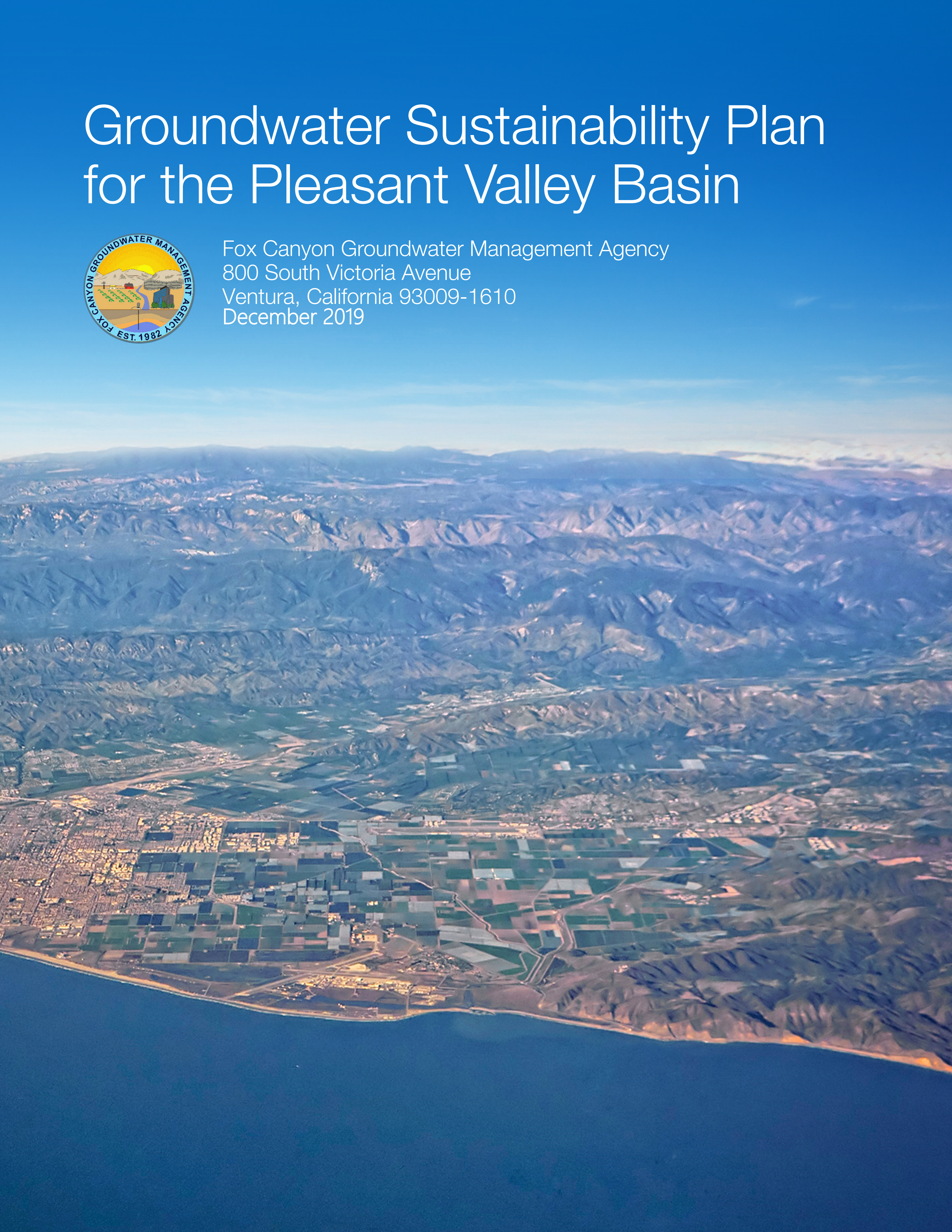
Groundwater Sustainability Plan for the Pleasant Valley Basin

Fox Canyon Groundwater Management Agency
800 South Victoria Avenue
Ventura, California 93009-1610
December 2019



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Board of Directors
Fox Canyon Groundwater Management Agency
800 South Victoria Avenue
Ventura, CA 93009

Subject: Groundwater Sustainability Plan for the Pleasant Valley Basin

Dear Board of Directors:

Dudek is pleased to submit this Groundwater Sustainability Plan (GSP) for the Pleasant Valley Basin to the Fox Canyon Groundwater Management Agency. This GSP was prepared this in accordance with California Code of Regulations, Title 23. Water, Division 2. Department of Water Resources, Chapter 1.5. Groundwater Management, Subchapter 2. Groundwater Sustainability Plans.

Respectfully Submitted,

Ronald Schnabel, PG #7836, CHG #867
Senior Hydrogeologist

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
AF	acre-feet
AFY	acre-feet per year
AHA	Adjusted Historical Allocation
ASRVB	Arroyo Santa Rosa Valley Basin
BMO	Basin Management Objective
CEQA	California Environmental Quality Act
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CMWD	Calleguas Municipal Water District
COCs	constituents of concern
CWD	Camrosa Water District
CWRF	Camrosa Water Reclamation Facility
DBS&A	Daniel B. Stephens & Associates Inc.
DPWM	Distributed Parameter Watershed Model
DWR	California Department of Water Resources
EPVMA	East Pleasant Valley Management Area
ET	evapotranspiration
FCA	Fox Canyon Aquifer
FCGMA	Fox Canyon Groundwater Management Agency
GCA	Grimes Canyon Aquifer
GDE	groundwater-dependent ecosystem
gpm	gallons per minute
GREAT	Groundwater Recovery Enhancement and Treatment
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
LAS	Lower Aquifer System
LPVB	Las Posas Valley Basin
M&I	municipal and industrial
mg/L	milligrams per liter
msl	above mean sea level
MWC	Mutual Water Company
MWTP	Moorpark Wastewater Treatment Plant
NPVMA	North Pleasant Valley Management Area
PVB	Pleasant Valley Basin
PVCWD	Pleasant Valley County Water District
PVMWC	Pleasant Valley Mutual Water Company
PVP	Pleasant Valley Pipeline
PVPDMA	Pleasant Valley Pumping Depression Management Area
RMSE	root-mean-squared error
SCAG	Southern California Association of Governments
SGMA	Sustainable Groundwater Management Act

Acronym/Abbreviation	Definition
SOAR	Save Open Space and Agricultural Resources
SWP	State Water Project
TAG	Technical Advisory Group
TDS	total dissolved solids
TMDL	total maximum daily load
UAS	Upper Aquifer System
UWCD	United Water Conservation District
UWMP	urban water management plan
WLPMA	West Las Posas Management Area
WQO	Water Quality Objective
WRP	Water Reclamation Plant
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

The Fox Canyon Groundwater Management Agency (FCGMA, or the Agency) has developed this Groundwater Sustainability Plan (GSP) for the Pleasant Valley Basin (PVB; DWR Basin 4-006), in compliance with the 2014 Sustainable Groundwater Management Act (SGMA) (California Water Code, Section 10720 et seq.). FCGMA is one of three Groundwater Sustainability Agencies (GSAs) in the PVB. The other two GSAs are the Camrosa Water District–Pleasant Valley GSA and the Pleasant Valley Outlying Areas GSA. This GSP is the sole GSP prepared for the PVB, and covers the entire PVB, including all areas of the PVB outside of FCGMA's jurisdiction. The purpose of this GSP is to define the conditions under which the groundwater resources of the entire PVB, which support agricultural, municipal and industrial, and environmental uses, will be managed sustainably in the future.

The PVB shares a boundary and is in hydraulic communication with Oxnard Subbasin (Subbasin; DWR Basin 4-004.02) to the west. The boundary between the PVB and the Oxnard Subbasin is associated with a change in character of recent and older alluvial deposits. In the PVB, these deposits are finer grained and are, in general, less suitable for groundwater production than the coarser-grained sediments of the same age in the Oxnard Subbasin. There is no corresponding change in character in the deeper aquifers, including the Fox Canyon Aquifer, which are continuous across the boundary between the PVB and the Oxnard Subbasin. Groundwater production from wells on either side of the boundary between the PVB and the Oxnard Subbasin influences groundwater elevations and the direction of groundwater flow across this boundary.

Historical groundwater production from the PVB and Oxnard Subbasin combined has resulted in seawater intrusion in the aquifers of the Subbasin. In the PVB, the average rate of groundwater production between 2015 and 2017 was approximately 13,200 acre-feet per year (AFY). In 2015, approximately 53% of the production from the Lower Aquifer System, which comprises the Hueneme, Fox Canyon, and Grimes Canyon Aquifers, and 47% of the production from the Upper Aquifer System, which comprises the older alluvium in the PVB, and the Oxnard and Mugu Aquifers in the Oxnard Subbasin. Numerical groundwater simulations indicate that if these production rates were carried into the future, groundwater elevations in the PVB would not recover during multi-year cycles of drought and recovery, and seawater intrusion would continue in the Oxnard Subbasin. The landward extent of the area in the Subbasin currently impacted by concentrations of chloride greater than 500 milligrams per liter is referred to as the "saline water impact front."[1]

Combinations of projects and management actions were explored to estimate the rate of groundwater production that would allow groundwater elevations in the PVB to recover during multi-year cycles

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[1] Sources of water high in chloride in the Oxnard Subbasin include modern seawater as well as non-marine brines and connate water in fine-grained sediments. Therefore, the area of the Subbasin impacted by concentrations of chloride greater than 500 milligrams per liter is referred to as the *saline water impact area*, rather than the *seawater intrusion impact area*, to reflect all the potential sources of chloride to the aquifers in this area.

of drought and recovery, and prevent future landward migration of the saline water impact front. This rate of groundwater production is referred to as the sustainable yield. With the currently available projects and management actions, the sustainable yield of the PVB was estimated to be approximately 11,600 AFY, with an uncertainty of ± 1,200 AFY. At the upper bound of the uncertainty estimate (12,600 AFY), the estimated sustainable yield of the PVB is 600 AFY lower than the 2015–2017 average production rate.

Adoption of this GSP represents the first step in achieving groundwater sustainability within the PVB by 2040, as required by SGMA. Evaluation of this GSP is required at a minimum of every 5 years following submittal to the California Department of Water Resources (DWR). As part of the 5-year evaluation process, the sustainable yield will be refined and adjusted. These refinements will be based on new data, additional studies undertaken to fill data gaps, and groundwater modeling. Refinements and adjustments will also be made to the minimum threshold groundwater levels developed to avoid undesirable results, the measurable objective groundwater levels that account for the need to continue groundwater production during drought cycles and the associated interim milestones to help gauge progress toward sustainability over the next 20 years.

In order to minimize the pumping reductions required to achieve sustainable management of the PVB, investment in projects to increase water supply, provide the infrastructure to redistribute pumping, and/or directly control seawater intrusion in the Oxnard Subbasin should be investigated. Inter-basin optimization studies, groundwater modeling, and project feasibility studies are recommended over the next 5 years to explore practicable processes and approaches to increasing the sustainable yield of the PVB.

ES.1 INTRODUCTION

The PVB is an alluvial groundwater basin, located in Ventura County, California. The climate is typical of coastal Southern California, with average daily temperatures ranging generally from 43°F to 80°F in summer and from 41°F to 74°F in winter. The PVB ranges in elevation from approximately 30 to 680 feet above mean sea level. Land use overlying the PVB is divided between agricultural and urban uses, with agricultural use covering approximately 40% of the land within Pleasant Valley, and residential and urban use covering approximately 50% of the land. The remaining 10% is open space. DWR has designated the 77-square-mile PVB as a high priority basin and subject to critical conditions of overdraft.

The PVB is bounded to the north by the Camarillo Hills and the Somis Gap, to the east by the Arroyo Santa Rosa Valley Groundwater Basin (DWR Groundwater Basin 4-007) and Conejo Mountain, to the southeast by the Santa Monica Mountains, and to the west and southwest by the Oxnard Subbasin. The Bailey Fault bisects the PVB, running northeast/southwest from the boundary of the Arroyo Santa Rosa Valley Groundwater Basin on the east to the boundary with the Oxnard Subbasin on the west. To the southeast of the Bailey Fault, the Fox Canyon Aquifer is absent in the subsurface. This area of the PVB has been designated as the East Pleasant Valley Management Area (EPVMA). The Camrosa Water District–Pleasant Valley GSA jurisdictional area coincides with the portion of the Camrosa Water District Service area in the EPVMA. The PVB Outlying Areas GSA covers the remaining portions of the EPVMA not within Camrosa Water District–Pleasant Valley GSA jurisdiction. Additionally, the PVB Outlying Areas GSA covers an approximately 3.6 acre area of the PVB on the boundary between the PVB and the Las Posas Valley Basin to the north. With the exception of the 3.6 acres in the jurisdiction of the PVB Outlying Areas GSA, the area northwest of the Bailey Fault lies within the jurisdictional boundaries of FCGMA.

FCGMA is an independent special district formed in 1982 by the California Legislature to manage and protect the aquifers within its jurisdiction for the common benefit of the public and all groundwater users (FCGMA et al. 2007). Extractors within FCGMA jurisdiction are subject to the Agency’s GSPs, ordinances, and policies created for the sustainable management of groundwater.

Public participation and stakeholder feedback have played a critical role in the development of this GSP. The FCGMA maintains a list of stakeholders interested in the GSP process, known as the *List of Interested Parties*. A monthly newsletter, meeting notices, and notices of GSP documents available for review were sent electronically to those on the List of Interested Parties. Public workshops were held to inform stakeholders and the general public on the contents of the GSP and to solicit feedback on that content. To further facilitate stakeholder understanding, the FCGMA Board of Directors (Board) approved release of a preliminary draft GSP for public comment in November 2017. Additionally, the FCGMA Board formed a Technical Advisory Group, which generally held monthly public meetings throughout the GSP development process, beginning in July 2015 and ending in February 2019. In addition, updates on the development of the GSP were given at meetings of the FCGMA Board, beginning in April 2015. All FCGMA Board meetings, Technical Advisory Group meetings, Board-appointed committee meetings, and Board special workshops are noticed in accordance with the Brown Act, and opportunities for public comment were provided at all FCGMA Board meetings, Technical Advisory Group meetings, Board-appointed committee meetings, and workshops.

ES.2 SUMMARY OF BASIN SETTING AND CONDITIONS

There are five commonly recognized hydrostratigraphic units in the PVB: the Shallow Alluvial Aquifer, older alluvium, the Upper San Pedro Formation, the Fox Canyon Aquifer, and the Grimes Canyon Aquifer. The boundary between the PVB and the Oxnard Subbasin is associated with a change in character of recent and older alluvial deposits. The Fox Canyon Aquifer and Grimes Canyon Aquifer are continuous across the boundary with the Oxnard Subbasin to the west. The majority of the PVB aquifers, except the Shallow Alluvial Aquifer, are confined. In northern PVB, the Shallow Alluvial Aquifer rests directly on the folded, faulted, and eroded surface of the Fox Canyon Aquifer. Water that recharges the Shallow Alluvial Aquifer via flow in Arroyo Las Posas is able to migrate to the Fox Canyon Aquifer in this area; however, migration of recharge to the Fox Canyon Aquifer and Grimes Canyon Aquifer from Arroyo Las Posas to other parts of the PVB may be limited by extensive faulting and folding.

Groundwater elevations and flow directions have varied historically in the PVB. In general, groundwater elevations are higher in the northeastern part of the PVB and are lower adjacent to the Oxnard Subbasin boundary, and the groundwater gradient drives flow from east to west in the PVB. Groundwater elevations and the direction of flow are poorly constrained in the EPVMA, which lacks monitoring wells and historical groundwater elevation data. Historical groundwater elevation data document rising groundwater levels in the older alluvium and the Fox Canyon Aquifer throughout the 1990s. These rising groundwater levels were driven by increased surface water recharge to the PVB as discharge from upstream wastewater treatment plants and shallow dewatering wells in Simi Valley produced perennial flow in Arroyo Las Posas. The effects of this increased flow reached the PVB in the early 1990s as both direct surface water flow and increased subsurface inflow from the Las Posas Valley Basin to the north. Perennial surface water flows no longer reach the PVB, and groundwater elevations have declined in response to the combined effects of the diminished recharge and the drought that began in 2011.

As the PVB began to receive additional recharge from perennial flows in Arroyo Las Posas, groundwater concentrations of total dissolved solids (TDS) began to increase in northern PVB. Increased concentrations of TDS have been observed in both the older alluvium and the Fox Canyon Aquifer. TDS concentrations have impaired municipal use of groundwater in the northern PVB.

In addition to groundwater quality concerns related to infiltrating surface water, brine migration along the Bailey Fault is also a concern in the PVB. Degradation of groundwater quality may occur in the PVB if groundwater levels fall below threshold elevations that maintain sufficient hydrostatic pressure to prevent upwelling of brines along the Bailey Fault and from the geologic formations underlying the PVB. However, a direct correlation between groundwater elevation and degraded water quality has not been established.

