for Stormwater Quality Measures, and thus does not address the implementation of a specific project or water management technique. It is assumed that the referenced Foster Park Wellfield Design Study proposes improvements which are consistent with the practices summarized on the referenced page, including: Conserve and Augment Water Supplies; Protect People, Property and the Environment from Adverse Flooding Impacts; and Protect and Restore Habitat and Ecosystems in Watersheds.

Cardno ENTRIX concurs that if a groundwater management plan is developed, it should be administered by a public agency.

VRCWD We Serve Water VRCWD

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January 12, 2012

Norma Camacho, Director
Ventura County Watershed Protection District
800 S. Victoria Ave.
Ventura, CA 93009-1600

SUBJECT: COMMENTS ON THE DRAFT VENTURA RIVER WATERSHED PROTECTION REPORT

Dear Norma;

The Ventura River County Water District respectfully submits comments to the draft Ventura River Watershed Protection Plan Report dated December 2011. The draft report was prepared by Cardno ENTRIX under the direction of the VCWPD.

Chapter 4 Water Demand and Water Budget

The water usage figures in this chapter are based upon the 2010 water year. While this may be close to an average year it is really irrelevant to water demand and water budgeting in the watershed because of the unique character of the Ventura River Watershed. The aquifers are small, hold only one to three years supply of water and re-fill rapidly in one good rain year.

It would be much more realistic to utilize the 20 year design drought Safe Yield analyses prepared by Casitas MWD because it is based upon actual ground water basin yields and user demands during droughts with variable rain years during the 20 years.

If needed the current Safe Yield analyses could be updated for recent changes in diversion restrictions and new pumping demands that may have occurred since the last update.

Chapter 8 Future Actions....

Section 8.1.4 Data Gaps recommends:

- The District should convene a technical advisory group to assess and prioritize data gaps that limit development of a comprehensive water budget, with input from the Ventura River Watershed Council.

Our District would recommend that the greatest data gap need is not for a "comprehensive water budget" but to move forward with the Data Gaps identified in the 2001 Surface Water-Ground Water Interaction Report referenced on page 2-42 of this report. The LARWQCB is scheduled to impose a Pumping TMDL for the Ventura River by 2019. The most critical data gap needed for implementing a Pumping TMDL is to fully understand the interactions between surface water, ground water and pumping. To that end we recommend changing the Section 8.1.4 bullet to read:

- The District (VCWPD) should convene a technical advisory group to assess and prioritize data gaps that limit the understanding of the groundwater – surface water – ground water pumping interactions, with input from the Ventura River Watershed Council.

Section 8.1.5 <u>Ventura River Groundwater Management Plan</u>

According to this report the Ventura River groundwater basins only hold a one to three year supply of water and refill with one wet year. This is in contrast to the ground water basins on the Oxnard Plain that hold a multi-year supply of water, do not recharge easily and are in overdraft. The report acknowledges that: "ground water extraction use during droughts has not exceeded recharge capability." (Section 2.6.3.2)

In order to survive a 20-year drought the water in the ground water basins must be utilized first before water is taken from Lake Casitas. Without the water in the groundwater basins there is not enough water in the valley to survive a 20-year drought.

Therefore we do not see a need to develop a Groundwater Management Plan for the Ventura River Watershed.

Section 8.1.6 <u>Water Budget</u>

The report recommends creating a watershed-wide water budget "to determine whether the water resources in the Ventura River watershed are sufficient to meet total water demand." However Casitas MWD already has a 20 year safe yield analysis that encompasses the lake, all ground water basins in the valley and water demand including anticipated future conservation efforts. This safe yield analysis utilizes historic and projected yields and demands. Creating a new "Water Budget" would be redundant.

If more water supply and demand precision is needed it would be better to update the Casitas 20-year Safe Yield analyses rather than create a new Water Budget. Therefore we recommend changing the recommendation bullet under **Section 8.1.6** to read:

- The Casitas MWD should update the 20-year safe yield analysis for Lake Casitas to incorporate current supply and demand projections with input from the Ventura River Watershed Council.

Chapter 3 Section 3.4 Groundwater Management Plan

Our District does not see the need at this time for a Groundwater Budget or a Groundwater Management Plan in this watershed. That being said we would like to comment on the recommendations for Component 11 & 12 on pages 3-22 & 3-23. These components recommend that the Watersheds Coalition of Ventura County and the Ventura River Watershed Council have administrative functions that should, in our opinion, be performed by a responsible Public Agency. The Coalitions serve as an excellent format for gathering stakeholders and being an advisory committee but they are not an "Agency."

The responsible Agency, if a Groundwater Management Plan is formed, should be the Watershed Protection District or Casitas MWD.

Additional comments are included on the marked up pages of the report attached to this letter.

Very Truly Yours

VENTURA RIVER COUNTY WATER DISTRICT

Bert J. Rapp

Bert J. Rapp, P.E.

General Manager

cc: Mark Horn, Senior Consultant/Water Resources, Cardno ENTRIX
Zia Hosseinipour, VCWPD
Casitas Municipal Water District
Ventura Water
Meiners Oaks County Water District