The water budget for the PVB provides an accounting and assessment of the average annual volume of groundwater and surface water entering (i.e., inflow) and leaving (i.e., outflow) the PVB and enables an accounting of the cumulative change in groundwater in storage over time. The United Water Conservation District developed the Ventura Regional Groundwater Flow Model, a MODFLOW numerical groundwater flow model, for the PVB, the Oxnard Subbasin, the western part of the Las Posas Valley Basin, and the Mound Basin. A peer review study of the United Water Conservation District model was conducted for this GSP. The historical groundwater budget for the PVB is based on the United Water Conservation District model, which had a historical base period from 1985 to 2015. During average conditions, which are defined as water years in which the precipitation in the PVB was between 75% and 150% of the average annual precipitation, the net change in groundwater storage for the older alluvium was an increase of 1,758 AFY and the net change in storage in the Lower Aquifer System was an increase of 860 AFY. This increase reflects the increased recharge along Arroyo Las Posas, and does not take into consideration the ongoing seawater intrusion in the Oxnard Subbasin during these years. Groundwater pumping during these years averaged 999 AFY in the older alluvium and 7,145 AFY in the Lower Aquifer System.

Several model scenarios were developed to assess the future sustainable yield of the PVB and the adjacent Oxnard Subbasin. Each future scenario covered a 50-year timeframe, from 2020 to 2069. In two scenarios the 2015–2017 average groundwater extraction rate was continued throughout the 50-year model period. The results of each of these scenarios indicated that continuing the 2015–2017 extraction rate would allow for net seawater intrusion in both the Upper Aquifer System and the Lower Aquifer System in the Oxnard Subbasin. In three additional scenarios, the groundwater production rate was decreased gradually over the first 20 years. These model scenarios indicated that reduced groundwater production can eliminate net seawater intrusion in the Oxnard Subbasin over periods of drought and recovery. Based on the suite of model scenarios, the sustainable yield of the PVB was calculated to be approximately 12,600 AFY, with an uncertainty of ± 1,000 AFY.

It is anticipated that the analysis for the 5-year update to the GSP will focus on developing new water supply projects, as well as examining the potential impacts of differential extractions on the coast and inland, particularly in the Lower Aquifer System. Additional modeling is recommended for the 5-year update process to understand how changes in pumping patterns and the addition of new water supply projects can increase the overall sustainable yield of the PVB. As this understanding improves, projects to support increases in the overall sustainable yield can be developed.

To reflect the current understanding of the hydrogeologic characteristics of the PVB, and in anticipation of future management strategies the PVB has been divided into three management areas. These areas are the EPVMA, the North Pleasant Valley Management Area, and the Pleasant Valley Pumping Depression Management Area. The Pleasant Valley Pumping Depression Management Area is adjacent to the Oxnard Subbasin, north of the EPVMA. The North Pleasant Valley Management Area is east of the Pleasant Valley Pumping Depression Management Area and north of the EPVMA. These areas are distinguished by differing hydrogeologic and water quality characteristics.

ES.3 OVERVIEW OF SUSTAINABILITY CRITERIA

The primary sustainability goal in the PVB is to maintain a sufficient volume of groundwater in storage in the older alluvium and the Lower Aquifer System so that there is no net decline in groundwater elevation or storage over wet and dry climatic cycles. Further, groundwater levels in the PVB should be maintained at elevations that are high enough to not inhibit the ability of the Oxnard Subbasin to prevent net landward migration of the saline water impact front after 2040.

Under SGMA, undesirable results occur when the effects caused by groundwater conditions occurring throughout the PVB cause significant and unreasonable impacts to any of the six sustainability indicators:

- Chronic lowering of groundwater levels
- Reduction of groundwater storage
- Seawater intrusion
- Degraded water quality
- Land subsidence
- Depletions of interconnected surface water

Of the six sustainability indicators, chronic lowering of groundwater levels, reduction of groundwater storage, degraded water quality, and land subsidence are applicable to the PVB. The PVB does not experience direct seawater intrusion, but groundwater elevations in the PVB affect seawater intrusion in the Oxnard Subbasin. Depletion of interconnected surface water is also not occurring within the PVB, where surface water bodies are ephemeral, losing streams, with groundwater elevations below the bottom of the stream channels. Minimum thresholds and measurable objectives, which are quantitative metrics of groundwater conditions in the PVB, were established for the sustainability indicators determined to be a current and/or potential future undesirable result. Groundwater elevations were used as a proxy for other sustainability indicators in establishing the minimum thresholds and measurable objectives.

The measurable objective groundwater levels for the PVB are the groundwater levels throughout the PVB, at which there is neither seawater flow into nor freshwater flow out of the Upper Aquifer System or the Lower Aquifer System in the Oxnard Subbasin. If groundwater levels in the PVB remained at the measurable objective in perpetuity, no groundwater would flow from the aquifer systems into the Pacific Ocean, and no ocean water would flow into the aquifer systems. To allow for operational flexibility during drought periods, groundwater levels in the PVB are allowed to fall below the measurable objective. In order to prevent net seawater intrusion over periods of drought and recovery, the periods during which groundwater elevations are below the measurable objective must be offset by periods when the groundwater elevations are higher than the measurable objective.

The minimum thresholds for the four applicable sustainability indicators are groundwater levels that were selected to allow declines in groundwater elevations during periods of future drought to be offset by recoveries during future periods of above-average rainfall in the PVB. These groundwater elevations also limit seawater intrusion in the Oxnard Subbasin. The minimum thresholds were tested with future groundwater model simulations that suggest the Oxnard Subbasin is likely to experience net landward migration of the 2015 saline water impact front after 2040 if groundwater levels fall below the minimum threshold elevations. These minimum thresholds are anticipated to improve the beneficial uses of the PVB by preventing chronic lowering of groundwater levels. This allows for long-term use of groundwater supplies in the PVB without ongoing loss of storage.

Although exceedance of a minimum threshold at any given well in the PVB may indicate an undesirable result is occurring in the PVB, a single exceedance is not necessarily sufficient to indicate PVB-wide conditions are causing undesirable results. To define the conditions under which undesirable results will occur in the PVB, three criteria were developed. The PVB would be determined to be experiencing an undesirable result if:

- In any single monitoring event, groundwater levels in four of nine identified key wells are below their respective minimum thresholds.
- The groundwater elevation at any individual key well is below the historical low groundwater level for that well.
- The groundwater level in any individual key well is below the minimum threshold for either three consecutive monitoring events or three of five consecutive monitoring events, which occur in the spring and fall of each year.

ES.4 OVERVIEW OF THE SUBBASIN MONITORING NETWORK

The overall objective of the monitoring network in the PVB is to track and monitor parameters that demonstrate progress toward meeting the sustainability goals. In order to accomplish this objective, the monitoring network in the PVB must be capable of the following:

- Monitoring changes in groundwater conditions (in four sustainability indicator categories)
- Monitoring progress toward minimum thresholds and measurable objectives
- Quantifying annual changes in water budget components

The existing network of groundwater wells includes both monitoring wells and production wells. This network is capable of delineating the groundwater conditions in the PVB and has been used for this purpose in the past. The current groundwater well network will be used to monitor groundwater conditions moving forward, in order to continue to assess long-term trends in groundwater elevation and groundwater quality in the PVB.

Although the current monitoring network is adequate to monitor groundwater conditions in the PVB, several improvements can be made to the network as funding becomes available. FCGMA has applied for funding through a DWR Technical Support Services (TSS) monitor well funding grant to add a monitoring well south of 5th Street to better constrain aquifer-specific groundwater elevations adjacent to the boundary with the Oxnard Subbasin. Additionally, there are no dedicated monitoring wells in either the North Pleasant Valley Management Area or the EPVMA. Adding a monitoring well to these management areas would provide for aquifer-specific water levels that would improve the understanding of groundwater gradients throughout the PVB. Lastly, to fill an existing data gap and to assist with understanding the potential connectivity between shallow groundwater and potential groundwater-dependent ecosystems, the monitoring network can be improved by installing shallow dedicated monitoring wells within the boundaries of the potential groundwater-dependent ecosystem along Arroyo Las Posas, Conejo Creek, and Calleguas Creek.

As funding becomes available, pressure transducers should be added to wells in the groundwater monitoring network. Pressure transducer records provide the high-temporal-resolution data that allows for a better understanding of water level dynamics in the wells related to groundwater production, groundwater management activities, and climatic influence.

In addition to supplementing the existing monitoring network with new wells, monitoring can also be improved in the future by coordination of monitoring schedules to ensure that groundwater monitoring activities occur over a 2-week window during the key reporting periods and mid-March and mid-October.

In the future, to the extent possible, additional dedicated monitoring wells will be incorporated into the existing monitoring network. These wells will provide information on groundwater conditions in geographic locations where data gaps have been identified, or where a dedicated monitoring well would better represent conditions in the aquifers than a production well currently used for monitoring.

ES.5 PROJECTS AND MANAGEMENT ACTIONS

Future projects and management actions have been identified to address potential impacts to beneficial uses and users of groundwater in the PVB resulting from groundwater production in excess of the current sustainable yield. One project was included in this GSP. This project was suggested by stakeholders and was reviewed by the FCGMA Board. The inclusion of this project does not constitute a commitment by the FCGMA Board to construct or fund it, but rather signals that it was sufficiently detailed to be included in groundwater modeling efforts that examined the quantitative impacts of the projects on groundwater elevations and the sustainable yield of the PVB. Projects included in the GSP or any amendment thereof that increase the available supply of groundwater are necessary to meet the sustainability goal for the basin in a manner that avoids adverse impacts to beneficial uses and users of groundwater within the basin.

Project No. 1 – Temporary Agricultural Land Fallowing

The Temporary Agricultural Land Fallowing Project will decrease groundwater production in the Pleasant Valley Pumping Depression Management Area, adjacent to the Oxnard Subbasin. This project will benefit the PVB by lessening pumping reductions for agricultural users of the PVB, while providing compensation for agricultural users who choose to fallow parcels of land.

Management Action No. 1 – Reduction in Groundwater Production

The primary management action proposed under this GSP is a reduction in groundwater production from the PVB. FCGMA has had the authority to monitor and regulate groundwater production in the portion of the PVB within its boundaries since 1983. The primary benefits related to reduction in groundwater production is recovery of groundwater elevations that have historically allowed for seawater intrusion in the Oxnard Subbasin. Reduction in groundwater production can be used to close any differential between groundwater elevations that can be obtained through implementation of projects and the groundwater elevations necessary to meet the sustainability goals for the PVB.

FCGMA approved an ordinance to establish an allocation system for the Oxnard Subbasin and PVB on October 23, 2019. The purpose of this ordinance is to facilitate adoption and implementation of the GSP and to ensure that the Oxnard Subbasin and PVB are operated within their sustainable yields. It is not the purpose of the ordinance to determine or alter water right entitlements, including those that may be asserted pursuant to California Water Code Sections 1005.1, 1005.2, or 1005.4.

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CHAPTER 1
ADMINISTRATIVE INFORMATION

1.1 PURPOSE OF THE GROUNDWATER SUSTAINABILITY PLAN

The Fox Canyon Groundwater Management Agency (FCGMA), acting as the Groundwater Sustainability Agency (GSA) for the portions of the Pleasant Valley Basin (PVB) within its jurisdictional boundaries, has developed this Groundwater Sustainability Plan (GSP) in compliance with the 2014 Sustainable Groundwater Management Act (SGMA) (California Water Code, Section 10720 et seq.). This GSP has been developed to apply to the entirety of the PVB, including those portions of the PVB that lie outside FCGMA's jurisdictional boundary, primarily consisting of fringe areas of the PVB. The County of Ventura (County) and the Camrosa Water District (CWD) have each elected to act as the GSA for portions of the PVB not within FCGMA's jurisdiction. The County and CWD will rely on this GSP and coordinate with FCGMA as necessary to ensure that the PVB is sustainably managed in its entirety, in accordance with SGMA.

SGMA defines sustainable groundwater management as the "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results." "Undesirable results" are defined in SGMA and are summarized here as any of the following effects caused by groundwater conditions occurring throughout the basin[1]:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply
- Significant and unreasonable reduction of groundwater storage
- Significant and unreasonable seawater intrusion
- Significant and unreasonable degraded water quality
- Significant and unreasonable land subsidence
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water

As described in Chapter 2, Basin Setting, of this GSP, undesirable results within the PVB have occurred historically with respect to chronic declines in groundwater level and significant and unreasonable reduction of groundwater storage. Although direct seawater intrusion has not occurred historically, and is unlikely to occur in the future in the PVB, groundwater production from the western part of the PVB influences groundwater elevations in the Oxnard Subbasin to the west. This influence has the potential to exacerbate seawater intrusion in the Oxnard Subbasin. Portions of the PVB are experiencing, or are under threat of experiencing, degraded water quality.

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[1] As defined in SGMA, "basin" means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to California Water Code, Section 10720 et seq. (Basin Boundaries).

Land subsidence has occurred historically in the PVB and has the potential to occur in the future if groundwater conditions are not managed sustainably. Depletions of interconnected surface water may have occurred historically in the PVB, although there is little data in the vicinity of the primary surface water courses in the PVB to document historical or current interactions between surface water and groundwater (see Section 1.3.2, Geography; Section 2.2.1, Geology; and Section 2.3.7, Groundwater-Dependent Ecosystems).

The purpose of this GSP is to define the conditions under which the groundwater resources of the PVB, which support agricultural, municipal and industrial (M&I), and environmental uses, will be managed sustainably in the future. The adoption of this GSP represents the first step in achieving groundwater sustainability within the PVB by 2040 as required by SGMA. Over the next 20 years, data will continue to be gathered and used to refine the estimated sustainable yield and potential paths for achieving sustainability set forth in the following chapters. As the understanding of the PVB improves, this GSP will be updated to reflect the new understanding of the PVB. This GSP outlines a plan for annual reporting and periodic (5-year) evaluations (Chapter 1); characterizes groundwater conditions, trends, and the cumulative impacts of groundwater pumping for each of the SGMA-defined sustainability indicators (Chapter 2); establishes minimum thresholds, measurable objectives and interim milestones by which sustainability can be measured and tracked (Chapter 3, Sustainable Management Criteria); outlines the monitoring network used to support and document progress toward sustainability (Chapter 4, Monitoring Networks); and identifies projects and management actions to be implemented by the GSA and/or stakeholders to minimize undesirable results (Chapter 5, Projects and Management Actions). This GSP documents a viable path, determined by the GSA in collaboration with stakeholders, and informed by the best available information, to achieving the sustainability goal within the PVB.

1.2 AGENCY INFORMATION

1.2.1 Agency Name

Fox Canyon Groundwater Management Agency (FCGMA or Agency)

1.2.2 Agency Address

Mailing Address:

Fox Canyon Groundwater Management Agency
800 South Victoria Avenue
Ventura, California 93009-1610

Office Location:

Ventura County Government Center
Hall of Administration
800 South Victoria Avenue
Ventura, California 93009

1.2.3 Organization and Management Structure

FCGMA is governed by five Board of Directors (Board) members who represent the (1) County of Ventura (County), (2) the United Water Conservation District (UWCD), (3) seven mutual water companies and water districts within the Agency (Alta Mutual Water Company, Pleasant Valley County Water District (PVCWD), Berylwood Mutual Water Company, Calleguas Municipal Water District (CMWD), CWD, Zone Mutual Water Company, and Del Norte Mutual Water Company), (4) the five incorporated cities within the Agency (Ventura, Oxnard, Camarillo, Port Hueneme, and Moorpark), and (5) the farmers (FCGMA 2019a). Four of these Board members, representing the County, UWCD, the mutual water companies and water districts, and the incorporated cities, are appointed by their respective organizations or groups. The representative for the farmers is appointed by the other four seated Board members from a list of candidates jointly supplied by the Ventura County Farm Bureau and the Ventura County Agricultural Association. An alternate Board member is selected by each appointing agency or group in the same manner as the regular member and acts in place of the regular member in case of absence or inability to act.

All members and alternates serve for a 2-year term of office, or until the member or alternate is no longer an eligible official of the member agency. All Board members and alternates serve on a volunteer basis and no compensation is provided for attendance at FCGMA meetings or events. Information regarding current FCGMA Board representatives can be found on the Agency's website (FCGMA 2019b).

Extractors in portions of the PVB within FCGMA jurisdictional boundaries will be subject to FCGMA's groundwater management actions under this GSP. These actions are administered by the Agency Executive Officer, who is appointed by the FCGMA Board. The Agency Executive Officer and other FCGMA staff are provided by the County of Ventura Public Works Agency pursuant to a contract with the County of Ventura (FCGMA 2019a).

1.2.4 Plan Manager

Executive Officer of FCGMA, Jeff Pratt, PE

Mailing Address:

Fox Canyon Groundwater Management Agency
800 South Victoria Avenue
Ventura, California 93009-1610

Phone: 805.654.2073

Email: Jeff.Pratt@ventura.org

1.2.5 Legal Authority

FCGMA is an independent special district formed by the California Legislature in 1982 to manage and protect the aquifers within its jurisdiction for the common benefit of the public and all agricultural, domestic, and M&I users (FCGMA et al. 2007). FCGMA's jurisdiction was established as the area overlying the Fox Canyon Aquifer (FCA) and includes portions of the Oxnard Subbasin and the Las Posas Valley Basin (LPVB), the PVB, and the Arroyo Santa Rosa Valley Basin (ASRVB). FCGMA may adopt ordinances for the purpose of regulating, conserving, managing, and controlling the use and extraction of groundwater within its territory (FCGMA Act, Section 403).