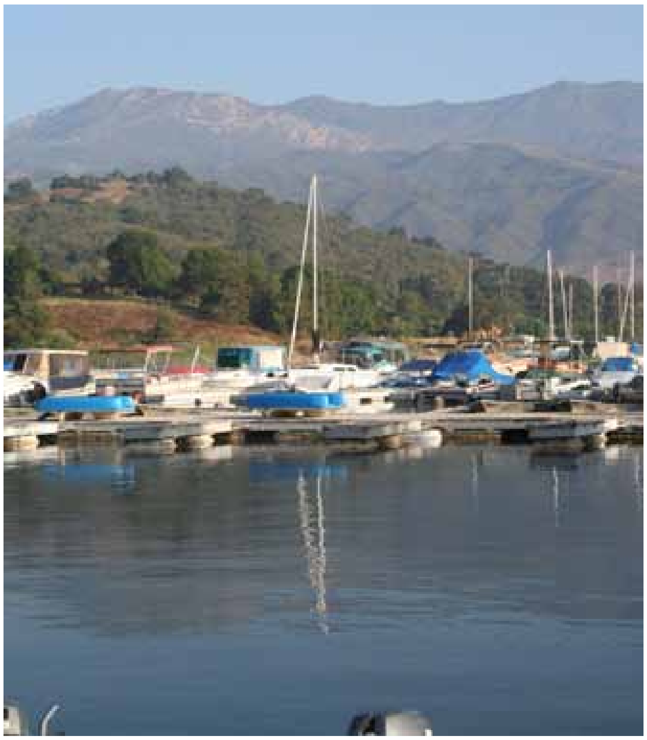
General Comment from VRCWD:

A location map is needed that shows the names of creeks and major roads along with major landmarks like the large faults etc.

Several multiple-use trails serve bicyclists, equestrians, and pedestrians in the watershed. The Ojai Valley Trail follows the abandoned Southern Pacific Railroad right-of-way and is located along the west side of State Route 33 from Ojai to northern Foster Park. In the City of Ventura, the Omer Raines Trail parallels the Ventura River and terminates at Main Street. A Class I trail, following the Southern Pacific Railroad easement connects the Ojai Valley Trail with the Omer Raines Trail. The City of Ventura owns and manages the Ventura River Trail, a multi-purpose trail that extends from Foster Park to the beach.

Is the Omer Raines Trail the Ventura River Trial? The text is not clear.

Lake Casitas is open to the public for non-body contact recreational activities. All recreational activities are operated by Casitas Municipal Water District (Casitas) or by concessionaries.



The Recreation Area encompasses approximately 4,097 acres and consists primarily of open space. The recreational facilities are located on approximately 400 acres scattered about the perimeter of the lake. Existing recreational facilities include camping, picnicking, motor boating, sailing, canoeing, and fishing. Lake Casitas hosted the 1984 Olympic Rowing and Canoeing Events and is currently the home of the Lake Casitas Rowing Association which provides recreational and competitive rowing training to youth and adults in the community. The lake is also used by bird watchers to view the many migratory birds that use Lake Casitas as they pass through the Pacific flyway. Facilities include stores, campgrounds, RV campgrounds, showers, restrooms, picnic areas, boat ramps, water playground, a radio-controlled airplane landing strip, and boat and trailer storage.

Lake Casitas is famous for its record fish catches. Fishing takes place from docks, boats, and shore. Lake Casitas contains a warmwater fishery that includes bass (primarily large mouth), catfish, sunfish, and crappie. These fish are non-native and were introduced when the lake was formed, but now are self-sustaining populations. Both the ~~California Department of Fish and Game (CDFG)~~ and Casitas also stock the lake annually with catchable size rainbow trout. Lake Casitas has also been stocked on an irregular basis with crappie and other panfish.

The Ventura County Parks Department maintains three regional parks (Camp Comfort, Soule Park, and Foster Park) located adjacent to waterways of the Ventura River. Camp Comfort Regional Park is situated adjacent to San Antonio Creek. Soule Park recreation area consists of a golf course and a public park. The confluence of San Antonio and Thacher creeks occurs within Soule Park, and the Ventura River runs through Foster Park. Activities at all parks include picnicking and playground areas and services such as public restrooms. Park users also wade in San Antonio Creek at Camp Comfort and in the Ventura River at Foster Park. Soule Park includes baseball and equestrian facilities as well as a public golf course. Water for golf course

Low Flows

Under summer low flow or drought conditions, surface streamflow at various locations in the watershed are governed by a complex interaction of precipitation input; discharge from springs; groundwater levels; the effects of water diversions, water storage, water supply releases, and treated wastewater discharge and groundwater extraction.

It is not unusual for streams in Southern California that are rainfed, and lack groundwater support, to dry up in summer months, in both average and below average precipitation years. In the Ventura River watershed, however, several of the smaller tributaries, and even the mainstem, have short perennial reaches that are fed by springs and/or the perched groundwater over shallow bedrock. Perennial flows are present in San Antonio Creek, and in the Casitas Springs/Foster Park reach, defined as the portion upstream of, and including, Foster Park and including lower San Antonio Creek from SR 33 to its confluence with the Ventura River. The presence of year-round flow in this reach of the river is due to high groundwater levels in the shallow alluvium over bedrock, which is artificially raised at Foster Park by the City's subsurface dam (URS Corporation 2003).

Small summer streamflows maintained by springs were documented by both Reclamation (1954) and EDAW et al. (1981) in the upper reaches of the larger sub-basins. EDAW reported typical summer base flows of 1 to 2 cfs in North Fork Matilija Creek, 1 to 3 cfs in Matilija Creek, and less than 0.5 cfs in San Antonio Creek and Coyote Creek below Casitas Dam. Since the 1960s, effluent discharge from the OVSD Wastewater Treatment Plant provides summer flows of approximately 1.9 cfs (2002 data) from the OVSD Wastewater Treatment Plant downstream to the lagoon.

2.6.3 Groundwater

Groundwater has been an important water source for irrigation and municipal supplies in the Ventura River watershed for many decades. In general, groundwater in the Ventura River system occurs under unconfined conditions. However, in some localized areas (where fine-grained overbank deposits form a relatively low permeability cap over old channel deposits with higher permeability), semi-confined conditions may exist, especially during periods of high water levels (Fugro 2002). The primary source of recharge to the alluvial aquifer system is direct infiltration of surface flows. Two other sources of recharge include direct infiltration of precipitation, and downvalley underflow through alluvial sediments.

The Ventura River system is composed of five major groundwater basins: the Upper Ojai basin; the Ojai basin; the Upper Ventura River basin; the Lower Ventura River basin; and the San Antonio Creek basin (ENTRIX 2001c). Of primary importance to this report are the Upper Ventura River, Ojai, and San Antonio Creek basins because local agencies operate and maintain water supply facilities in these areas (Figure 2.6-6). A description of the major groundwater basins is provided below.

Table 3.4-1 Shows Precipitation: 40%, Irrigation: 24% and Surface Water to Groundwater: 34%. So the primary source of recharge would be precipitation not surface flows. Which is correct?

2.6.3.1 Groundwater Basins

Upper Ventura River Basin

The Upper Ventura River Basin has a partial downslope along the Arroyo Parida fault to the north (ENTRIX 2001b). The upper basin extends from the confluence of Matilija Creek and North Fork Matilija Creek (RM 16.2) to the City's subsurface dam at Foster Park (RM 5.9), which delineates the boundary between the Upper and Lower Ventura River groundwater basins. The basin is believed to have a capacity of approximately 14,000 AF when full (USACE 2004). The boundary between the Ojai Basin and the Upper Ventura River Basin is situated between Camp Comfort to the south and Arbolada to the north. The depth to bedrock decreases in the vicinity of this boundary resulting in a decrease in thickness of the aquifer materials.

The Upper Ventura River is underlain by alluvial deposits with a maximum thickness of approximately 200 feet and an average thickness of 60 to 100 feet. A natural subsurface obstruction blocks subsurface flow below the Ventura River just above San Antonio Creek causing groundwater to rise as springs. Therefore, the groundwater beneath the Ventura River is divided into an upper cell and a lower cell (Reclamation 2003).

This Figure is missing

The thickness of aquifer materials is generally shallow, but varies along the river due to the geologic structure of the basin (variations in the depth to bedrock and faulting). Along the Upper Ventura River, the water-bearing units increase in thickness downstream of the confluence of Matilija and North Fork Matilija creeks, attaining a maximum thickness of approximately 200 feet on the north (down dropped) side of the Arroyo Parida-Santa Ana fault (Figures 2.6-7 and 2.6-8). Downstream of the Santa Ana fault, in the Mira Monte area, the alluvium thickness is controlled by the folded bedrock surfaces and is approximately 65 feet thick. In the Foster Park area, north of the subsurface dam and in the vicinity of the City's Nye Wells, the aquifer materials are 45 to 60 feet thick, providing a saturated thickness ranging from 35 to 45 feet (Fugro West 2002). The total storage capacity of about 14,000 AF typically empties during a 1 to 3-year critical dry period. The dominant source of recharge is direct infiltration or precipitation and percolation from local streambeds (ENTRIX and Woodward Clyde Consultants 1997).

Ojai Groundwater Basin

The Ojai Groundwater Basin (Ojai Basin) is located within the Ventura River watershed, within the western portion of Ventura County, California. The Basin is bordered by the Topa Topa Mountains and Santa Ynez Mountain Range on the north and east, Black Mountains on the south, and the Upper Ventura River Groundwater Basin to the west. Ground surface elevations across the alluvial surface of the Basin range from over 1,300 feet above mean sea level (amsl) at the northeastern portion of the Basin, to approximately 700 feet amsl. The drainage area for the basin comprises 36 square miles and rises to elevations over 4,500 feet amsl. The alluvial groundwater Basin is 10.7 square miles (Kear 2005, as cited in Daniel B. Stephens & Associates [DBS&A 2010b]). A large fraction of land within the basin is dedicated to orchards, with the remaining area composed of residential, pasture, commercial and vacant land uses. Municipal and agricultural water requirements of the basin have historically been supplied by both surface water and groundwater sources.

The Ojai Basin is composed of alluvium deposits within a structural depression, and the lateral boundaries of the basin are defined by the contact between the alluvial deposits and the underlying sedimentary rocks (SGD 1992, as cited in DBS&A 2010b). The alluvial aquifer consists of undifferentiated and poorly consolidated deposits of clay, sand, gravel, and boulders. Confining clay units exist within the alluvium, and Kear (2005, as cited in DBS&A 2010b) reported that the units are thickest in the southern portion of the basin.

Component 3. Establish a plan to involve other agencies whose boundaries overlie the Basin in development of the GWMP. This may include involvement via agency representative participation in the Ventura River Watershed Council (see Component 4).

Component 4. Establish a process for the Ventura River Watershed Council to serve as the designated advisory committee of stakeholders (interested parties) within the plan area that will help guide the development and implementation of the GWMP and provide a forum for resolution of controversial issues.

Component 5. Describe, in detail, the area to be managed under the GWMP, including (1) the physical structure and characteristics of the aquifer system underlying the plan area in the context of the overall basin; (2) a summary of the availability of historical data; (3) issues of concern; and (4) a general discussion of historical and projected water demands and supplies.

Component 6. Establish management objectives (MOs) for the groundwater basin that is subject to the plan. MOs are intended to contribute toward a more reliable supply for long-term beneficial uses of groundwater in the plan area. For example, MOs for a typical groundwater basin may include the installation of infiltration basins or reduction in groundwater extraction.

Component 7. For each MO in Component 6, describe how meeting the MO will contribute to a more reliable supply for long-term beneficial uses of groundwater in the plan area, and describe existing or planned management actions to achieve MOs.

Component 8. Adopt monitoring protocols for the monitoring and management of groundwater levels, groundwater quality, potential inelastic land surface subsidence, and changes in surface flow and surface water quality that directly affect groundwater levels of quality.