The FCGMA Act prohibits the Agency from engaging in water supply activities normally and historically undertaken by its member agencies. Nonetheless, FCGMA may exercise the water supply powers and authorities authorized under SGMA provided the Board makes a finding that FCGMA is otherwise unable to sustainably manage the basin. The full text of the FCGMA Act, Assembly Bill 2995, as well as amendments and additional legislation, can be accessed on the Agency's website (FCGMA 2019c). FCGMA is identified in SGMA as an agency created by statute to manage groundwater that is the exclusive groundwater sustainability agency within its territory with powers to comply with SGMA (SGMA, Section 10723[c][1][D]). FCGMA notified the California Department of Water Resources (DWR) of its intent to undertake sustainable groundwater management under SGMA on January 26, 2015 (Appendix A).

1.2.6 Groundwater Sustainability Plan Implementation and Cost Estimate

This GSP will be implemented by FCGMA in coordination with the other GSAs in the PVB. The following sections provide a discussion of the standards for and costs associated with GSP implementation including annual reporting, periodic updates, monitoring protocols, and projects and management actions. Potential funding sources and mechanisms are presented along with a tentative schedule for implementing the GSP's primary components. In addition, annual reporting and 5-year evaluation procedures for the PVB are described.

1.2.6.1 Standards for Plan Implementation

Annual Reporting

The GSA shall submit an annual report to DWR by April 1 of each year following the adoption of the GSP. The annual report shall include the following components for the preceding water year (23 CCR, Section 356.2):

- General information, including an executive summary and a location map depicting the basin covered by the report
- A detailed description and graphical representation of
    - Groundwater elevation data from wells identified in the monitoring network
    - Groundwater extraction for the preceding water year
    - Change in groundwater in storage
    - Surface water supply used or available for use
    - Total water use
- A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report

The description and graphical representation of groundwater elevations will include groundwater elevation contour maps for each principal aquifer in the PVB illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions. Additionally, hydrographs of groundwater elevations and water year type, using historical data to the greatest extent available, including from January 1, 2015, to the current reporting year, will be included in the annual report. As described in Section 1.2.6.2, GSP Implementation Budget, under "Data Collection, Validation, and Analysis," relevant data collected by entities within the PVB are regularly provided to FCGMA and will be used to prepare the annual reports submitted to DWR.

The description and graphical representation of change in groundwater storage will include a graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the Basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.

Five-Year Evaluation

FCGMA will evaluate the GSP at least every 5 years. This 5-year evaluation will be provided as a written assessment to DWR. The assessment shall describe whether the Plan implementation, including implementation of projects and management actions, are meeting the sustainability goal in the Basin. The evaluation will include the following:

- A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones, and minimum thresholds
- A description of the implementation of any projects or management actions, and the effect on groundwater conditions resulting from those projects or management actions
- Revisions, if any, to the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives
- An evaluation of the basin setting in light of significant new information or changes in water use, and an explanation of any significant changes
- A description of the monitoring network within the basin, including whether data gaps exist, or any areas within the basin are represented by data that does not satisfy the requirements of the GSP Regulations (23 CCR, Sections 352.4 and 354.34[c])
- A description of significant new information that has been made available since GSP adoption, amendment, or the last 5-year assessment
- A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the GSP
- Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the basin
- A description of completed or proposed GSP amendments
- A summary of coordination that occurred between FCGMA and other agencies, if appropriate, in the Basin, as well as between FCGMA and other agencies in hydrologically connected basins

1.2.6.2 GSP Implementation Budget

The primary costs associated with implementing the GSP are anticipated to be connected with:

- Data collection, validation, and analysis
- Ongoing data gap analysis and assessments of priorities for filling data gaps
  - Filling of data gaps
  - Operations and maintenance

- Annual report preparation and preparation of the 5-year GSP evaluation
- Regional studies for basin optimization, groundwater modeling
- Management, administration, and other costs

Data Collection, Validation, and Analysis

FCGMA has historically obtained data from the Ventura County Watershed Protection District (VCWPD) to monitor streamflow, precipitation, groundwater elevation, and groundwater quality throughout the PVB. Besides VCWPD, entities that monitor groundwater level and groundwater quality in the PVB include UWCD, the City of Camarillo, PVCWD, and small mutual water companies. Relevant data collected by these entities are regularly provided to VCWPD, and the data are shared with FCGMA for use in the FCGMA annual groundwater reports. This process will continue, but analysis will now include comparison of collected data against sustainable management criteria established by this GSP.

The majority of water level and water quality data in the PVB are generated by VCWPD and UWCD. To date, this data sharing has not required expenditures from FCGMA because FCGMA did not control the location or timing of data and sample collection. The existing monitoring schedules and locations are discussed in Chapter 4, Monitoring Networks. It is anticipated that as long as the existing schedules are maintained, the VCWPD will continue to host the data for the PVB and FCGMA will be able to use the data for annual monitoring reports and the 5-year GSP evaluations. However, to the degree that monitoring schedules and locations will change, a cost-sharing agreement will be developed between VCWPD and FCGMA.

Data Gap Analysis and Priorities

During the initial 5-year period after the GSP is adopted, FCGMA will explore options for filling data gaps identified in this GSP. The primary data gaps identified in the historical data are spatial and temporal gaps in groundwater elevation and groundwater quality measurements. In order to assess the priorities for filling these gaps, FCGMA plans to review options and potential costs associated with those options to direct funding toward the solutions that are needed most. One option that will be investigated would include adding pressure-transducers to existing agricultural wells in the monitoring network. These transducers would record water levels at regular intervals (e.g., hourly) to determine static, or recovered, water levels. The cost for purchasing and installing transducers in agricultural wells must be assessed and incorporated into the cost of GSP implementation. As instrumentation is added to the monitoring network, the annual cost of operations and maintenance will also be factored in to the budget for GSP implementation.

In addition to assessing the need for new instrumentation, the analysis of data gaps and priorities will review the potential cost and need to substitute existing agricultural wells in the monitoring network with dedicated monitoring wells, or install monitoring wells in key areas where there are no appropriate wells to monitor. While monitoring wells are often preferred to agricultural wells, for the time being, the agricultural well data provide a link to historical data. This link is critical in assessing progress toward sustainability. Therefore, the data gap analysis and priorities assessment will review which agricultural wells may need to be substituted and which wells should be retained for ongoing historical comparison.

Annual Report Preparation and Preparation of the 5-Year Evaluation

Details of the information that will be included in the annual reports are presented in Section 1.2.6.1, Standards for Plan Implementation. It is currently anticipated that the annual reports will be produced by FCGMA staff and the costs associated with these reports will be incorporated in the annual operating budget of FCGMA.

Every fifth year of GSP implementation and whenever the GSP is amended, the GSA is required to prepare and submit an Agency Evaluation and Assessment Report to DWR together with the annual report for that year. The tasks associated with preparing this report include updating the water budget, updating the groundwater model, and reassessing the sustainable yield, minimum thresholds, and measurable objectives (see Section 1.2.6.1). Additionally, the evaluation will provide an assessment of the pumping allocations. It is currently anticipated that the 5-year evaluation reports will be produced by FCGMA staff with the assistance of consultants and that the costs associated with these reports will be incorporated in the annual operating budget of FCGMA.

Basin Optimization Studies, Groundwater Modeling, and Project Feasibility

During the initial 5-year period after the GSP is adopted, FCGMA will explore opportunities to optimize basin management. The work required to assess these opportunities includes implementing and supporting regional studies and groundwater modeling efforts that assess how to maximize the sustainable yield of the PVB and the adjoining Oxnard Subbasin. These studies are anticipated to include more detailed feasibility studies of projects that were proposed and modeled for this GSP, as well as an investigation of how the projects will be implemented, the costs associated with project implementation, and potential cost-sharing agreements for these projects. Current anticipated costs for implementing projects in the PVB that were analyzed as part of this GSP are presented in Table 1-1.

In addition, it is anticipated that basin optimization studies will be undertaken in the initial 5-year period after the GSP is adopted to assess projects that were not included in this GSP. This assessment is expected to include an investigation of how adjustments to the location of groundwater production will maximize the sustainable yield of the combined aquifer systems of the PVB, the Oxnard Subbasin, and the West Las Posas Management Area. Basin optimization investigations are inherently tied to groundwater modeling, which would be conducted to provide the estimated sustainable yield for all scenarios analyzed. It should be noted that Chapter 5 of this GSP includes projects that were far enough along in development and/or implementation that meaningful information could be included about their potential to improve sustainable management of the Subbasin. Additional projects may be implemented within the next 20 years to, for example, minimize the need for pumping reductions. This GSP does not preclude future projects and/or existing projects that are too early in the stage of development to be included in Chapter 5 from being investigated or undergoing feasibility analysis in the coming years. Relevant information about new projects and/or updates to existing projects described in Chapter 5 will be provided in annual reports and 5-year evaluations.

Lastly, as part of the project feasibility analyses, FCGMA anticipates evaluating potential revenue streams for implementing the projects required to optimize basin management. This analysis will include a review of the potential for implementing basin replenishment fees and the costs associated with proposing and passing such fees.

Cost Estimate

The estimated total GSP implementation costs are presented in Table 1-2. The starting cost for operations and monitoring is estimated to be $1 million for 2020. Costs were increased annually, using a 2.8% inflation rate, from 2020 to 2040 (see Table 1-2). The annual reviews to DWR are anticipated to be included as part of the operations and monitoring costs for FCGMA. The management, administration, and other costs for 2020 are based on the 2019–2020 fiscal year budget, in which these costs are estimated to be $1,455,000.

The 5-year evaluation costs, are anticipated to cover the professional specialty services to evaluate and assess the GSP, and perform the additional work necessary to fill data gaps and analyze projects and management actions for the PVB, as well as for the Oxnard Subbasin and the LPVB. FCGMA is the GSA for these three basins along with the coordinating GSAs and will be responsible for evaluating the GSP for each basin every 5 years. Initial costs for the 5-year evaluation were estimated to be $100,000 per basin, with 2.8% inflation between 2020 and 2024. Costs for 2025 through 2029 were estimated to be $100,000 if the work were performed in 2020, but include 2.8% annual inflation between 2020 and 2025. Costs between 2030 and 2033 were calculated from the 2.8% annual inflation on $50,000. Subsequent years were calculated either based on 2.8% inflation on $100,000, or 2.8% inflation on $50,000, depending on whether the year included preparation of a physical report for DWR.

Finally, the estimated implementation costs include a 10% contingency on the total operating and monitoring costs, management administration and other costs, and the 5-year evaluation.

1.2.6.3 Funding Sources

FCGMA funds its basic operations using groundwater extraction charges. Surcharges for extractions in excess of an allocation may also be used in carrying out FCGMA's groundwater management functions. FCGMA collects a groundwater extraction fee of $6 per acre-foot and imposes a surcharge of up to $1,961 for excess extractions. Together, these pump fees have generated more than $1 million in operating revenues each fiscal year (ending in June) between 2013 and 2016.

Under SGMA, FCGMA gained additional authority to impose regulatory fees and currently collects a sustainability of fee of $11 per acre-foot in addition to its groundwater extraction fee. The sustainability fee is projected to generate additional annual revenue of $1,375,000. The sustainability fee will increase to $14 per acre-foot in 2020 and generate an additional $375,000 in annual revenue. Upon adoption of this GSP, FCGMA will have authority to impose replenishment fees and to also fund projects and management actions that can influence groundwater supply. Projects to achieve sustainability are anticipated to require funding beyond that generated by the existing extraction and sustainability fees. FCGMA anticipates working with other agencies and stakeholders to understand how individual projects will impact stakeholders and identify the most appropriate funding sources for these projects.

1.3 DESCRIPTION OF PLAN AREA

1.3.1 Description

The PVB (DWR Groundwater Basin 4-006) is bounded to the north by the Camarillo Hills and the Somis Gap, to the east by the ASRVB (DWR Groundwater Basin 4-007) and Conejo Mountain, to the southeast by the Santa Monica Mountains, and to the west and southwest by the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin (DWR Groundwater Basin 4-04.02; Figure 1-1, Vicinity Map for the Pleasant Valley Basin). The PVB ranges in elevation from approximately 30 to 680 feet above mean sea level.

On the west and southwest, the PVB is in hydrogeologic communication with the Oxnard Subbasin. The boundary between the PVB and Oxnard Subbasin is defined by a facies change between the predominantly coarser-grained sand and gravel deposits that compose the Upper Aquifer System in the Oxnard Subbasin and the finer-grained clay and silt-rich deposits of the Upper Aquifer System in the PVB. To the north, in the Camarillo Hills area, the Springville Fault Zone is believed to form a groundwater flow barrier at depth between the aquifers in the LPVB and the PVB, based on historical hydraulic head differences of up to 60 feet across the fault zone (DWR 1975). However, shallow alluvial deposits in the vicinity of Arroyo Las Posas and the Somis Gap are in hydraulic communication with the LPVB (CMWD 2017).

The eastern boundary of the PVB is formed by a constriction in Arroyo Santa Rosa (SWRCB 1956; DWR 2003).

The southern boundary of the PVB is delineated by the contact between the alluvial deposits and surface exposures of bedrock in the Santa Monica Mountains (DWR 2003).

In this report, to distinguish between features on the land surface and in the subsurface, the term “Pleasant Valley” will be used to refer to the geographic area overlying the PVB.

Administrative Boundaries

Multiple boundaries have been used to define or manage the PVB (Figure 1-2, Administrative Boundaries for the Pleasant Valley Basin), including the following:

1. The boundary of the PVB currently used by DWR (as amended in the 2016 Basin Boundary Modification)
2. The jurisdictional boundary of FCGMA
3. The boundary of the PVB historically used by FCGMA
4. The boundary of the PVB historically used by VCWPD

In 2019, DWR finalized its latest Basin Boundary Modification process, in which the boundaries of the PVB remained the same as those defined in the 2016 Basin Boundary Modification (DWR 2019).

The boundary of the PVB currently used by DWR extends beyond FCGMA jurisdiction to the southeast (Figure 1-2). The jurisdictional boundary of FCGMA was established based on a vertical projection of the FCA, as provided by the FCGMA Act in 1982 (Figure 1-1). As a result, the FCGMA jurisdictional boundary in the PVB follows the northeast–southwest trace of the Bailey Fault through Pleasant Valley. The FCA is absent in the subsurface to the south and east of this fault. Conversely, DWR’s PVB boundary is based on the surface extent of alluvium in Pleasant Valley, and the location of geologic structures and facies changes that impede flow between the PVB and neighboring groundwater basins (DWR 2003). Consequently, the DWR PVB boundary extends beyond FCGMA jurisdiction to the southeast, and approximately 8.5 square miles, or roughly 25%, of the DWR PVB area lies outside FCGMA jurisdiction (Figures 1-1 and 1-2).

The majority of the area southeast of the Bailey Fault in the PVB lies within the jurisdiction of CWD. CWD is the GSA for the Camrosa Water District–Pleasant Valley, which covers the portion of CWD’s service area that lies within the PVB and outside of FCGMA jurisdiction (CWD 2017; Figure 1-2). The remaining area southeast of the Bailey Fault lies within the jurisdiction of the County of Ventura (County). The County is the GSA for the Pleasant Valley Basin Outlying Areas (County of Ventura 2017; Figure 1-2). The PVB boundary historically used by FCGMA is similar to the PVB boundary defined by DWR, though the two extents are not identical (Figure 1-2). The main discrepancy between these two extents is in the southwestern corner, along the boundary between the PVB and the Oxnard Subbasin. In this area, the DWR PVB boundary is farther east than the FCGMA PVB boundary. Therefore, the eastern area of the DWR Oxnard Subbasin adjacent to the PVB was historically considered by FCGMA to be part of the PVB (Figure 1-2).

Table 1-3 provides a summary of the areal extent of GSAs within the PVB and the percentage of each GSA that is overlapped by the PVB. The Pleasant Valley Basin Outlying Areas GSA represents the portion of the PVB within the boundaries of the PVB historically used by VCWPD, and the Camrosa Water District–Pleasant Valley GSA represents the portion of the PVB within the jurisdiction of CWD. Although both CWD and VCWPD manage larger areas, they have delineated their GSAs according to DWR basin boundaries, and thus are contained by the PVB.

Land Ownership and Jurisdiction

Land within the PVB is under a variety of municipal, state, and County jurisdictions. The City of Camarillo is nearly entirely encompassed by the northern part of the PVB and makes up 52.5% of the land area. Land under County jurisdiction outside the incorporated city composes 44.7% of the PVB’s land area. There is no federal land ownership within the PVB. Land owned by the Pleasant Valley Recreation and Park District and the County of Ventura is used for open space or parks. The majority of land owned by California State University, Channel Islands, occurs within the PVB, and occupies 1.7% of the land area. A summary of land ownership and jurisdiction is provided in Table 1-4.

1.3.2 Geography

1.3.2.1 Surface Water and Drainage Features

The dominant surface water bodies in Pleasant Valley are the Arroyo Las Posas, Calleguas Creek, and Conejo Creek, which drain watersheds that extend beyond the boundaries of the PVB. The western portion of the City of Camarillo contains lined drains that flow to the west and discharge to Revolon Slough in the Oxnard Plain (Figure 1-3, Pleasant Valley Basin Weather Station and Stream Gauge Locations).