Component 9. Describe the monitoring program, including the following:

- A map indicating the general locations of any applicable monitoring sites for groundwater levels, groundwater quality, subsidence stations, or stream gages.
- A summary of monitoring sites indicating the type (groundwater level, groundwater quality, subsidence, stream gage) and frequency of monitoring. For groundwater level and groundwater quality wells, indicate the depth interval(s) or aquifer zone monitored and the type of well (public, irrigation, domestic, industrial, or monitoring).
- A QAPP for monitoring in the basin.
- Standard operating procedures for monitoring in the basin.

Component 10. Describe any current or planned actions by the local managing entity to coordinate with other land use, zoning, or water management planning agencies or activities.

Component 11. Provide for periodic report(s) summarizing groundwater basin conditions and groundwater management activities. The report(s) prepared annually or at other frequencies as determined by the Watersheds Coalition of Ventura County, should include the following:

- Summary of monitoring results, including a discussion of historical trenc
- Summary of management actions during the period covered by the repor

The responsibility for Component 11 needs to be fulfilled by a responsible Agency not a Coalition.

- Discussion, supported by monitoring results, of whether management actions are achieving progress in meeting MOs.
- Summary of proposed management actions for the future.
- Summary of any plan component changes, including addition or modification of MOs during the period covered by the report.
- Summary of actions taken to coordinate with other water management and land use agencies and other government agencies.

Component 12. Provide for the periodic reevaluation and updating of the plan by the Ventura River Watershed Council.

Needs to be a responsible Agency not a Coalition.

3.5 Upper San Antonio Creek Watershed Giant Reed Removal Project

Giant reed (*Arundo donax*) is an invasive plant that consumes large quantities of water; displaces native vegetation and wildlife; disperses readily during floods; and exacerbates flooding, erosion, and fire intensity. The goal of the Upper San Antonio Creek Watershed Giant Reed Removal Project was to substantially reduce the abundance and distribution of giant reed from the Upper San Antonio Creek Watershed, including Upper San Antonio, McNell, Thacher, and Reeves creeks. The distribution of giant reed within these creeks is patchy; overall, its percent cover relative to other vegetation is fairly low (less than about 20 percent). However, there are a few locations where its percent cover is as much as 76 percent. Figure 3.5-1 provides a giant reed distribution map of the project area. The project also involved the opportunistic removal of castor bean in areas where it occurs in close proximity to the giant reed. The intended outcome of the Project is the re-colonization of native vegetation and the restoration of native habitats. A total of 212 acres were targeted for giant reed removal (District 2010c)

The “cut and daub” method was used to remove the giant reed and treatments only occurred when surface water was not present. The method involved manually cutting off the canes of the giant reed and painting the freshly cut surface with a glyphosate-based herbicide that is approved and labeled for use near and in open water, such as Aquamaster®. Treatment began in June 2010 and ended in December 2011.

Glyphosate is a broad-spectrum, non-selective, post-emergent herbicide that readily and completely biodegrades in soil and has little potential for leaching into groundwater. The primary MCL for glyphosate in drinking water sources or water bodies with a MUN (municipal and domestic supply) beneficial use designation has been set by the USEPA at 700 parts per billion (ppb). This is the equivalent of 700 parts of glyphosate to 999,999,300 parts of water and is the level of protection that the USEPA believes would not cause potential short-term or long-term health effects. Therefore, as a protective measure, the threshold for glyphosate for this project was also set at 700 ppb.

Aminomethylphosphonic acid (AMPA) is a breakdown product of glyphosate as the result of microbial metabolism. The laboratory method used to analyze for AMPA also measured glyphosate and glufosinate. Glufosinate is similar to glyphosate in its chemical structure and use. There are no regulatory limits for AMPA or glufosinate.

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- Ventura (City) provides service to the entire city and some adjacent unincorporated areas. Its water portfolio includes shallow wells in the Ventura River near Foster Park, rights to reclaim water from the OVSD Wastewater Treatment Plant, several connections to a Casitas pipeline, and groundwater sources from the east end of Ventura.
- Ventura River County Water District provides service to Casitas Springs, Rio Via, Monte Via and Oak View, and relies on two wells in the Ventura River and supplemental water from Casitas.

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4.2 Water Demand

4.2.1 Muncipal and Industrial (M&I) Demand

The overall M&I water usage (demand) for an average water year can be calculated from deliveries reported by Casitas along with the groundwater extractions for municipal and domestic uses in the Upper and Lower Ventura sub-basins, the Ojai Basin, and the Upper Ojai Basin, as provided in Table 4-1 below. These cumulative water deliveries are representative of the basin as a whole because Casitas provides water service to a large portion of the watershed, and the remaining areas receiving M&I supplies are supported by Golden State (City of Ojai) and the City of Ventura, and the various smaller water providers (which primarily rely on groundwater with supplemental supplies from Casitas).

Table 4-1 Estimated 2010 Municipal and Industrial Water Demand

Source/Location	Amount (AF)	Note
Casitas	9,674	Sum of 2010 urban water demand and sales to other retail agencies, not including City of Ventura[1]
Golden State	1,741	2010 (groundwater) demand, not including sales from Casitas[2]
Ventura (City)	2,507	Pro-rated share of 2010 Ventura City demand within watershed[3]
Upper and Lower Ventura Sub-Basins	8,657	Estimated annual domestic & municipal extractions, 1997-2007[4]
Upper Ojai Basin	11	Extractions in 2008 by Sisar Mutual Water Company[5]
Total	22,591	Total of all extractions within watershed for M&I use

Sources:

1: Casitas, 2011, Tables 6 and 9, not including 300 AF of groundwater from Mira Monte well

2: Kennedy/Jenks, 2011b, Table 4-1, not including supplemental water delivered by Casitas.

3: Pro-rated estimate based on population residing within the Ventura River watershed. Total 2010 water demand in service area for the City of Ventura (including residential, commercial, industrial, institutional/government, and landscape uses) is 15,671 AF (Kennedy/Jenks, 2011a, Table 2-1). Population within the Ventura River watershed is estimated at 18,121 (for Ventura County census tracts 21.02, 22, 23 & 24, per census tract data from California Department of Finance, 2011), which is 16% of total service area population (of 113,478, per Kennedy/Jenks, 2011a, Table 2-1)

4: DBS&A, 2010a, Tables 13 and 14

5: Casitas, 2011, Table 8

It should be noted that the available data does not allow development of an estimate for a consistent timeframe (as the estimate in Table 4-1 is primarily for 2010, except for groundwater extractions). Thus some variations in the estimate are likely due to annual variations in climatic conditions. In addition, the Ojai Basin Groundwater Management Agency (OBGMA) assumes that all water extractions outside the Golden State service area are for irrigation use (as discussed below).

Responses to comments from Bert J. Rapp, January 12, 2012

Chapter 4, Water Demand and Water Budget: The estimate of Water Demand is generally based on 2010 data, to the extent that such data was available, and covers the entire watershed, including those portions of the watershed that are outside the service boundaries of the Casitas Municipal Water District. A more comprehensive estimate of water demand and supply could help improve the management of water resources, particularly if that assessment considered a variety of water year conditions, such as an average, dry, and critically-dry water years, consistent with recent Urban Water Management Plans. The suggested update of Safe Yield analysis for Lake Casitas would be a useful component, but additional data would be needed to reflect demand and supply for the entire watershed, including those areas for which water demand and supply information is only marginally available (such as Upper Ojai).

Section 8.1.4: Data Gaps: Cardno ENTRIX concurs that the understanding of the interaction between surface and groundwater within lower stretches of the Ventura River above Foster Park is not well understood. In their recommendations to improve groundwater estimates in the lower Ventura River groundwater basin, Daniel B. Stephens & Associates (DBS&A 2010a), proposed the installation of monitoring gauges to better track surface and groundwater in this area. This issue is one of the hindrances to the development of a water budget or a groundwater model, which could both be relevant to future planning related to compliance with a future TMDL related to pumping.

Section 8.1.5: Ventura River Groundwater Management Plan: Cardno ENTRIX acknowledges that differences of opinion exist with respect to the need to develop a groundwater management plan.

Section 8.1.6: Water Budget: The Water Supply and Use Status Report (Casitas 2004), which provides an estimate of the Safe Yield for Lake Casitas, is focused on surface water diversions to the lake, and thus does not address flows that enter the lower portions of the Ventura River, such as San Antonio Creek, nor addresses the utilization of groundwater on a comprehensive basis in the watershed. A comprehensive water budget would address all sources of water supply, including both surface and groundwater in a comprehensive fashion.

Chapter 3, Section 3.4 Groundwater Management Plan: Cardno ENTRIX concurs that if a groundwater management plan is developed, it should be administered by a public agency.

In response to the marked-up pages, the body of the report was revised to correct or clarify the text.

Unsigned comment letter from Ojai Basin Groundwater Management Agency, January 12, 2012

The Ojai Basin Groundwater Management Agency (OBGMA) appreciates the opportunity to comment on the Draft Ventura River Watershed Protection Plan Report of December 2011 (Draft Report, Report, also Plan) prepared by Cardno ENTRIX (CE) for the Ventura County Watershed Protection District (WPD).

The OBGMA manages the Ojai Groundwater Basin, the largest alluvial groundwater basin within the Ventura River Watershed. Numerous bedrock water wells are also within the OBGMA boundaries, similar to other bedrock aquifers elsewhere in the Ventura River Watershed. Comments contained herein are the result of a collaborative effort of board members, staff, and stakeholders within the OBGMA jurisdiction.

Based on presentations to the Ventura River Watershed Council by the WPD and CE, we understood that the Draft Report intended to summarize the four other elements in the top-priority project suite of the Proposition 50 Implementation Grant for the Ventura River Watershed (Project V-1). There is considerable information quoted from existing reports that should be validated and be in context with conclusions made, and the report should be clear on which information is original to the CE effort. Project V-1 is not the only Proposition 50-funded project within the Ventura River Watershed; the V-2 project (SACSGRP) and others contribute to the understanding of the system and should at least be discussed in the Plan.

The Ventura River Watershed is very dynamic and unique. The Plan should lay an outline for understanding and managing the Ventura River Watershed rather than attempt to fit a plan into the mold of another drainage basin. Inclusion of other plans in the Report seems unnecessary.

One of the most significant recommendations within the plan is to develop a water budget for the whole watershed. This recommendation echoes those of other efforts, and based on the experience of the OBGMA this is a difficult task that is compounded by the number of alluvial groundwater basins within the Watershed (note the differences between State delineations and County delineations), the overlap of surface water divides over alluvial groundwater basins (such as Upper Ojai) and the complex bedrock geology and hydrogeology. Bedrock systems are also linked to other watersheds. A complex, comprehensive model will likely be necessary to most accurately develop the water budget for the entire watershed. The Report should build the framework for funding and implementing such a recommendation, and should be a significant focus of the Ventura River Watershed Protection Plan.

In the Draft Report, water conservation activities are discussed as not being accomplished at the present time. Casitas MWD is leading the way in Conservation activities in the Watershed. The Plan should discuss those activities as well as any of the purveyors' conservations programs, such as Golden State Water Company's free distribution of water-saving fixtures to customers in Ojai.

The Draft Report contains many details and we encourage a thorough quality assurance/quality control review of the report both internally and with respect to cited references.

Responses to comments from OBGMA

The introduction to the report has been modified to clarify which sections summarize existing information and which contain new information.

A description of the San Antonio Spreading Grounds Rehabilitation Project was added to Section 2.9.1.