Arroyo Las Posas enters Pleasant Valley through the Somis Gap, between the Camarillo Hills and the Las Posas Hills, and flows to the south and the southwest. At the confluence of the Arroyo Las Posas and an unnamed stream southwest of Saint John’s Seminary, Arroyo Las Posas becomes Calleguas Creek (Figure 1-1). Calleguas Creek exits Pleasant Valley to the west of California State University Channel Islands and crosses the southern portion of the Oxnard Plain before flowing into the Pacific Ocean near Point Mugu (Figure 1-1).

Conejo Creek enters Pleasant Valley from the ASRVB to the east and flows generally to the southwest along the southeastern border of the PVB, passing the base of Conejo Mountain and the foothills of the Santa Monica Mountains, until it joins Calleguas Creek.

Characterization of Flow

Streamflow records for one inactive and four active streamflow gauging stations (Figure 1-3; Table 1-5) were used to characterize flow in upstream Calleguas Creek (Stations 806 and 806A), in Conejo Creek (800 and 800A), and in downstream Calleguas Creek (Station 805).

Within Pleasant Valley, Calleguas Creek upstream of Conejo Creek (i.e., at Station 806) is dry in dry weather (VCWPD 2009). Dry-weather flow is observed in Conejo Creek and in Calleguas Creek downstream of the confluence with Conejo Creek. The primary sources of dry-weather flow to Conejo Creek are two wastewater treatment plants (WWTPs): the Hill Canyon WWTP, operated by the City of Thousand Oaks, which discharges to Arroyo Conejo, a tributary of Conejo Creek; and the Camarillo Sanitary District WWTP, operated by the City of Camarillo, which discharges directly to Conejo Creek. Irrigation water from agriculture and/or landscaping may also serve as a source of flow in both channels during some parts of the year. The complete record and the monthly minimum of average daily flows at these three stations are presented on Figure 1-4, Average Daily Flows (ADF) and Monthly Minimum ADF in Pleasant Valley Surface Waters.

In Calleguas Creek upstream of the Conejo Creek confluence, the available stream flow record within the PVB extends from 1968 to 2014, at Stations 806 and 806A. Station 806A is now operated as a Peak Only (Event) Site, but previously was operated as a Recording Stream Gauge. Peak flow typically occurs between November and April of any given water year and baseflow generally falls to 0 cubic feet per second (cfs) between May and September.[2] The highest gauged flow was 7,080 cfs in January 2005 (Figure 1-4[A]).

In Conejo Creek, the available streamflow record within Pleasant Valley extends from 1971 to 2013 at Stations 800 and 800A. Peak flow typically occurs between December and March of any given water year, and flow has consistently been present in the channel flows during dry weather since the record began. The highest gauged flow was 3,980 cfs in March 1983 (Figure 1-4[B]).

In Calleguas Creek downstream of the Conejo Creek confluence, the available streamflow record within Pleasant Valley extends from 1968 to 2014 at Station 805. Peak flow typically occurs between December and March of any given water year. Between July and September, baseflow tends to be between 5 and 13 cfs. The highest gauged flow was 9,686 cfs in March 1983 (Figure 1-4[C]).

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[2] The water year runs from October 1 through September 30 of the following calendar year. For example, the 2015 water year began October 1, 2014, and ended September 30, 2015.

To qualitatively assess changes in baseflow, all streamflow gauges were assigned a minimum average daily flow for each month of the record (Figures 1-4[D] through 1-4[F]). In Conejo Creek and in Calleguas Creek downstream of the confluence with Conejo Creek, the minimum monthly flow recorded at the stream gauge is lower in the past 5–10 years than it was from 1980 to 2005, corresponding in some years with low rainfall associated with the recent drought. Other factors contributing to the decline in base flow include the relocation of Station 800A to downstream of the Conejo Creek Diversion structure and CWD began diverting from Conejo Creek beginning in 2002.

1.3.2.2 Current, Historical, and Projected Climate

Current Climate

The climate of Pleasant Valley is typical of coastal Southern California, with average daily temperatures ranging generally from 43°F to 80°F in summer and from 41°F to 74°F in winter, as measured at the weather station in Camarillo operated by the California Irrigation Management Information System (CIMIS; CIMIS 2016; NOAA 2010). Typically, approximately 85% of precipitation in the Ventura County region falls between November and April (Hanson et al. 2003).

Records of rainfall were collected from VCWPD weather stations located within the boundary of Pleasant Valley (seven active and five inactive; Figure 1-3, Figure 1-5 [Pleasant Valley Annual Precipitation], and Table 1-6). Annual precipitation varies from gauge to gauge (Figure 1-5 and Table 1-6).

Evapotranspiration (ET) is measured at CIMIS Station 152, located on the Leisure Village Golf Course. The monthly average ET calculated using the Penman–Monteith equation at Station 152 ranges from 2.07 inches in December to 5.70 inches in July. This monthly average was calculated for data collected between 2001 and 2015. The average total annual ET is 46.86 inches.

Historical Climate Trends

In order to characterize rainfall variability in Pleasant Valley over the past century, two stations whose combined records cover the entire period were selected: Stations 003 and 219A (Note: only preliminary data was available for water years 2014–2016 for Station 219A). Station 219A (Camarillo–Hauser) is located approximately 3.8 miles northeast of Station 003 (Camarillo–Springville Ranch; Figure 1-3). Precipitation records can vary based on several factors, including geographic location, the type of gauge used to measure precipitation, and the physical characteristics of the area surrounding a measurement site. Therefore, in order to examine how rainfall recorded at these two stations compared to the other stations, correlation coefficients (R) were calculated for the period of time in which the station records overlap. Using the entire record (including preliminary data for 2014–2016 in the record of Station 219A), correlation coefficients calculated for all pairwise combinations of stations that include Stations 003 and 219A exceed 0.97.

The variability in the records of precipitation measured at Stations 003 and 219A is similar to that measured at the other precipitation stations, indicating that records from these two stations can be used to characterize the precipitation trends in Pleasant Valley over the 113-year period from 1903–2016 (Figure 1-5).

The long-term trend record was based on the record from Station 003 for the period from 1903–1992. After 1992, no data are available for Station 003. Therefore, from 1992–2016, the annual precipitation value recorded at Station 219A was used to predict precipitation at Station 003, based on a linear regression of the annual precipitation values in the 20 years of overlap (1973–1992) of the records for Stations 003 and 219A (see formula below).

$$\textit{Station 003 (inches)} = 0.9709 * \textit{Station 219A (inches)} - 0.5973 \qquad (R^2 = 0.9798)$$

The root-mean-squared error (RMSE) between the observed annual precipitation at Station 003 and the predicted precipitation using Station 219A was 1.1 inches per year. The bias was −0.00032 inches.

Based on the long-term (1902 to 2013) record of measured and calculated precipitation at Station 003, the mean annual precipitation in western Pleasant Valley is 12.9 inches (Figure 1-6, Long-Term Precipitation Trends in Pleasant Valley). For each water year in the record, the total annual precipitation was compared to the long-term mean annual precipitation in order to calculate the cumulative departure from mean precipitation (Figure 1-6). Historical drought periods were defined as a falling limb on the cumulative departure from the mean curve (Figure 1-6). Based on the historical record, a drought in Pleasant Valley can be defined as a period of years in which the area experiences no more than one consecutive year of above-average precipitation and at least 18 inches of cumulative precipitation deficit (see Table 1-7 and Figure 1-6).

The century-long precipitation record demonstrates that drought cycles have frequently impacted Pleasant Valley. The average drought duration in the past century was 7.6 years, and the average cumulative rainfall deficit during the droughts was −27.3 inches. The duration of periods of average or above-average rainfall was rarely more than 10 years. Consequently, planning for drought cycles in the coming decades will be an integral component of water resources management.

Projected Climate

The literature review conducted in support of the U.S. Bureau of Reclamation's Los Angeles Basin Stormwater Conservation Study Task 3.1 Report found that the following changes are anticipated in Southern California due to global climate change (Bureau of Reclamation 2013):

- Increased temperature (1°C to 3°C)
- Increased evaporation rate

- Decrease in annual precipitation (2% to 5%)
- Increase in extreme precipitation events

Future climate conditions were modeled in the PVB using climate change factors provided by DWR. The impacts to the future water budget are discussed in more detail in Chapter 2, Basin Setting.

1.3.2.3 Historical, Current, and Projected Land Use

Historical land uses within Pleasant Valley were determined based on review of data from the Southern California Association of Governments (SCAG), which has mapped over 105 land use categories to a minimum 2-acre resolution for the years 1990, 1993, 2001, and 2005 (SCAG 2005). Current land uses within Pleasant Valley were determined based on review of the General Plan land use map for Ventura County, shown on Figure 1-7, Land and Water Use (VCPD 2015). Existing land use patterns and trends are expected to continue, and are described based on information and maps contained in General Plan documents.

Pleasant Valley consists of unincorporated areas of Ventura County and the City of Camarillo, in approximately equal parts. Approximately 14% of the area of the City of Camarillo extends into Las Posas Valley (the Sterling Hills and Spanish Hills golf clubs and estates), and about 1% of the City of Camarillo is in the Oxnard Plain (the western portion of the Camarillo Airport; Figure 1-1). Agricultural land use covers approximately 40% of the land area within Pleasant Valley and is dominated by row crops, with a small portion dedicated to nurseries and orchards (DBS&A 2017). Urban and residential land uses in the basin are concentrated in the City of Camarillo. The only concentration of residences outside incorporated boundaries consists of student housing at California State University, Channel Islands, as well as a portion of Camarillo Heights. Open space (i.e., *not* consisting of agricultural or urban uses) is limited to the Calleguas Creek and Conejo Creek corridors, as well as undeveloped land around California State University, Channel Islands and the steeper terrain on the valley edges. Table 1-8 shows the County General Plan land uses within Pleasant Valley, tabulated by area and percentage.

The land use pattern within the City of Camarillo is a concentration of industrial and commercial land uses along the Highway 101 corridor, around the Camarillo Airport, and southeast of Lewis Canyon Road/CA Highway 34. Commercial areas also consist of the business district along Ventura Boulevard; and community shopping centers along Carmen Drive, Las Posas Road, Mission Oaks Boulevard, and Arneill Road. In all other locations within the City, land use consists of residential and municipal uses (e.g., schools, parks, and public services). Residential uses are for the most part low-density single family homes, but increase in density near the commercial and industrial areas and major thoroughfares. Building heights generally do not exceed 3–4 stories. The land area within the City of Camarillo is occupied by residential (54%), commercial (5%), industrial (9%), conservation (15%) and public (16%) uses (City of Camarillo 2016a). According to the City's 2015 annual report, there were

349 residential units completed (there is an annual limit of 400 units), five new commercial projects totaling nearly 20,000 square feet completed, nine previously approved but not completed commercial projects totaling of 85,159 square feet, and 13 industrial projects approved for a total floor area of 745,182 square feet (City of Camarillo 2016a).

In the future, agricultural preservation and open space land use policies are expected to limit the rate and reach of "greenfield" development and direct growth through infill development and zoning policies that allow higher-density and mixed-use development (VCPD 2015). Furthermore, the Urban Restriction Boundary around the City promotes the formation and continuation of a cohesive community by defining boundaries and helping to prevent urban sprawl. The purpose of this Urban Restriction Boundary is to ensure that the purposes and principles set forth in the Camarillo General Plan relating to Land Use (Chapter IV) and Open Space and Conservation (Chapter IX) are inviolable against transitory short-term political decisions and that agricultural, watershed and open space lands are not prematurely or unnecessarily converted to other non-agricultural or non-open space uses without public debate and a vote of the people (City of Camarillo 2004).

For unincorporated areas within Pleasant Valley, the Ventura County General Plan Environmental Impact Report (EIR) identifies the widening of roads as potential growth-inducing effect of the General Plan land uses and policies, as well as policies that allow for the creation of substandard-sized parcels for farmworker housing complexes and an increase in allowable building coverage for farmworker housing complexes in Agricultural and Open Space designations (VCPD 2005). However, given that unincorporated areas are nearly entirely used for agricultural purposes, little change is expected to occur in the future, except perhaps in the type of crops grown. Demographics and population growth within the Pleasant Valley Basin are addressed in Section 1.3.2.4, Historical, Current, and Projected Demographics.

1.3.2.4 Historical, Current, and Projected Demographics

There are several sources of population data for Pleasant Valley, most of which are derived from decennial census counts, the last of which occurred in 2010. Sources of population information are as follows:

- **U.S. Census Bureau.** The U.S. Census Bureau conducts a census count every 10 years. Census data is gathered by tracts, blocks, and census-designated places. Census tracts were intersected with the PVB boundary to determine the population within the Basin for 2010. Census tracts that intersected the boundaries of the PVB were area-weighted to determine the population that falls within the Basin.
- **City and County General Plans.** The City of Camarillo and the County of Ventura gather data on development, growth, and land use patterns and make population estimates in

conjunction with census data. The cities' general plans and websites were reviewed for historical and current population data.

- **Southern California Association of Governments.** SCAG is the nation's largest metropolitan planning organization, representing 6 counties, 191 cities, and more than 18 million residents. SCAG produces demographics data and growth forecasts for the entire Southern California region.

At a County-wide level, population growth is skewed toward incorporated cities (such as Camarillo). The population distribution within Ventura County is the result of a 1969 County–City agreement, called the Guidelines for Orderly Development, which directs urban-level development to incorporated cities in Ventura County (VCPD 2015). That agreement limits urban-level development and services in unincorporated areas. The total increase in population in unincorporated areas in Ventura County was only 1.9% from 2000 to 2010, whereas population in the cities increased at a much higher rate, closer to 10.4%, over the same period.

Table 1-9 shows the past, current, and projected population for Ventura County, the City of Camarillo, and Pleasant Valley. The population of Pleasant Valley is estimated to have been 58,899 in 2010, based on census data. It should be noted that the methodology for calculating the population in Pleasant Valley is likely to have resulted in an underestimate. This is because a significant number of census tracts crossed the boundary of the Basin, and these were area-weighted to determine a population. Review of aerial photographs indicates that for most of the area-weighted census tracts, the population appears to reside within the Basin. The current population of the City of Camarillo is estimated to be 66,300 residents, with an average household size of 2.67 (SCAG 2016). The population of unincorporated areas in Pleasant Valley is therefore a small/negligible portion of the total population of the Basin.

1.4 EXISTING MONITORING AND MANAGEMENT PLANS

Over the past few decades, multiple agencies have implemented programs to monitor and manage water within the PVB. Local and state agencies have worked together and with basin stakeholders to develop management strategies and monitoring programs. Table 1-10, Pleasant Valley Basin Existing Water Resources Monitoring Programs, and Table 1-11, Pleasant Valley Basin Existing Water Resources Management Projects, Programs, and Strategies, summarize the monitoring and management programs, projects, and strategies that are currently in effect.

1.4.1 Monitoring and Management Programs

Table 1-10 provides a summary of existing monitoring programs. It is subdivided into monitoring programs that are primarily for surface water and those primarily for groundwater.

Table 1-11 provides a summary of existing management programs, projects, and strategies. It is similarly subdivided into projects that address primarily surface and those that address primarily groundwater. It also contains a third category, "other," for projects that address both surface and groundwater or an additional parameter.

For information regarding coordination between the GSP implementation activities and existing monitoring and management programs and projects, see Chapter 4 and Chapter 5. For more information on the water budget and how surface water and groundwater have historically been used in the PVB, see Chapter 2.

Table 1-11 indicates whether each project and program is associated with conjunctive use. As used herein, "conjunctive use" applies to programs, projects, and strategies that meet the 2003 Bulletin 118 definition of the term: "Conjunctive management in its broadest definition is the coordinated and combined use of surface water and groundwater to increase the overall water supply of a region and improve the reliability of that supply" (DWR 2003). For example, PVCWD uses surface water diverted from the Santa Clara River and Conejo Creek to supplement agricultural irrigation from groundwater wells. Use of surface water for agricultural purposes reduces the volume of groundwater pumped from the PVB (UWCD 2014). For a description of some of the most important projects and programs, see Section 1.5, Existing Conjunctive Use Programs.

Due to the overlapping jurisdictions of the agencies that manage groundwater resources, there are many programs that occur within the basin or benefit multiple basins. Therefore, Tables 1-10 and 1-11 include a column ("Multi-Basin Program") that lists the basins in which the programs are conducted or those that benefit from each program.

1.4.2 Operational Flexibility Limitations

Existing water monitoring and management activities are described in Tables 1-10 and 1-11. Some of these have been developed, in part, to increase the operational flexibility within the PVB and within FCGMA's jurisdiction as a whole. As the agency responsible for groundwater management in most or part of the four groundwater basins within its jurisdiction, FCGMA fosters operational flexibility through groundwater monitoring requirements, project oversight, and the collection of fees. Because the basins are all interconnected to some extent, either physically or through water sources, the opportunity for operational flexibility exists and has been used by the FCGMA and local water agencies. Examples of projects that have increased operational flexibility within the PVB include the Pleasant Valley Pipeline and the Conejo Creek Diversion, which allow for agricultural use of surface water during wetter than average periods, when flow is available for diversion (Table 1-11). Consequently, groundwater elevations recover and there is additional groundwater in storage available for use during periods of drought.