Cardno ENTRIX concurs that the Ventura Watershed has many characteristics that are unique in Southern California, most notably the complete reliance on local water supplies. The review of other watershed plans was not intended to determine the scope of the proposed Watershed Management Plan. Instead it was intended to identify useful lessons from those plans that might inform the development of the watershed plan for the Ventura River.

Cardno ENTRIX concurs that the development of a water budget is a complex issue and underscores the potential value of a budget for the comprehensive management of water resources.

Any inference that the Draft Report suggested that water conservation activities are not being implemented was unintentional. Cardno ENTRIX acknowledges that Casitas and other water agencies have ongoing water conservation programs and remain committed to the continued implementation of those programs.

The inclusion of numerous citations throughout the body of the report was at the request of the District. Development of the report was subject to a QA/QC process to confirm the validity of the cited materials.

From: Bill O'Brien [mailto:billo@hawkscivil.com]
Sent: Monday, January 16, 2012 4:28 PM
To: Mark Horne
Subject: Followup Comments for Ventura River Watershed Protection Plan Report

Mark,

I realize I am late for your cut off date so will just submit a clean copy of the map I gave to Lorraine Woodman of your team when you gave the Dec. 13 presentation to the Ventura River Council.

I'd like to submit the pdf version for your use or reference in the water budget section of the report.

My comment at the River Council was that the answer to the water budget is in the reservoirs. We may not have, and may never have some of the detailed inputs – or outputs, but we do have the change in storage as represented by the groundwater levels (or better if we have isohyets), and in the case of surface water, the storage in Lake Casitas. This leads to the recommendation of a lumped parameters approach to the water balance may be the next best step.

Also attached is a map we did for the May 2010 Ventura River Watershed U. that shows the largest water related agencies in the watershed.

Please credit these comments or either of these drawings to the City of Ojai, Public Works Department if you use them.

Let me know if you have any questions.

Thanks for your work on this report.

Best,

Bill

William (Bill) O'Brien, PE, CFM

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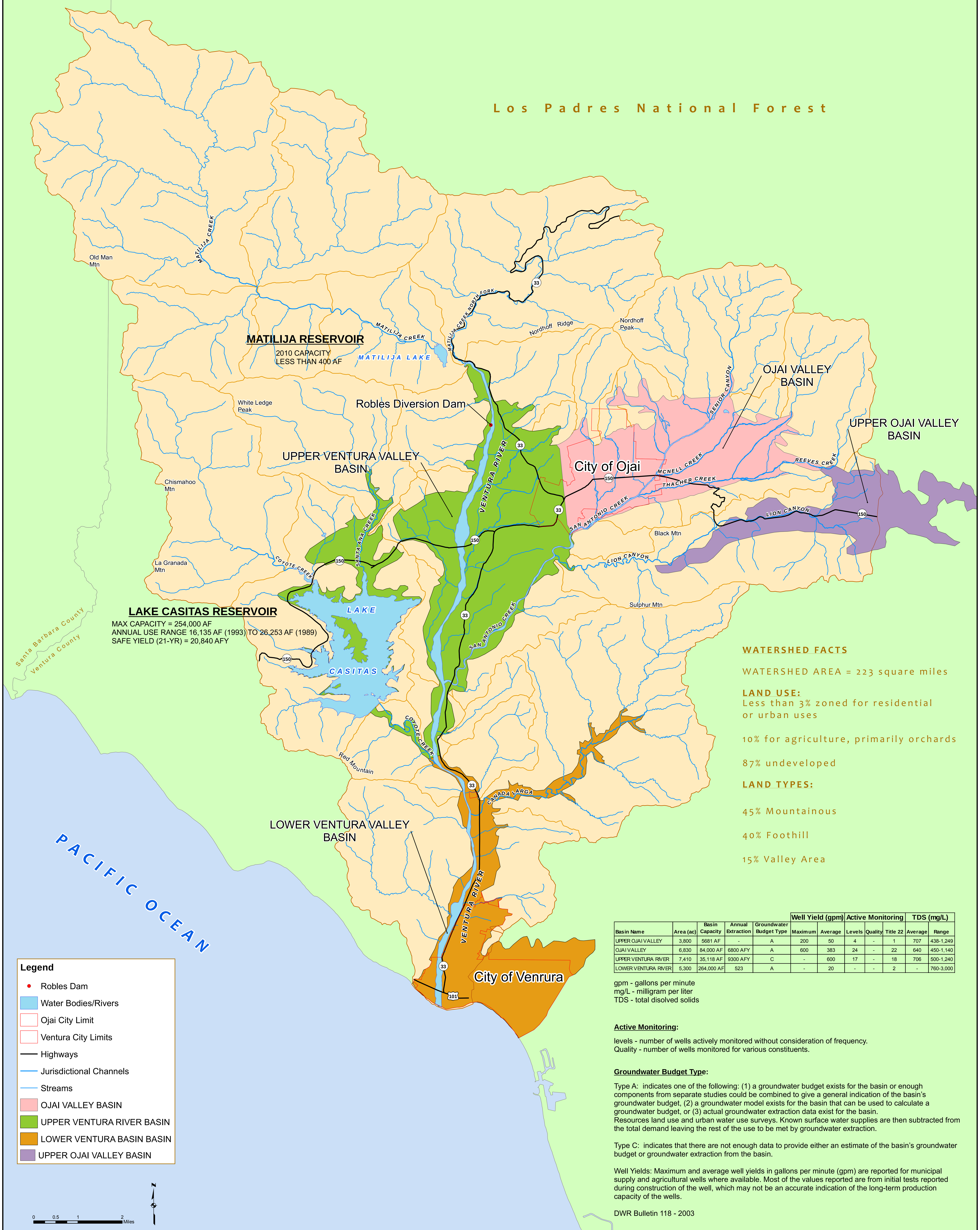
VENTURA RIVER WATERSHED

Ground Water Basins And Surface Water Reservoirs



WATERSHED FACTS

WATERSHED AREA = 223 square miles

LAND USE:
Less than 3% zoned for residential or urban uses

10% for agriculture, primarily orchards

87% undeveloped

LAND TYPES:

45% Mountainous

40% Foothill

15% Valley Area

					Well Yield (gpm)		Active Monitoring			TDS (mg/L)	
Basin Name	Area (ac)	Basin Capacity	Annual Extraction	Groundwater Budget Type	Maximum	Average	Levels	Quality	Title 22	Average	Range
UPPER OJAI VALLEY	3,800	5681 AF	-	A	200	50	4	-	1	707	438-1,249
OJAI VALLEY	6,830	84,000 AF	6800 AFY	A	600	383	24	-	22	640	450-1,140
UPPER VENTURA RIVER	7,410	35,118 AF	9300 AFY	C	-	600	17	-	18	706	500-1,240
LOWER VENTURA RIVER	5,300	264,000 AF	523	A	-	20	-	-	2	-	760-3,000

gpm - gallons per minute
mg/L - milligram per liter
TDS - total disolved solids

Active Monitoring:

levels - number of wells actively monitored without consideration of frequency.
Quality - number of wells monitored for various constituents.

Groundwater Budget Type:

Type A: indicates one of the following: (1) a groundwater budget exists for the basin or enough components from separate studies could be combined to give a general indication of the basin's groundwater budget, (2) a groundwater model exists for the basin that can be used to calculate a groundwater budget, or (3) actual groundwater extraction data exist for the basin.
Resources land use and urban water use surveys. Known surface water supplies are then subtracted from the total demand leaving the rest of the use to be met by groundwater extraction.

Type C: indicates that there are not enough data to provide either an estimate of the basin's groundwater budget or groundwater extraction from the basin.

Well Yields: Maximum and average well yields in gallons per minute (gpm) are reported for municipal supply and agricultural wells where available. Most of the values reported are from initial tests reported during construction of the well, which may not be an accurate indication of the long-term production capacity of the wells.

DWR Bulletin 118 - 2003

November 14, 2011

HAWKS & ASSOCIATES

CITY OF OJAI CALIFORNIA

SOURCES OF INFORMATION:
Ventura River Ground Water Basins from Ventura County (VCWPD) 2010 Ground Water Section Annual Report (Pg5).

Ventura River Watershed Ground Water Basins And Surface Water Reservoirs

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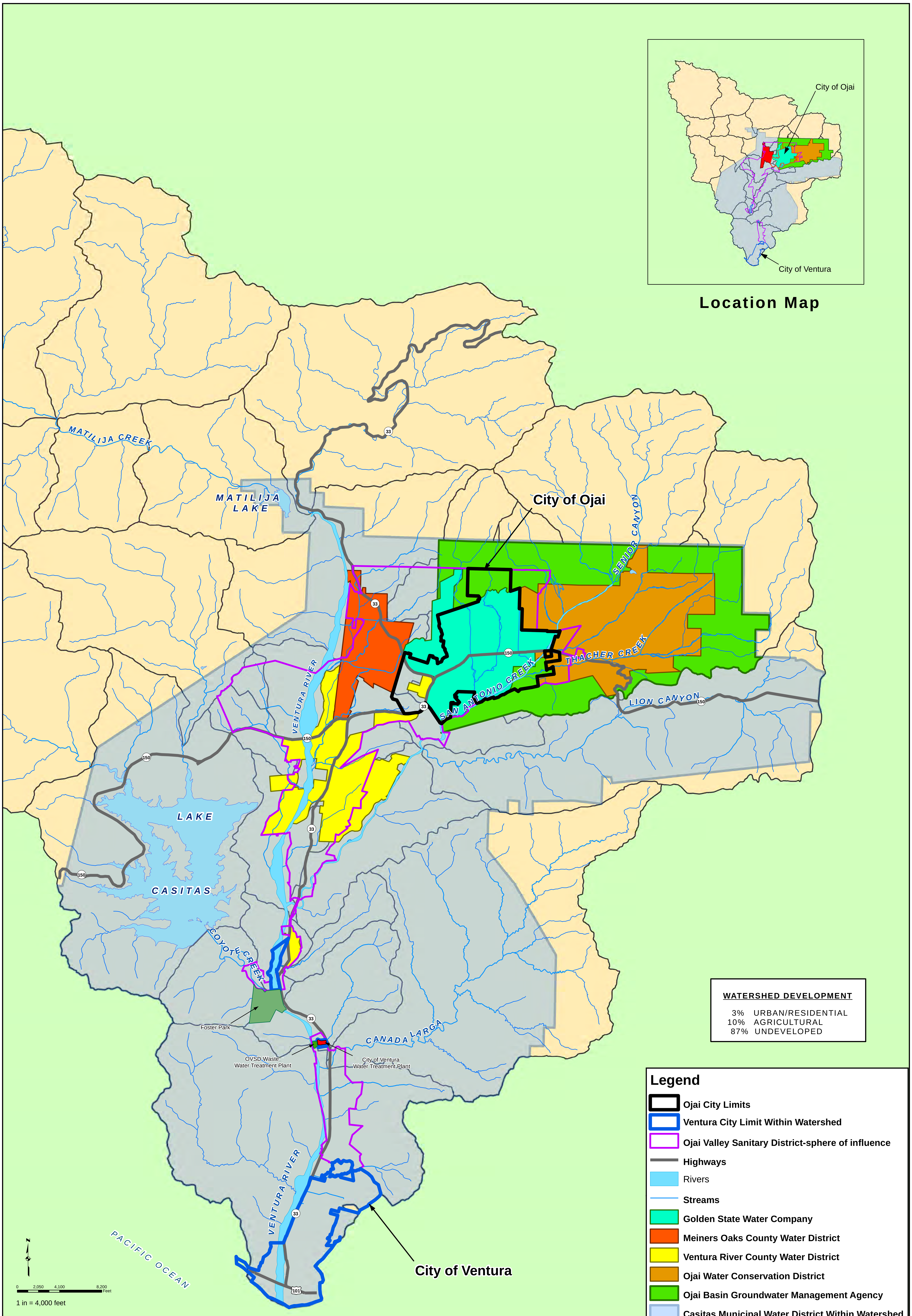