Despite the coordination of projects and programs within the PVB, limits to operational flexibility remain. These limits include constraints imposed by interaction with other regulatory programs, including the Recycled Water Policy (2009, amended 2013) that was adopted by the State Water Resources Control Board, Section 303(d) of the federal Clean Water Act, and the federal Endangered Species Act. The Recycled Water Policy intends to encourage the safe use of recycled water by recognizing its benefits, establishing statewide recycled water goals and targets, clarifying regulatory agency roles and permitting approaches for various types of recycled water projects, and establishing an approach to avoid or minimize potential adverse consequences (e.g., excessive salts, nutrients, and/or constituents of emerging concern). For example, the policy requires that local water and wastewater entities prepare Salt and Nutrient Management Plans for the groundwater basin in which they operate. The Salt and Nutrient Management Plan for the Oxnard Plain and Pleasant Valley Basins has been submitted to the Los Angeles Regional Water Quality Control Board, but has not yet been accepted (City of Oxnard 2016b).

Water quality in the Calleguas Creek Watershed, which includes parts of the PVB, is currently listed as impaired by pollutants including nutrients, sulfates, total dissolved solids, and boron (State of California 2006). Six total maximum daily loads (TMDLs) have been implemented in the Calleguas Creek Watershed to restore the impaired watersheds (RWQCB 2016). These TMDLs impact operational flexibility by identifying the maximum amount of pollutant that Calleguas Creek and its tributaries can receive and still meet water quality standards. Reductions in pollutant load are accomplished through both water-quality-based discharge limits for point sources and through local, state, and federal programs for non-point sources.

UWCD has prepared a Draft Multiple Species Habitat Conservation Plan as part of its application for incidental take permits under Section 10(a)(1)(B) of the Endangered Species Act (UWCD 2016). The Draft Multiple Species Habitat Conservation Plan specifies conditions under which flow diversions from the Santa Clara River would be allowed. The diverted flow at the Freeman Diversion is delivered to the PVB via the Pleasant Valley Pipeline and is provided in lieu of groundwater production in PVB. The operational flexibility provided by this project is constrained by habitat requirements for the federally endangered Southern California steelhead trout (*Oncorhynchus mykiss*) in the Santa Clara River. Climate fluctuations and future climate may also impact the quantity of water diverted from the Santa Clara River. Currently, the project permit limits access to flows. Water diversion is primarily during large storm events.

The Pleasant Valley Pipeline is subject to both demand and capacity limitations. Although there are some facilities and projects allowing for the extraction, treatment, and use of brackish groundwater (see “Groundwater Supply Policy” in Table 1-11, under Existing Groundwater Management Programs), areas of shallow and brackish groundwater in the northern PVB will be utilized by Camarillo’s North Pleasant Valley Desalter. Additionally, parts of the PVB depend on imported water from the State Water Project (SWP). Such supplies have been, and may continue to be, limited by climate, infrastructure, and increased commitment for environmental and supply purposes (see Section 1.6.2, Urban Water Management Plans).

1.5 EXISTING CONJUNCTIVE USE PROGRAMS

Due to the history of interagency collaboration on groundwater management within FCGMA jurisdiction and Pleasant Valley, multiple conjunctive-use programs are currently operational. These are identified and described in Table 1-11, as introduced in Section 1.4, Existing Monitoring and Management Plans. Some of the most important of these projects and programs are described in this section.

UWCD Freeman Diversion Project. The predecessor to the UWCD Freeman Diversion Project was constructed in 1927 as a series of earthen levees that diverted water from the Santa Clara River, which were washed out and replaced after large flows. The current project, constructed in 1991, is a significant component of water supply within the PVB and the Oxnard Subbasin, with diversions averaging more than 62,000 acre-feet per year (AFY). Since 1985, deliveries from the project, including direct and groundwater pumped from the Saticoy Wells, have averaged about 9,200 AFY. Water from the project is delivered to the PVB and the Oxnard Subbasin through the Pumping Trough Pipeline and Pleasant Valley Pipeline, which supply water for non-potable applications (see Table 2-8, Other Pleasant Valley Basin Imported Water).

The Freeman Diversion Project is one of the important water supply/management projects for the PVB and FCGMA’s jurisdiction as a whole. It provides a critical source of recharge to the Basin and offsets groundwater pumping by providing an alternative supply. Of consequence to the future of groundwater sustainability within the Basin is the potential for significant limitation of Freeman Diversion Project diversions due to the Multiple Species Habitat Conservation Plan now under development (UWCD 2016).

SWP deliveries are supplied by the CMWD to various retail water agencies within the PVB, including the City of Camarillo. All of these are potable and are used to fill M&I demand (see Table 1-10). In addition, up to 5,000 AFY of the Ventura County SWP allocation may be delivered to Lake Piru and later released for percolation or diversion at the Freeman Diversion Project. Note that CMWD is a member agency of Metropolitan Water District of Southern California (MWD), which supplies water from a number of sources, including the Colorado River.

Conejo Creek Diversion Project. The Conejo Creek Diversion Project was implemented in 2002 by CWD. Recycled water discharged to Conejo Creek from the Thousand Oaks Hill Canyon WWTP, urban runoff, and natural flows are diverted from Conejo Creek near Highway 101 (Figure 2-35, Pleasant Valley Basin Stream Gauges and Water Infrastructure). This non-potable water is used in the PVB, LPVB, and ASRVB for agricultural and municipal irrigation and offsets groundwater pumping in those basins. Diversions from the project are tracked and the volume of water diverted is reported to FCGMA. Water not used by CWD is delivered to PVCWD and water produced from this project is subject to one-to-one credits from FCGMA. Flows from the Hill Canyon WWTP have decreased in response to conservation programs and are expected to decrease further in the future, thus reducing the potential yield of the project. Diversions of surface water on Conejo Creek prior to 2002 were estimated to average 2,450 AFY from 1985 to 2002 (see Chapter 2 of the GSP). Although diversions also occurred prior to 1985, the volume of water diverted before 1985 is not known. By Resolution 2014-01, FCGMA approved the Conejo Creek Water Pumping Program involving CWD and PVCWD using the Conejo Creek Diversion.

Fox Canyon Groundwater Management Agency Programs. FCGMA has been charged with groundwater management for decades and now implements several programs that encourage efficient use of groundwater, new water sources, and brackish groundwater. Most programs apply to the entire FCGMA jurisdiction, but some management programs apply to specific areas. In addition to programs and ordinances that require reporting and fees for groundwater use, FCGMA implements a groundwater storage credit program that provides groundwater credits equal to the amount of water that was used in lieu of pumping groundwater and could have been used for groundwater recharge (spreading or injection).

FCGMA approved an ordinance to establish an allocation system for the Oxnard Subbasin and PVB on October 23, 2019. The purpose of this ordinance is to facilitate adoption and implementation of the GSP and to ensure that the Oxnard Subbasin and PVB are operated within their sustainable yields. It is not the purpose of the ordinance to determine or alter water right entitlements, including those that may be asserted pursuant to California Water Code Sections 1005.1, 1005.2, or 1005.4. A copy of this ordinance is included in Appendix A.

1.6 LAND USE ELEMENTS OR TOPIC CATEGORIES OF APPLICABLE GENERAL PLANS

SGMA requires that the GSP include a description of the consideration given to the applicable county and city general plans and the various adopted water-resources related plans and programs and an assessment of how the GSP may affect those plans (California Water Code, Section 10727.2[g]). In addition to these elements, the GSP may include processes to review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity (California Water Code, Section 10727.2[g]). Land use plans contain provisions that affect water use and sustainability within FCGMA jurisdiction. DWR requires that the GSP include a summary of these plans and a description of: how these plans may change water demands or affect FCGMA's ability to achieve sustainability and how the GSP addresses these potential effects, and how the GSP may affect the water supply assumptions made in these plans (DWR 2016b, Section 354.8[f]).

California state law requires that cities and counties prepare and adopt a "comprehensive long-term general plan for the physical development of the county or city…" and that "elements and parts [of the plan] comprise an integrated, internally consistent and compatible statement of policies for the adopting agency" (California Government Code, Sections 65300 and 65300.5). Among the required elements of the plan is the conservation, development, and utilization of water developed in coordination with groundwater agencies such as FCGMA (California Government Code, Section 65302[d][1]). For more than three decades, FCGMA has participated in the management of groundwater within its jurisdiction. Such management includes oversight of many aspects of groundwater production and use, as well as coordination with other entities responsible for water supply and land use issues. Because of these long-term relationships, many of the plans described in this section are consistent with the goal of sustainable groundwater management over the planning and implementation horizon.

The following sections contain a description of the land use and water management plans that are applicable to the PVB and a discussion of the consideration given to the land use plans and an assessment of how the GSP may affect those plans. The plans included were selected as the plans with the most salient information relating to sustainable management. However, this is not intended to be a comprehensive list. Other plans that include information pertinent to water management in the PVB are the MWD UWMP and the Calleguas Creek Watershed Management Plan (MWD 2016; CMWD 2004).

1.6.1 General Plans

General plans are considered applicable to the GSP if they have the potential to direct urban growth, zoning changes, or redevelopment anywhere within the PVB. General Plans applicable to the PVB are the Ventura County General Plan and the City of Camarillo General Plan.

FCGMA staff has participated on the Ventura County General Plan Update Water Element Focus Group and continues to work with Ventura County planning staff to ensure that the GSP and the General Plan Update are mutually consistent. Furthermore, the FCGMA Board includes a representative for both the County and all the incorporated cities within FCGMA's jurisdiction, ensuring representation and coordination between the GSA, the County, and the incorporated cities.

Based on the timing of the adoption of the General Plan Update and the GSP, the GSA will be subject to the following California Government Code sections pertaining specifically to the coordination of planning and SGMA-related documents:

- California Government Code, Section 65350.5 – requires that the planning agency review and consider GSPs prior to General Plan adoption.

- California Government Code, Section 65352 – requires that prior to adoption of a General Plan Update, the legislative body must refer the plan to the GSA for review.
- California Government Code, Section 65352.5 – requires that the GSA provide the current version of the GSP to planning agencies preparing to update or adopt the General Plan.

All existing general plans and future updates undergo an analysis of environmental impacts under the California Environmental Quality Act (CEQA). In addition, all discretionary projects proposed within the PVB under municipal, County, and/or state jurisdiction are required to comply with CEQA. In 2019, the Governor’s Office of Planning and Research released an update to the CEQA Guidelines that included a new requirement to analyze projects for their compliance with adopted GSPs. Specifically, the applicable significance criteria include the following:

- Would the program or project substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?
- Would the program or project conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

Therefore, to the extent general plans allow growth that could have an impact on groundwater supply, such projects would be evaluated for their consistency with adopted GSPs and for whether they adversely impact the sustainable management of the PVB. Under CEQA, potentially significant impacts identified must be avoided or substantially minimized unless significant impacts are unavoidable, in which case the lead agency must adopt a statement of overriding considerations.

Ventura County General Plan

Plan Description

The Ventura County General Plan (VCPD 2015) applies to the county as a whole and includes area-specific plans for distinct unincorporated areas. The County General Plan was last amended in October 2015. However, the County Planning Department is now undertaking a comprehensive update of the plan, thereby providing an immediate opportunity for coordination between FCGMA (as the GSA) and the County Planning Department, as required by SGMA.

The comprehensive update of the County General Plan is due to be completed by mid-2020 and will have a planning horizon of 20 years.

How the Plan May Affect Sustainable Water Management

Because General Plans and the associated elements define long-term policy related to community growth, development, and land use, General Plans are integral to the implementation of sustainable water management. The County General Plan is in the process of undergoing a comprehensive update, which provides the opportunity for consistency in regard to the relevant areas of the General Plan and GSP. Areas where FCGMA will coordinate with the County include the following:

- The compatibility of County land use with the goals and requirements of SGMA and groundwater sustainability. This includes county programs and policies for the protection or re-designation of urban, agriculture, and open space for the purpose of reducing or adjusting groundwater use, recharge, or groundwater quality.
- The consistency of discretionary development as it pertains to the FCGMA basins' water resources.
- The development of thresholds by the County for development within available water supply limits as determined by the GSPs for the FCGMA basins.
- Coordinated water-related monitoring programs within the FCGMA basins.
- The inclusion of land subsidence, drought, and point-source pollution as "hazards," as identified in the County General Plan.
- The coordination of goals, policies, and programs of the Water Resources section of the General Plan, which pertain to groundwater overdraft, environmental uses of surface water, groundwater and surface water quality, and demand management and reuse. The programs of the Water Resources section specifically address the coordination of water agencies and County support of FCGMA plans.
- The coordination of capital projects or programs proposed as part of the GSP to achieve sustainability within the FCGMA basins.
- The regulatory authority of the GSA as it relates to that of the County.

How the GSP May Impact the Water Supply Assumptions of the General Plan

Sections 1.3.1 through 1.3.3 of the General Plan describe the goals, policies, and programs that apply to water resources. The goals outlined in Section 1.3.1 of the General Plan include monitoring water supply and quality, maintaining or restoring water quality and supply, balancing supply and demand, protecting aquifer recharge areas, and protecting wetlands. The GSP includes specific provisions for each of these: the monitoring of water resources (Chapter 4), the definition and maintenance of groundwater-dependent ecosystems (wetlands), definition of sustainability as it pertains to water resources (Chapter 3), and projects and management actions by which these goals will be attained (Chapter 5). The General Plan also has a resource appendix that describes in general terms the groundwater resources in Ventura County. The next time the general plan is updated, the information in the GSP will be used to provide information relevant to the groundwater resources appendix.

The General Plan policies listed in Section 1.3.2 (VCPD 2015) include provisions and requirements for discretionary development. Some of the projects and management actions of the GSP will likely constitute discretionary development and therefore require consistency with General Plan or demonstration of "overriding considerations." The GSAs within the PVB will encourage municipalities to consider the GSP in the implementation of each of their general plans and to incorporate groundwater management criteria, where applicable and relevant, from the GSP into future general plan updates. General Plan Section 1.3.3 lists specific programs that County divisions will support in the application of the General Plan. Programs (management actions) implemented by FCGMA as part of the GSP may be added to those supported by the General Plan.

The 1998 Save Open Space and Agricultural Resources (SOAR) ordinance generally requires an approval by the electorate for any General Plan Amendment changes in land use designations for agricultural, rural, or open-space-designated lands. This and similar ordinances are in effect for much of the FCGMA area, including the Cities of Camarillo, Oxnard, and Ventura and unincorporated County areas, through at least 2050 (VCPD 2015). Should implementation of the GSP result in the conversion of agricultural, rural, or open space lands to other uses, either to accommodate GSP projects or as a result of management actions that reduce water demand, a vote of the electorate would be required.

City of Camarillo General Plan

Plan Description

The City of Camarillo General Plan (Camarillo General Plan; City of Camarillo 2016a) applies to the area within the City limits, and was last updated in 2003. Development within the City of Camarillo is constrained by the Camarillo Urban Restriction Boundary, which was established by the Camarillo SOAR Ordinance in 1998 to promote urban density and conservation of open space and agricultural lands.

How the Plan May Affect Sustainable Water Management

Land use changes and development within the City of Camarillo may affect sustainable water management within the PVB. However, provisions to consult other agencies on water policy are included in the Camarillo General Plan. Specifically, coordination between the City of Camarillo and all other water agencies on issues regarding water resources and consequent policies is prescribed within the Open Space element of the General Plan. The General Plan further specifies that "City, county and state laws which specifically address watershed, groundwater sources, freshwater treatment, storage and distribution system, and wastewater collection and treatment system, as well as contamination of groundwater and landslides thereof will be strictly enforced and adhered to."

How the GSP May Impact the Water Supply Assumptions of the General Plan

The City amended its General Plan in 1998 by adopting the SOAR Ordinance. The ordinance created the Camarillo Urban Restriction Boundary and requires approval by the electorate for development projects outside of the urban limits and within the Camarillo Sphere of Influence. Similar ordinances are in effect for much of the FCGMA area, including Oxnard and unincorporated County areas, through at least 2050 (VCPD 2015). Should implementation of the GSP result in the conversion of agricultural, rural, or open space lands to other uses, either to accommodate GSP projects or as a result of management actions that reduce water demand, a vote of the electorate would be required.

It is not the role of a general plan to make water supply assumptions, but to take into consideration existing and anticipated water supply conditions in planning for growth; this includes FCGMA's water supply allocations, as incorporated into the 5-year UWMPs. General plan policies for all jurisdictions include provisions to maximize water conservation for both indoor use and outdoor irrigation/landscaping. Furthermore, the areas zoned for development are generally already built out, so growth, where it occurs, is likely to consist of redevelopment projects or small areas of new development. As all new development is subject to supply mitigation, which includes installing dual plumbing and the use of nonpotable water where feasible, any offset of or increase in the volume of water used on the land being developed or redeveloped is mitigated; land conversion and changes in land use planning are not anticipated to adversely affect implementation of the GSP. Furthermore, City and County officials make up part of the FCGMA Board, and like the SGMA process, both UWMPs and general plans are living documents subject to periodic updates and reviews.