HAWKS & ASSOCIATES

CITY OF OJAI CALIFORNIA

WATER AGENCIES IN THE VENTURA RIVER WATERSHED

T:\PROJECTS\6-2 Ojai Projects\6-2 Ventura River\Water District Map\Water Distribution District Map.mxd

Response to comment from Bill O'Brien, January 16

The two maps attached to this comment are included on the preceding pages of this appendix for reference.

Cardno ENTRIX concurs that a lumped parameters approach could facilitate the development of a water balance, as it would simply the number of parameters that would be required and could overcome some of the limitations in a traditional approach (which was described in Section 4.3).

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Casitas Municipal Water District

January 10, 2012

Norma Camacho, Director
Ventura County Watershed Protection District
800 S. Victoria Avenue
Ventura, California 93009-1600

Comments on the Draft Ventura River Watershed Protection Report – December 2011

Dear Norma,

The Casitas Municipal Water District respectfully submits the following comments and recommended corrections to the December 2011 Draft Ventura Watershed Protection Plan. Our comments are provided with the understanding that the purpose of the Report is to summarize conditions and provide relevant information that can inform development of a comprehensive and integrated Ventura River Watershed Management Plan.

Our comments and corrections are as follows:

Page 2-30, Section 2.6.2.1. The Report perpetuates the opinion that the Coyote stream flow measurements are "not considered reliable". The assessment and the reasoning of this opinion is not accurate. Note that Casitas and the District continued to jointly operate the station after 1988 as one of many original County Alert stations, sharing data and responsibilities for the station. While this statement continues from a previous report, this Report does not recognize the Santa Ana Creek station which also continuously monitors inflow above Lake Casitas. We recommend the removal of the negative bias and instead, the Report should state the fact that these two stations monitor the two main tributaries that flow into Lake Casitas.

Page 2-36, Section 2.6.2.2. The Report makes the statement referring to the Robles Diversions having little effect on large peak flows, "since diversions do not occur under the high-suspended sediment conditions associated with large peak flows." This statement is not accurate or true. The diversions have little effect on high peak flows because the diversion is usually only a small percentage of the high peak flow conditions that occur at the Robles Diversion. Casitas does attempt to divert at peaks if no other obstructions or reasons cause Casitas to shutdown diversions (i.e., clogging of the fish screens). It is recommended to delete the above quoted portion of that sentence.

Also on this page is a reference to the major flood event of 2005 and stating flows of "January (1,826 cfs) and February (1,229 cfs)." These figures do not seem to relate to the flows of 2005, and with no reference for the source of the data, it is difficult to interpret the meaning and significance of the data. Please check the source, accuracy, and meaning of this data.

Page 2-41, Section 2.6.3.2. The Report refers to a basin being depleted. Please indicate or name which basin or basin(s) attained depletion.

Page 2-53, Section 2.9.4. The Report states that "The water balance in Lake Casitas is closely monitored, and daily discharge records have been obtained back to 1970; however, only the records from 1991 on are currently available in electronic form (Tetra Tech 2008a)." First it should be acknowledge that daily records for Lake Casitas have been maintained since 1959 and are available paper form. The Report purpose is limited in this sentence to not stating the fact that additional data is available – just not in digital form (which is one of the primary reasons for the bias regard Coyote Creek data). Recommend stating that the record keeping of the water balance for Lake Casitas dates to the first impoundment of water behind that dam in 1959.

Page 3-25, Component 6. Component 6, last sentence, provides two examples of management objectives. First, no other component in this section provides any examples to help clarify the statement in the component. Secondly, the examples may not be a direction in which the plan proponents proceed. Recommend deletion of the sentence with the two examples.

Page 3-25, Component 11. Component 11 suggests the report frequency be determined by the Watersheds Coalition of Ventura County. There has been no nexus in the Report between previously mentions groups and agencies and the Watersheds Coalition of Ventura County, or the determination authority therein. Suggest deleting "by the Watersheds Coalition of Ventura County" and include an "and" in the sentence.

Page 8-2, Section 8.1.3. In the first bullet, the Report refers separately to the Ojai Valley Land Conservancy, the Ventura River Watershed Council, and the District. To our knowledge, the Ojai Valley Land Conservancy is a member of the Ventura River Watershed Council. Suggest that this bullet be revised to refer to the Council and the District.

If you have any questions in regard to the above comments, please do not hesitate to contact me.

Sincerely,

Steven E. Wickstrum
General Manager

CC: Mark Horn, Cardno ENTRIX

Response to comment from Casitas Municipal Water District, January 10, 2012

Page 2-30, Section 2.6.2.1. The text indicating the Coyote stream flow measurements are not considered reliable was removed. The statement that the two stations monitor the two main tributaries that flow into Lake Casitas was not added, because similar information was not included for other monitoring stations.

Page 2-36, Section 2.6.2.2. The text regarding large peak flows was modified as recommended. The sentence describing flows in January and February 2005 was removed.

Page 2-41, Section 2.6.3.2. As mentioned in the preceding sentence, the text is referring to the Upper Ventura Basin.

Page 2-53, Section 2.9.4. The text was modified as recommended.

Page 3-26, Component 6. The text was modified as recommended.

Page 3-26, Component 11. The text was modified as recommended.

Page 8-2, Section 8.1.3. The text was modified as recommended.

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