1.6.2 Urban Water Management Plans

The Urban Water Management Planning Act of 1983 requires urban water suppliers to report on water sources, deliveries, demand, and efficiency, as well as performing water shortage contingency planning. Such plans are to be updated every 5 years (in years ending in 0 and 5) and submitted to DWR. The Urban Water Management Planning Act applies to both urban retail suppliers that provide potable municipal water to more than 3,000 end users or 3,000 AFY and to urban wholesale water suppliers that provide more than 3,000 AFY at wholesale (DWR 2016a). The applicable codes have been modified multiple times to include various provisions for water-related reporting. Within UWMPs, urban water suppliers must:

- Assess the reliability of water sources over a 20-year planning time frame.
- Describe demand management measures and water shortage contingency plans.
- Report progress toward meeting a targeted 20% reduction in per-capita (per-person) urban water consumption by the year 2020.
- Discuss the use and planned use of recycled water.

The information, collected from the submitted UWMPs, is useful for local, regional, and statewide water planning. Besides annual review of the GSP, the 5-year evaluation interval required for GSPs under SGMA works well with the equivalent review interval for UWMPs, ensuring that information on water supply, groundwater in particular, is updated appropriately. Water suppliers that operate groundwater wells within the jurisdiction of FCGMA and the other GSAs (County and CWD) in the Subbasin will update their water supply projections in accordance with the allocation of groundwater production available. Groundwater supply assumptions made by urban water suppliers in their 2015 UWMPs will be superseded by the groundwater allocation reduction management actions discussed in Chapter 5 of this GSP.

Calleguas Municipal Water District UWMP

Description/Summary of Agency and Plan

CMWD is an independent special district and a wholesale water provider, the service area of which includes significant parts of each of the basins within the FCGMA area (Figure 1-7; FCGMA et al. 2007). Within Pleasant Valley, CMWD supplies eight water purveyors: Zone Mutual Water Company (MWC), Pleasant Valley MWC, Crestview MWC, City of Camarillo, Oxnard Union High School District, Ventura County Waterworks District No. 19, CWD, and Arroyo Las Posas MWC (Figure 1-7). CMWD has been a member agency of MWD since 1960, and provides wholesale water to 19 retail water purveyors, including several of the major cities within the FCGMA boundary. CMWD supplies water mainly for M&I uses. Most of the water supplied by CMWD is SWP water purchased from MWD. Storage facilities available to CMWD include a surface water reservoir (Lake Bard) in Thousand Oaks and underground storage via the LPVB Aquifer Storage and Recovery Project (see Table 1-11).

CMWD does not operate any wastewater treatment facilities but supports the use of recycled water through the ownership and operation of recycled water pipelines and other facilities.[3] The Salinity Management Pipeline transfers salty water away from surface waters in the southwestern Ventura County region to other beneficial uses or to the Pacific Ocean (Table 1-11). CMWD actively conducts water conservation programs. Such programs include rebate/incentive programs school programs, social media campaigns, and workshops.

The UWMP, adopted June 15, 2016, has a planning horizon of 25 years. The production of the UWMP involved coordination with, and obtaining information from, numerous water suppliers and management agencies, including CWD; the Cities of Camarillo, Oxnard, Port Hueneme, and Moorpark; Ventura County Waterworks District No. 1 and No. 19; and FCGMA, MWD, and UWCD. CMWD notified the appropriate agencies and the public of the production of the UWMP, conducted a public hearing, and incorporated public comments prior to adopting the plan.

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[3] CMWD’s use of recycled water takes place outside the FCGMA area.

Coordination with SGMA and Other Agencies

The UWMP contains a section describing FCGMA and the programs that it implements. The SGMA legislation and GSP requirements are also described, including FCGMA's role as the GSA and in preparing the GSPs (CMWD 2017, Section 6-2).

In January of 2016, the CMWD Board of Directors adopted a strategic plan, one of the provisions of which is to, "Work with FCGMA, United Water Conservation District, agricultural pumpers, purveyors, and other groundwater interests to encourage, support, and facilitate the development and implementation of groundwater sustainability plans within the service area that increase certainty in groundwater management and promote conjunctive use operations" (CMWD 2017, p. 7-13).

How the Plan May Change Water Demands within the Basin

The UWMP incorporates and reflects water demand and sustainability issues that must be addressed under SGMA. Implementation of this GSP will require continued coordination between the many agencies and stakeholders within the PVB and periodic adjustment of assumptions regarding climate, population, land use, environmental requirements, and other factors impacting water demand. The CMWD UWMP recognizes those factors and provides for adaptation where necessary.

Such adaptation includes support of Senate Bill X7-7 goals for conservation, an extensive demand management program, participation in capital projects that provide for conjunctive use on a regional scale, and the goal of reducing imported water.

How the Plan may Affect Sustainable Groundwater Management within the Basin

For the reasons noted previously, the CMWD UWMP fosters the goals of sustainable management within the PVB. Both CMWD and MWD (which provides SWP water to CMWD) are pursuing remedies to improve the reliability of water supplies within their respective services areas. UWMP strategies to remediate reliability issues of water supplies include pursuing demand management programs and local water supply projects such as increased use of recycled and brackish groundwater. In regard to SWP supply reliability, MWD and CMWD support DWR in projects and strategies to increase reliability from the Sacramento/San Joaquin Delta. These programs include California WaterFix and California EcoRestore (CMWD 2017, p. 7-2).

In terms of projects related to water quality, the CMWD plan provides a benefit to the region by introducing imported supplies that are in many cases of better quality than those obtained locally. CMWD constructed, and plans to expand, the Salinity Management Pipeline, which will foster the development of additional water treatment and desalination projects and provide a means to convey brine away from surface waters within the southwestern Ventura County area to other beneficial uses or to the Pacific Ocean (Table 1-11).

How the GSP May Impact the Assumptions of the UWMP

The UWMP presents strategies for preparing for SWP reliability challenges, climate variability, and emergency shortages. For planning purposes, the UWMP considers demand to be the total demand within the service area after accounting for local supplies. The GSP anticipates groundwater extraction reductions below historical average for M&I and agricultural uses without contribution from water supply projects. The UWMP assumes an increase in imported normal year demand of 5% between 2020 and 2040. Therefore, the UWMP may underestimate the demand upon which supply calculations are made. The UWMP assumes future water projects and demand management measures in water demand and reliability calculations. Those assumptions may be modified by those projects and management actions included in the GSP.

City of Camarillo UWMP

Description/Summary of Agency and Plan

The City of Camarillo lies primarily within the PVB and also overlies small parts of the LPVB and the Oxnard Subbasin. The City of Camarillo Water Division serves as a retail water agency that supplies water for urban, M&I, and agricultural uses.

Wastewater from within the City’s treatment area is collected and treated at the Camarillo WWTP by the Camarillo Sanitary District. The recycled water is treated to tertiary standards and delivered for irrigation of agriculture and landscaping or discharged to Conejo Creek. The City anticipates that future delivery projects will allow for additional use of recycled water and provide opportunities for water transfers and industrial uses (City of Camarillo 2016b).

The City of Camarillo Water Division supplies potable water from two sources. Imported water is supplied to the City’s water service area by CMWD, a member agency of MWD. This supply is normally SWP water but may also include some water from the Colorado River Aqueduct (limited to a maximum of approximately 30% of the City supply based on delivery capacity). The other source of potable water is groundwater extracted from the PVB. Since the year 2000, the proportion of groundwater to imported water has averaged about 40%–60%, but the proportion of these sources varies with climate, water quality, and other factors.

Groundwater quality in the City’s north basin wells has worsened since approximately 1990, likely due to poor-quality recharge water from Arroyo Las Posas (City of Camarillo 2016b, p. 6-4). Therefore, the groundwater from these wells has been blended with imported water to meet water quality standards. The City started construction in Fall 2019 of a groundwater desalter that is to treat brackish groundwater extracted from the northern part of the PVB. Because the City obtained approval in Fall 2019 for the project, the UWMP does not include the potential water supply in future supply calculations (City of Camarillo 2016b, p. 6-2).

The City of Camarillo has an inclusive demand management program consisting of prohibitions on water waste, metering of all water connections, a conservation-oriented price structure, and various education and outreach programs. The City also offers water audits to residential and business customers and a water retrofit program.

Coordination with SGMA and Other Agencies

As a PVB pumper, the City of Camarillo Water Division is subject to the FCGMA ordinances and allocation system. As such, the City has a groundwater allocation in accordance with Emergency Ordinance E (Table 1-11). The City of Camarillo will need to obtain approval for any future groundwater-related projects from FCGMA. The Camarillo UWMP includes a section on the SGMA and the coordination responsibility of FCGMA.

The final UWMP was adopted by the Camarillo City Council on October 12, 2016. Agencies that were notified and/or coordinated with in the preparation of the UWMP include CMWD, Camarillo Sanitary District, and the Ventura County Public Works Agency. A public hearing was conducted September 28, 2016.

How the Plan May Change Water Demands within the Basin

The Camarillo UWMP, as required by law, presents a plan to achieve a 20% demand reduction by the year 2020 from a stipulated baseline. This GSP presents Basin-wide allocation scenarios that may impact the groundwater supply availability under SGMA and the GSP.

How the Plan May Affect Sustainable Groundwater Management within the Basin

The City of Camarillo lies within the jurisdiction of FCGMA and is subject to the provisions of the GSP. It is not expected that the UWMP will hinder sustainable management within the PVB as long as water supplies and demand management efforts are coordinated with those of the GSP. It should be noted that the Camarillo UWMP assumes that the FCGMA allocation associated with Emergency Ordinance E will remain in effect through the planning horizon.

How the GSP May Impact the Assumptions of the UWMP

The implementation of a new allocation system in response to GSP provisions may require adjustment of the pumping scenarios discussed in the UWMP in order to not adversely impact groundwater management within the Basin. The UWMP assesses water supply reliability using the minimum historical consecutive 3-year period. The GSP determines drought periods differently and may result in different assumptions about water supply reliability for planning purposes. In addition, water reliability calculations in the UWMP are based on the FCGMA Emergency Ordinance E Temporary Extraction Allocation, which is going to change with the adoption of an allocation plan as part of the GSP process.

Camrosa Water District UWMP

Description/Summary of Agency and Plan

CWD is an independent special district and a retail water supplier created in 1962. Its service area includes all of the ASRVB, the east part of the PVB, a small portion of the southeast LPVB, and a small portion of the Oxnard Subbasin. CWD serves water for M&I and agricultural use throughout its service area. It also extends to the east of FCGMA jurisdiction and encompasses parts of the Cities of Camarillo and Thousand Oaks. A discontinuous portion of CWD includes the California State University, Channel Islands (Figure 1-1 and Figure 1-8 [Ventura County Water Purveyors]).

CWD supplies imported water from CMWD, an MWD member agency. The majority of this water is obtained from the SWP, but a small amount has been supplied from the Colorado River as drought conditions necessitate (CWD 2015). About 60% of CWD's potable supply comes from imported water, although CWD has plans to reduce its dependence on imported water over time.

Groundwater makes up about 40% of CWD's potable supply. CWD extracts groundwater from the PVB and ASRVB within FCGMA jurisdiction, as well as from the Tierra Rejada Basin, which lies outside the jurisdiction of FCGMA. Groundwater extracted from the ASRVB is also withdrawn east of the Bailey Fault, outside of FCGMA jurisdiction. Due to water quality requirements, CWD blends groundwater with imported water.

CWD's other supply sources include recycled water from the Camrosa Water Reclamation Facility, which collects and treats wastewater from part of the City of Camarillo to a tertiary level for distribution to agriculture and other users through a dedicated recycled water distribution system; treated water from the Round Mountain Water Treatment Plant (constructed in 2014), which treats water extracted from sediments east of the Bailey Fault (Figure 2-2, Geology of the Pleasant Valley Basin); diverted surface water from the Conejo Creek Project, which includes surface runoff and wastewater discharged from the City of Thousand Oaks Hill Canyon WWTP and is used for agricultural and landscape irrigation. Water from the Conejo Creek Project that is in excess of CWD's needs is delivered to PVCWD.

The CWD UWMP was adopted by the Board of Directors on June 9, 2016, and has a planning horizon of 20 years. CWD has an active public outreach and education program, the components of which include a dedicated website, newsletter, speaker's bureau, bill inserts, demonstration garden, and school tours of District facilities. Some of these activities are co-funded or coordinated with MWD, CMWD, and the City of Camarillo.

Coordination with SGMA and Other Agencies

CWD is an active participant in FCGMA and in the production of the GSP. The UWMP describes FCGMA and the programs that it implements. The SGMA legislation and GSP requirements are also described, including FCGMA's role as the GSA and in preparing the GSPs (CWD 2015, p. 6-2). Because only part of CWD's jurisdiction is within FCGMA, the management actions and plans of each will need to be coordinated. Currently, there is significant coordination of this kind due to intersecting interests and collaborative projects such as the Conejo Creek Diversion Project and the Camrosa Water Reclamation Facility.

The production of the CWD UWMP was coordinated with numerous water suppliers and management agencies including CMWD, the Cities of Camarillo and Thousand Oaks, California State University Channel Islands, the County of Ventura, PVCWD, and the Ventura Local Agency Formation Commission. CWD notified and solicited public input prior to the adopting the plan (CWD 2015).

How the Plan May Change Water Demands within the Basin

The CWD service area overlies FCGMA jurisdiction in the west part of the ASRVB, the southern and eastern part of the PVB, and the southern part of the LPVB (Figure 1-8). These portions are subject to the FCGMA ordinances and groundwater management activities described in Table 1-11. Future water projects discussed in the CWD UWMP include increased groundwater recharge, increased use of recycled water, and increased stormwater capture, all of which would foster the goal of sustainability and are consistent with management described in the GSP. To the extent that there is significant coordination of water issues between CWD and FCGMA and participation of CWD representatives in FCGMA planning, it is expected that the plan will not negatively impact water demand within the Basin.

How the Plan may Affect Sustainable Groundwater Management within the Basin

As described herein, the CWD UWMP fosters the goals of sustainable management within the PVB. CWD goals, policies, and projects are consistent, and coordinated, with those of FCGMA. For example, CWD has instituted a policy requiring all new development to install dual plumbing for the use of non-potable water where possible. CWD was a full participant in the preparation of the GSP. CWD's reliance on imported water supplies presents a potential obstacle to long-term sustainability if shortages in imported water are expected to be offset by additional groundwater consumption.

How the GSP May Impact the Assumptions of the UWMP

Only the northwestern portion of CWD is located within FCGMA jurisdiction and within the northeastern portion of the PVB. CWD plans to expand pumping capacity within the PVB. To the extent that it anticipates a modification of FCGMA groundwater extraction allocation, the GSP may impact the water available to CWD from the PVB.

1.6.3 Additional Plan Summaries

Calleguas Creek Watershed Management Plan

The Calleguas Creek Watershed Management Plan is designed to "facilitate comprehensive natural resource management, protection and enhancement" in the Calleguas Creek Watershed, which covers an area of approximately 341 square miles, which includes all of the PVB (CMWD 2004). Among the highest priority action recommendations in the Calleguas Creek Watershed Management Plan is removing the water quality impairment to restore beneficial uses of surface water and reclaim valuable groundwater resources (CMWD 2004).

Metropolitan Water District UWMP

MWD is a public agency that delivers water from the Colorado River and the SWP to its member agencies (MWD 2016). The member agencies of MWD include 14 cities, 11 municipal water districts, and 1 county water agency (MWD 2016). MWD supplies imported water to CMWD, and MWD does not directly pump groundwater in the Pleasant Valley Basin.

1.7 WELL PERMITTING POLICIES AND PROCEDURES

The two well permitting agencies within the PVB are FCGMA and the Ventura County Public Works Agency. The FCGMA well permit requirements pertain to the entirety of FCGMA's jurisdiction. The Ventura County ordinances do not preclude or supplant any other agency requirements.

1.7.1 FCGMA

Since its inception, FCGMA has implemented multiple ordinances and policies related to well permitting and the extraction and use of groundwater. A complete list of historical policies and ordinances is kept and updated on the FCGMA website (FCGMA 2019c). Those currently pertaining to well permits are described here.

Emergency Ordinance E, adopted April 11, 2014, in response to severe drought, declining water levels, and seawater intrusion, prohibits the issuance of permits for new groundwater wells associated with new or increased groundwater use, and changed groundwater extraction allocations for M&I and agricultural users (FCGMA 2014). In addition, the ordinance temporarily suspends the acquisition and use of conservation credits, and thus removed the ability to use accrued credits to avoid paying extraction surcharges.

Emergency Ordinance E temporarily replaced the then-in-use allocation systems (Historical Allocation and Baseline Allocation) for M&I well operators with a Temporary Extraction Allocation that uses average annual extractions from the base period 2003 to 2012. The ordinance sets a series of allocation reductions from the base amount to take effect beginning July 1, 2014, with a 10% reduction. The ordinance requires an additional 5% reduction every 6 months through January 2016, resulting in a total of 20% reduction.

Emergency Ordinance E requires all agricultural well operators to apply for a 25% reduced Efficiency Allocation. An Efficiency Allocation is based on a well operator demonstrating that water used for agriculturally developed land is at least 80% efficient (FCGMA 2011, Resolution No. 2011-04). Emergency Ordinance E also contains provisions for the FCGMA Board to undertake additional adjustments to irrigation allowances by resolution.

Under Emergency Ordinance E, accounts that are solely associated with domestic wells operate well(s) using a 25% reduced Historical Allocation (also known as an Adjusted Historical Allocation) and/or a Baseline Allocation. A Historical Allocation is an average of annual extractions from the base period 1985 to 1989. A Baseline Allocation is associated with a parcel and based on new development after the close of the Historical Allocation base period.

Since 1983, FCGMA ordinances have required registration of wells, reporting of extractions, and payment of pumping fees. Currently, the FCGMA Ordinance Code continues these requirements. Additionally, the Ordinance Code (Chapter 2) requires that permits be obtained from FCGMA for new wells prior to construction. For wells to be installed within the FCGMA area, the applicant must subsequently obtain a permit from the Ventura County Public Works Agency. FCGMA Ordinance Code requires the installation and maintenance of flow meters, providing proof of flowmeter accuracy, and reporting of all extractions semi-annually (Table 1-11). In 2018, FCGMA adopted an ordinance that will require all wells within the Agency to be equipped with advanced metering infrastructure telemetry by October 1, 2020.

1.7.2 Ventura County

The ordinances relating to groundwater wells in Ventura County are contained in Ventura County Ordinances, Division 4, Chapter 8, Water, Article 1 – Groundwater Conservation, Sections 4811–4828 (County of Ventura 2016). These ordinances regulate the construction, maintenance, operation, modification, and destruction of groundwater wells. Ventura County requires well permits for any construction, modification, replacement, repair, or destruction of wells. Permit requirements include "information as the Agency may deem necessary in order to determine whether underground waters will be protected" (County of Ventura 2016, Chapter 8, 4813, C8).

Ventura County requires that a well permit application from FCGMA be completed and authorized prior to consideration for a Ventura County permit. Ventura County well construction or destruction activity standards are required to comply with the DWR Well Standards Bulletins Nos. 74-81 and 74-90. New water wells must be equipped with a flow meter and calibrated every 3 years; however, de minimis extractors (those producing less than 2 AFY) are exempt from this requirement. Completion logs are required for all wells and geophysical logs are required where necessary to prevent cross contamination of pumping zones.

Section 4826 pertains to the Aquifer Protection Program, the purpose of which is to require destruction or repair of wells that are causing groundwater pollution. The provision requires annual reporting of water extractions, time of operation, static water levels, and pump test data if available. Based on these data, all wells are classified in regard to location and operational condition.

Due to pervasive drought conditions, as of October 28, 2014, Section 4826.1 prohibited the construction of new wells within the unincorporated area of Ventura County except under specific circumstances. With the initiation of SGMA, the ordinance was modified to include only basins designated as high or medium priority by DWR, which includes the PVB.

1.8 NOTIFICATION AND COMMUNICATION

1.8.1 Notification and Communication Summary

Notification and communication regarding the development of the PVB GSP takes place in the following four key phases:

1. Initial Notification
2. GSP Development
3. Draft GSP Review and Comment
4. GSP Implementation

The Initial Notification was completed with the FCGMA submittal of the Notice of Intent on February 24, 2017, to the California DWR to develop a GSP for the PVB. The GSP Development phase included extensive outreach and engagement with the stakeholders, including beneficial users, as described in more detail in Section 1.8.3, Public Meetings Summary, and Section 1.8.6, Communication.

The Draft GSP Review and Comment phase will include the formal public comment period for the Draft GSP and response to comments, as discussed in Section 1.8.4, Summary of Comments and Responses. The GSP Implementation notification and communication period will begin once FCGMA submits the final GSP to DWR and will include engagement with the public and beneficial users regarding the progress of monitoring and reporting updates on the GSP to DWR, establishment of fees, and the development and implementation of management strategies, including projects as needed.

1.8.2 Summary of Beneficial Uses and Users

Beneficial uses of groundwater from the Basin include agricultural, M&I, urban, and environmental uses. As discussed in Section 1.3.2.3, Historical, Current, and Projected Land Use, land use in Pleasant Valley includes most of the City of Camarillo and agricultural land uses. Agricultural land covers approximately 40% of the Pleasant Valley, including beans, beets, strawberries, other corps, and some nurseries and orchards. Of the groundwater produced from the older alluvium and LAS, approximately 88% is used for agriculture and the remaining 12% is used for M&I and urban use. Environmental uses of groundwater are not well characterized in PVB. Willow/mulefat riparian scrub and Arundo vegetation communities are found along the banks of Conejo Creek, and Calleguas Creek, lower Arroyo Las Posas and Conejo Creek include reaches of natural channel with riparian woodland/wetland habitat (see Section 2.3.7). These communities are likely supported by percolating surface water rather than groundwater in the PVB.

Beneficial users of groundwater and property interests potentially affected by the use of groundwater are described in the following paragraphs.

Surface Water. The primary surface water suppliers within the PVB are UWCD and CWD, which both operate conjunctive-use programs. Consultation with UWCD and CWD staff has occurred formally and informally throughout the development of the GSP, including participation in public meetings and the Technical Advisory Group (TAG). UWCD has also contributed data from their monitoring programs. There are also environmental uses of surface water, as discussed in this section under Environmental Users. Identified surface water users in the PVB have been added to the interested parties list that is sent monthly electronic newsletters and meeting notices regarding the status of the GSP.

Municipal Well Operators, Public and Private Water Purveyors: All of the purveyors in the PVB, including all municipal well operators, are supplied water by either UWCD or CMWD. Both of these wholesale water districts have been an integral part of the GSP development. Staff from both UWCD and CMWD have provided groundwater monitoring data, participated in public meetings, and regularly collaborate with FCGMA staff. CMWD is an independent special district and a wholesale water provider that supplies eight water purveyors in Pleasant Valley: Zone MWC, Pleasant Valley MWC, Crestview MWC, City of Camarillo, Oxnard Union High School District, Ventura County Waterworks District No. 19, CWD, and Arroyo Las Posas (Figure 1-8). CMWD supplies water for mainly M&I uses. UWCD serves five water purveyors within Pleasant Valley. The City of Camarillo also has direct representation on the FCGMA Board and TAG by the representative appointed to serve on behalf of the five incorporated cities within FCGMA jurisdiction. Some of the smaller water districts and mutuals have also participated in FCGMA public meetings and provided comments throughout the development of the GSP.

Agricultural Users. Agricultural users have been identified as key stakeholders since the creation of FCGMA in 1982 and have direct representation through one of five members on the FCGMA Board. The primary crops grown in Pleasant Valley are cropland, orchards, and vineyards. Agricultural user interests are represented within Pleasant Valley by the Ventura County Agricultural Commissioner, the Ventura County Farm Bureau, individual pumpers, and groups of pumpers that have organized to advocate for their interests during the GSP development process. FCGMA maintains a database of well owners, including agricultural well owners. Email addresses within the database have been added to the list of interested parties who receive electronic newsletters regarding the status and development of the PVB GSP.

Domestic Users. The majority of domestic groundwater users in the PVB are supplied water by a city, special district, or mutual water company. FCGMA maintains a database of well owners, including domestic well owners. Email addresses within the database have been added to the list of interested parties who receive electronic newsletters regarding the status and development of the PVB GSP.

Local Land Use Planning Agencies. FCGMA staff has reached out to all local land use planning agencies with jurisdiction over Pleasant Valley, including the County of Ventura and the City of Camarillo. The County of Ventura holds one of five seats on the FCGMA Board. The FCGMA Board also has a member appointed to represent the five incorporated cities, including the City of Camarillo. As discussed in Section 1.6, Land Use Elements or Topic Categories of Applicable General Plans, FCGMA has established working relationships with the land use planning agencies. FCGMA staff has participated on the Ventura County General Plan Update Water Element Focus Group and continues to work with Ventura County planning staff to ensure that the GSP and General Plan Update are consistent.

Environmental Users. Environmental uses of groundwater are not well characterized in PVB. Calleguas Creek, lower Arroyo Las Posas and Conejo Creek include reaches of natural channel with riparian woodland/ wetland habitat, but it is unclear whether this habitat is supported by groundwater or percolating surface water (see Section 2.3.7). FCGMA has taken steps to incorporate the interests of environmental users in the development of the GSP through appointing an environmental representative on the TAG. The TAG held a special meeting focusing on potential groundwater-dependent ecosystems and accepted comments from the public on the potential impacts to surface water bodies. There are several non-governmental organizations with missions associated with environmental water uses on the list of interested parties that receives electronic newsletters regarding the status and development of the PVB GSP.

California Native American Tribes. According to the U.S. Bureau of Indian Affairs California Tribal Homelands and Trust Land Map, updated in 2011 and available from the DWR website, the entire PVB is within the Chumash Tribal/Cultural area. There are not currently any federally recognized tribes, Indian land currently or historically held in trust by the U.S. government, or smaller Reservation or Rancheria areas in the PVB. FCGMA recognizes that the Chumash culture and associated cultural resources are important in Ventura County. Several active local groups and individuals representing the interests of tribal communities in Ventura County have been added to the list of interested parties, including representatives from the Barbareno/Ventureno Band of Mission Indians (Chumash) and the Wishtoyo Chumash Foundation. FCGMA has reached out to the DWR Southern Region Office Tribal Liaison, Jennifer Wong, and added her to the list of interested parties. The San Gabriel Band of Mission Indians has also shown an interest in the groundwater sustainability planning process and has been added to the list of interested parties.

Disadvantaged Communities. The only Disadvantaged Communities shown on the DWR mapping tool (DWR 2017) within the PVB is within the City of Camarillo and is represented by the City as discussed earlier in this section.

1.8.3 Public Meetings Summary

FCGMA has been discussing the development of a GSP since March 2015. Table 1-12 lists FCGMA public meetings in which participants discussed or took action on the PVB GSP.

1.8.4 Summary of Comments and Responses

The FCGMA Board approved release of a Preliminary Draft GSP in January 2018, with a 90-day comment period. An evening public workshop was held on February 8, 2018, to present the Preliminary Draft GSP, answer questions, and solicit comments. Formal comments were accepted in writing only. The comments were submitted in person at the public workshop and electronically via email to fcgma-gsp@ventura.org. A total of 32 comment letters were received by FCGMA on all three GSPs. A summary of the comments was presented to the FCGMA Board at the May 23, 2018, meeting. In consideration of these comments, FCGMA completed an independent peer review of the numerical groundwater models, completed additional analysis for the water quality approach, and extended the timeline for completion of the GSP. Comments on the Preliminary Draft GSP and direction from the FCGMA Board after consideration of public comments have been incorporated into the Draft GSP.

Before completing the Draft GSP, additional information was made available to the public to enhance understanding of the technical information and processes used for the development of the Draft GSP. The following documents were posted on the FCGMA website, discussed in public FCGMA meetings, and sent to the list of interested parties in electronic newsletters:

- Minimum Thresholds and Measurable Objectives Data, March 2019

- Peer Review of the United Water Conservation District and Calleguas Municipal Water District Models for the Oxnard Subbasin, Pleasant Valley Basin, and Las Posas Valley Basin, March 2019
- Approach for GSP Modeling of Future Conditions in the Oxnard Subbasin, Pleasant Valley Basin and Las Posas Valley Basin, January 2019
- Minimum Thresholds and Measurable Objectives in the Las Posas Valley Basin, Oxnard Subbasin, and Pleasant Valley Basin, January 2019
- Assessing the Sustainable Yield of the Oxnard Subbasin, Pleasant Valley Basin, and Las Posas Valley Basin, January 2019

A public workshop was held on March 15, 2019, to discuss the estimated sustainable yield, minimum thresholds, and measurable objectives proposed for the Draft GSP. Comments received at the public workshop were incorporated into the Draft GSP. The Draft GSP was approved by the FCGMA Board and released for a 60-day public comment period on July 29, 2019, during which time FCGMA solicited formal comments on the Draft GSP.

Before completing this Final GSP, the public comments received on the Draft GSP were reviewed and where appropriate incorporated into this Final GSP. Public comments on the Draft GSP are included in Appendix A.

1.8.5 Summary of Initial Information on Relationships between State and Federal Regulatory Agencies

FCGMA has not entered into any formal agreements with the federal government regarding preparation or administration of this GSP or groundwater management pursuant to SGMA, Section 10720.3(c). There are no federally recognized Indian tribes within the PVB boundaries.

FCGMA recognizes the need for both formal and informal consultation with state and federal regulatory agencies throughout the implementation of the GSP. FCGMA received a formal request from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) on October 11, 2016, to be added to the list of interested parties for the development of the GSP. FCGMA has added NMFS to the list of interested parties, as well as the following state and federal regulatory agencies:

- Los Angeles Regional Water Quality Control Board
- U.S. Fish and Wildlife Service
- California Department of Fish and Wildlife
- California Department of Water Resources

1.8.6 Communication

A public outreach and engagement plan (Appendix B to this GSP) was developed for all of the GSPs that FCGMA is developing. The purpose of the plan is to create a common understanding and transparency throughout the groundwater sustainability planning process, including fulfilling the requirements of SGMA, as described in DWR 2016b, Section 354.10.d. The plan discusses the FCGMA decision-making process; identifies opportunities for public engagement and provides a discussion of how public input and response will be used; describes how FCGMA encourages the active involvement of diverse social, cultural, and economic elements of the population within the PVB; and describes the method FCGMA shall follow to inform the public about progress implementing the plan, including the status of projects and actions.

FCGMA has provided ongoing and innovative opportunities for stakeholders to engage in the GSP development process. FCGMA has provided regular updates to interested parties through monthly electronic newsletters highlighting monthly progress on the GSP development, upcoming meetings, and opportunities for engagement. Monthly updates and opportunities for public comment were provided at FCGMA Regular Board Meetings, FCGMA Special Board Meetings, and TAG Meetings. Meeting agendas and minutes, as well as video recordings of all FCGMA Board Meetings and Workshops, were made available on the FCGMA website. Additional technical information about the GSP development was made available on the FCGMA website, including the Preliminary Draft GSP, Technical Memoranda, and TAG Meeting Materials. The Preliminary Draft GSP was available online for more than 120 days, including an official 90-day public comment period. FCGMA encouraged active participation from stakeholders through four public workshops (November 15, 2016; September 20, 2017; February 8, 2019; and March 15, 2019), a survey for input on sustainability indicators, and a public call for project ideas for incorporation into the GSP.

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Table 1-1
Estimate of Project Cost and Water Supply for First 5 Years

Proposed Project	Estimated Annual Costs	Estimated Acre-Feet of Water	Estimated Cost per Acre-Foot
Temporary Land Fallowing	$4,332,772	2,410	$1,800
Total	**$4,332,772**	**2,410**	**$1,800**

Table 1-2
Groundwater Sustainability Plan Estimated Implementation Cost through 2040

Fiscal Year	Operations and Monitoring Costs	Management, Administration and Other Costs	5-Year GSP Evaluation[a]	10% Contingency	Total[b]
2020	$1,000,000	$1,455,000	$300,000	$275,500	$3,030,500
2021	$1,028,000	$1,495,740	$308,400	$283,214	$3,115,354
2022	$1,056,784	$1,537,621	$317,035	$291,144	$3,202,584
2023	$1,086,374	$1,580,674	$325,912	$299,296	$3,292,256
2024	$1,116,792	$1,624,933	$335,038	$307,676	$3,384,439
2025	$1,148,063	$1,670,431	$114,806	$293,330	$3,226,630
2026	$1,180,208	$1,717,203	$118,021	$301,543	$3,316,976
2027	$1,213,254	$1,765,285	$121,325	$309,986	$3,409,851
2028	$1,247,225	$1,814,713	$124,723	$318,666	$3,505,327
2029	$1,282,148	$1,865,525	$128,215	$327,589	$3,603,476
2030	$1,318,048	$1,917,759	$65,902	$330,171	$3,631,881
2031	$1,354,953	$1,971,457	$67,748	$339,416	$3,733,573
2032	$1,392,892	$2,026,658	$69,645	$348,919	$3,838,113
2033	$1,431,893	$2,083,404	$71,595	$358,689	$3,945,581
2034	$1,471,986	$2,141,739	$147,199	$376,092	$4,137,016
2035	$1,513,201	$2,201,708	$75,660	$379,057	$4,169,626
2036	$1,555,571	$2,263,356	$77,779	$389,671	$4,286,376
2037	$1,599,127	$2,326,730	$79,956	$400,581	$4,406,394
2038	$1,643,903	$2,391,878	$82,195	$411,798	$4,529,773
2039	$1,689,932	$2,458,851	$168,993	$431,778	$4,749,553
2040	$1,737,250	$2,527,699	$86,862	$435,181	$4,786,992
Total[b]	**$28,067,603**	**$40,838,363**	**$3,187,009**	**$7,209,297**	**$79,302,272**

Notes: GSP = Groundwater Sustainability Plan.
Costs are in 2020 dollars.

[a] The 5-year update costs include costs for the PVB, as well as the Oxnard Subbasin and LPVB, for which FCGMA is the GSA.

[b] Amounts may not sum precisely due to rounding.

Table 1-3
Groundwater Sustainability Agencies in the Pleasant Valley Basin

GSA Name	Total Area of GSA (acres)	% of GSA Area within the PVB	Acres within the PVB	% of the PVB
Fox Canyon Groundwater Management Area	117,280	12.3%	14,477	73.0%
Camrosa Water District–Pleasant Valley Basin	3,880	95.6%	3,708	18.7%
Pleasant Valley Basin Outlying Areas	1,642	100%	1,642	8.3%
		Total	**19,827 (out of 19,840)**	**100%**

Notes: GSA = Groundwater Sustainability Agency; PVB = Pleasant Valley Basin.

Table 1-4
Summary of Land Ownership in the Pleasant Valley Basin

Ownership	Jurisdiction	Description	Acres within the PVB (% of Total)
Private[a]			
Private	County of Ventura	Privately owned land under County jurisdiction, largely agriculture and open space	8,859 (44.7%)
Private	City of Camarillo		10,411 (52.5%)
		Subtotal (private land)[a]	*19,270 (97.1%)*
Public			
Special District	Pleasant Valley Recreation and Park District	Parks	222 (1.1%)
County	County of Ventura	Camarillo Oak Grove County Park and other holdings	19 (0.1%)
State	California State University	CSU Channel Islands	329 (1.7%)
		Subtotal (public land)	*570 (2.9%)*
		Total	**19,840 (100%)**

Notes: CSU = California State University; PVB = Pleasant Valley Basin.

[a] This may include small land areas that are publicly owned for utility, civic, and/or public educational uses.

Table 1-5
Pleasant Valley Stream Gauge Information

Station Number	Station Name	Record Start	Record End	Active?	Latitude	Longitude	Elevation (ft msl)	Gauge Type
800	Conejo Creek above Hwy 101	1971	2011	No	34.23653	−118.965	145	Recording Stream Gauge
800A	Conejo Creek at Ridge View Street	2009	N/A	Yes	34.20583	−118.999	105	Recording Stream Gauge

Table 1-5
Pleasant Valley Stream Gauge Information

Station Number	Station Name	Record Start	Record End	Active?	Latitude	Longitude	Elevation (ft msl)	Gauge Type
805	Calleguas Creek at California State University Channel Islands	1968	N/A	Yes	34.17903	−119.04	58	Recording Stream Gauge
806	Calleguas Creek above Hwy 101	1968	1997	No	34.22111	−119.014	160	Recording Stream Gauge
806A	Calleguas Creek at Hwy 101	1997	N/A	Yes	34.21537	−119.016	152	Peak Only (Event) Gauge

Source: VCWPD 2016b.
Note: ft msl = feet above mean sea level; N/A = not applicable, because gauge is active.

Table 1-6
Pleasant Valley Precipitation Station Information

Station Number	Station Name	Record Start	Record End	Active?	Latitude	Longitude	Elevation (ft amsl)	Station Type	Mean Annual Rainfall (in.) for Period of Record
003	Camarillo–Springville Ranch	1902	1992	No	34.204722	−119.067778	73	Standard Precipitation	13.1
194	Camarillo–Adohr	1955	1998	No	34.204722	−119.0125	130	Standard Precipitation	13.4
194A	Camarillo–Adohr (Sanitation Plant)	1998	2016	Yes	34.196769	−119.00241	110	Recording Precipitation Gauge	10.7
219	Camarillo–Hauser	1964	1972	No	34.227778	−119.026389	172	Standard Precipitation	13.3
219A	Camarillo–Hauser	1972	2013[a]	Yes	34.237126	−119.027131	192	Standard Precipitation	14.3
259	Camarillo–PVWD	1981	2016	Yes	34.213014	−119.069475	80	Recording Precipitation Gauge	13.4
152	Camarillo–Leisure Village	1984	2004	No	34.219111	−118.990917	115	Standard Precipitation	12.0
152A	Camarillo–Leisure Village CIMIS 152	2004	2016	Yes	34.219553	−118.992344	115	CIMIS Site	13.6
500	Santa Rosa Valley–Conejo (Type B)	2003	2008	No	34.236528	−118.963639	145	Non-Standard Recorder	11.4
500A	Camrosa Water District	2009	2016	Yes	34.238726	−118.967411	200	Recording Precipitation Gauge	7.1
505	Camarillo–CSUCI (Type B)	2003	2016	Yes	34.179028	−119.039528	58	Non-Standard Recorder	9.8
512	Camarillo–Upland (Type B)	2012	2015	Yes	34.239469	−119.007585	200	Non-Standard Recorder	4.1

Source: VCWPD 2016b.

Notes: CIMIS = California Irrigation Management Information System; CSUCI = California State University Channel Islands; ft amsl = feet above mean sea level; in. = inches; PVWD = Pleasant Valley Water District.

[a] Only preliminary data was available for water years 2014–2016 for Station 219A.

Table 1-7
Drought Periods in Pleasant Valley

Drought Period	Duration (years)	Cumulative Deficit
1918–1934	16	−36.3
1944–1951	7	−31.4
1958–1964	6	−26.3
1969–1977	8	−18.3
1986–1991	5	−26.2
1998–2004	6	−18.4
2011–2016	5	−34.0

Table 1-8
Past and Present Land Use within Pleasant Valley, 1990–2015

Land Use Category	1990		1993		2001		2005		2015	
	Acres	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*
Agriculture										
Orchards and Vineyards	1,485	7%	1,432	7%	1,641	8%	1,293	7%	—	—
Cropland and Improved Pasture Land	7,930	40%	7,893	40%	7,105	36%	6,787	34%	—	—
Nurseries	37	0%	37	0%	164	1%	334	2%	—	—
Horse Ranches	0	0%	0	0%	4	0%	8	0%	—	—
Other Agriculture	73	0%	81	0%	86	0%	82	0%	—	—
Dairy And Intensive Livestock, and Associated Facilities	4	0%	4	0%	0	0%	0	0%	—	—
Total	**9,530**	**48%**	**9,448**	**48%**	**9,000**	**45%**	**8,503**	**43%**	**7,390**	**37%**
Vacant/Open Space										
Open Space	2,598	13%	2,627	13%	2,025	10%	1,941	10%	—	—
Water	57	0%	57	0%	67	0%	67	0%	—	—
Total	**2,656**	**13%**	**2,684**	**14%**	**2,092**	**11%**	**2,008**	**10%**	**1,251**	**6%**
Urban/Built-Up										
Residential	4,438	22%	4,561	23%	4,961	25%	5,384	27%	—	—
Mixed Commercial and Industrial	527	3%	402	2%	675	3%	708	4%	—	—
Commercial and Services	967	5%	989	5%	1,202	6%	1,319	7%	—	—
Industrial	608	3%	638	3%	759	4%	762	4%	—	—
Transportation, Communication, and Utilities	1,116	6%	1,120	6%	1,151	6%	1,156	6%	—	—
Total	**7,656**	**39%**	**7,709**	**39%**	**8,749**	**44%**	**9,330**	**47%**	**11,197**	**56%**

Sources: SCAG 2005 (for 1990–2005); VCPD 2015 (for 2015).

Notes: Acres and percentages are rounded to the nearest whole number. The land use data for 2015 is based on the Ventura County General Plan land use map, which has a lower geographic resolution and uses fewer land use categories than data provided by SCAG for prior years.

Table 1-9
Past, Current, and Projected Population for Ventura County, the City of Camarillo, and Pleasant Valley

Population	1990	2000	2010	2012	2015	2040
Ventura County	669,016	756,902	825,378	833,000	853,188	965,210
City of Camarillo	52,303	57,077	65,201	66,300	—	79,900
Pleasant Valley	—	—	58,205	—	—	—

Sources: SCAG 2016 (for Ventura County 1990–2040 and City of Camarillo 2010–2040); City of Camarillo 2004 (for City of Camarillo 1990 and 2000); U.S. Census Bureau 2016 (for Pleasant Valley 2010).
Note: — = not available or unknown.

Table 1-10
Pleasant Valley Basin Existing Water Resources Monitoring Programs

Program	Program Agency	Program Description	Parameter	Multi-Basin Program	Source	Link
Existing Surface Water Monitoring Programs						
Ventura County Precipitation Monitoring	VCWPD	Collection of “real-time” and historical data from a network of precipitation gauges throughout Ventura County (approximately 8 within the PVB). Data is available on the web along with some statistical reports. Gauge data is available in various time increments depending on gauge type.	Precipitation	PVB, LPVB, ASRVB, and Oxnard Subbasin	VCWPD. 2016. Ventura County Watershed Protection District, Hydrology Section Website. Accessed September 15, 2016.	http://vcwatershed.net/hydrodata/gmap.php?param=rain
CIMIS	California Department of Water Resources	CIMIS manages a network of over 145 automated weather stations in California.	Temperature, Precipitation, Evapotranspiration	PVB, LPVB	CIMIS. 2018. CIMIS Data Website. Accessed January 15, 2018.	http://www.cimis.water.ca.gov
Ventura County Stormwater Quality Monitoring Program	VCWPD, Camarillo, Moorpark, Oxnard, Port Hueneme and others	Program meets the requirements of the Ventura County Stormwater Permits. Includes water quality sampling, watershed assessments, business inspections, and pollution prevention programs.	Surface Water Quality	PVB, LPVB, ASRVB, and Oxnard Subbasin	Ventura Countywide Stormwater Quality Management Program Website, Accessed September 15, 2016.	
Ventura County Stream Gauging Program	U.S. Geological Survey, United Water Conservation District	Approximately 64 stream locations are monitored county wide. Available data includes average daily flow, event hydrographs, and peak flows.	Stream Flow	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 31).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
Surface Water Quality Monitoring Program	UWCD	Monitoring of surface water quality at variable intervals. Parameters monitored include general minerals, temperature, and pH. Data is used to confirm water quality is acceptable for groundwater recharge and agricultural irrigation.	Stream Flow	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 31).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
Surface Water Quality Monitoring Program	Ventura County Agricultural Irrigated Lands Group	Monitoring of surface water quality at variable intervals.	Surface Water Quality	PVB, LPVB, and Oxnard Subbasin	Ventura County Agricultural Irrigated Lands Group Website	http://www.farmbureauvc.com/issues/water-issues/water-quality/
Calleguas Creek Watershed TMDL Compliance Monitoring Program	Calleguas Creek Watershed (Stakeholders)	Nitrogen, OC pesticides, toxicity, metals, and salts.	Surface Water Quality	PVB, LPVB	Seventh Year Annual Monitoring Report	https://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/caltrans/monitoring_results/mrr_apxg_calleguas_monit_rpt2015.pdf
Existing Groundwater Monitoring Programs						
California Aquifer Storage Elevation Statewide Groundwater Elevation Monitoring (CASGEM)	DWR Program implemented by VCWPD	DWR mandated program (SBX7-6) to track seasonal and long term groundwater elevation trends.	Groundwater Elevation	PVB, LPVB, ASRVB, and Oxnard Subbasin	DWR. 2016. "California Statewide Groundwater Elevation Monitoring (CASGEM) Program." Accessed September 15, 2016.	http://www.water.ca.gov/groundwater/casgem/

Table 1-10

Pleasant Valley Basin Existing Water Resources Monitoring Programs

Program	Program Agency	Program Description	Parameter	Multi-Basin Program	Source	Link
Ventura County Groundwater Elevation Monitoring Program	VCWPD	Quarterly measurement of approximately 200 groundwater well elevations (approximately 16 within the PVB) throughout Ventura County by District staff.	Groundwater Elevation	PVB, LPVB, ASRVB, and Oxnard Subbasin	VCWPD. 2015. 2014 Annual Report of Groundwater Conditions (p. 12).	http://pwaportal.ventura.org/WPD/docs/Groundwater-Resources/2014%20Annual%20Report-Web.pdf
Groundwater Ambient Monitoring and Assessment Program (GAMA)	State Water Resources Control Board	State Water Resources Control Board Program implemented in 2000 (modified by AB 599 in 2001) to monitor and assess groundwater basins throughout the state.	Groundwater Quality	PVB, LPVB, ASRVB, and Oxnard Subbasin	California State Water Resources Control Board. 2016. GAMA – Groundwater Ambient Monitoring and Assessment Program website. Accessed September 22, 2016.	http://www.swrcb.ca.gov/gama/
Ventura County Groundwater Quality Monitoring Program	VCWPD	Approximately 150 wells sampled throughout the County (approximately 14 in the PVB) and analyzed for general minerals and other constituents.	Groundwater Quality	PVB, LPVB, ASRVB, and Oxnard Subbasin	VCWPD. 2015. 2014 Annual Report of Groundwater Conditions (p. 12).	http://pwaportal.ventura.org/WPD/docs/Groundwater-Resources/2014%20Annual%20Report-Web.pdf
UWCD Groundwater Quality Monitoring Program	UWCD	Measurement of groundwater quality within UWCD boundaries to comply with state standards for aesthetics and safety, monitor saltwater intrusion and saline migration, and track changes to water quality. Approximately four wells are sampled in the PVB.	Groundwater Quality	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013, UWCD Open-File Report 2014-12 (p. 26).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
FCGMA Groundwater Extraction Reporting Program (1985)	FCGMA	Since 1985, well operators are required to report their groundwater extractions twice per year using FCGMA approved forms. Requirements include periodic verification of flowmeter accuracy.	Groundwater	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007. Calendar Year 2014 Annual Report (p. 11).	http://www.fcgma.org/public-documents/reports
Basin Management Objectives Monitoring	FCGMA	The FCGMA has established a set of Basin Management Objectives that pertain to the overall health of the groundwater basins including water levels and water quality. Each year, FCGMA publishes a report tracking the progress toward meeting the objectives.	Groundwater Conditions	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. iii).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan

Notes: ASRVB = Arroyo Santa Rosa Valley Basin; CIMIS = California Irrigation Management Information System; CMWD = Calleguas Municipal Water District; DWR = California Department of Water Resources; FCGMA = Fox Canyon Groundwater Management Agency; LPVB = Las Posas Valley Basin; OC = organochlorine; PVB = Pleasant Valley Basin; TMDL = total maximum daily load; UWCD = United Water Conservation District; VCWPD = Ventura County Water Protection District.

Table 1-11
Pleasant Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameters	Conjunctive Use Program?	Multi-Basin Program	Source	Link
Existing Surface Water Management Programs							
Camarillo Water Reclamation Plant (1955)	Camarillo Sanitary District	Located in the southeast part of the City, the Camarillo Water Reclamation Plant collects and treats wastewater to a tertiary level and provides it for agricultural use. Treated water that is not used is released to Conejo Creek.	Surface Water Reuse	Yes	PVB	City of Camarillo. 2016b. 2015 UWMP for the City of Camarillo. Final Draft. Prepared by Water Systems Consulting Inc. August 2016.	http://www.cityofcamarillo.org/docs/Camarillo%202015%20Final%20Draft%20UWMP.pdf
Camrosa Water Reclamation Facility (1997)	CWD	Reclaimed water from within CWD is tertiary treated and distributed for use in agriculture and public landscaping.	Surface Water	No	PVB and LPVB	Camrosa Water District. 2015. 2015 UWMP.	https://www.camrosa.com/documents/2015UWMP/CWD2015_UWMP_DRAFT.pdf
Pleasant Valley Delivery System	UWCD	Water diverted from Santa Clara River is provided to PVCWD via a pipeline that terminates at the Pleasant Valley Reservoir. This water is supplied to agricultural users and offsets the need for groundwater pumping.		Yes	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 8).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
Conejo Creek Diversion (2000)	CWD, City of TO, PVCWD	Natural flow and recycled water from upstream treatment plants are diverted from Conejo Creek and replaces pumping in the PVB. Water used for agricultural irrigation and landscaping.	Surface Water	Yes	PVB, LPVB, and ASRVB	CWD. 2015. 2015 UWMP (p. 3-4). FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 17).	https://www.camrosa.com/documents/2015UWMP/CWD2015_UWMP_DRAFT.pdf http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
Round Mountain Water Treatment Plant	Camrosa Water District	Brackish water is produced east of Bailey Fault, treated in the brackish water desalination facility, and provided to the Cal State University Channel Islands.	Groundwater	No	PVB, Oxnard Subbasin, and ASRVB	CWD. 2015. 2015 UWMP (p. 20).	https://www.camrosa.com/documents/2015UWMP/CWD2015_UWMP_DRAFT.pdf
SWP Importation	DWR, Ventura County, UWCD	Purchase of up to 5,000 AFY of Ventura County's 20,000 AFY SWP allocation for release and percolation from Lake Piru, the Freeman Diversion, and surface deliveries to Pleasant Valley through the Pumping Trough Pipeline. The water reaching the Freeman Diversion is considered a "foreign water supply" and credited to UWCD.	Supplemental Water	Yes	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 36). FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 50).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
Importation of Metropolitan Water District water	CMWD	Import and deliver water from wholesaler Metropolitan Water District. Water purchased by water retailers such as the City of Camarillo to supplement water supply instead of pumping groundwater.	Supplemental Water	Yes	PVB, LPVB, and Oxnard Subbasin	CMWD. 2015. UWMP – Final, p. 1-1, 4-1, 4-2 (Figure 4-1), 6-1, 6-13.	http://www.mwdh2o.com/Who%20We%20Are%20%20Fact%20Sheets/Member%20Agency%20Map.pdf http://www.mwdh2o.com/WhoWeAre/Member-Agencies/Pages/default.aspx http://www.mwdh2o.com/WhoWeAre/History/Pages/default.aspx http://www.calleguas.com/images/docs-documents-reports/cmwdfinal2015uwmp.pdf
Salt TMDL	Los Angeles Regional Water Quality Control Board	Salt TMDL developed for the Calleguas Creek Watershed.	Surface Water Quality	No	PVB and LPVB	LPUG. 2012. Final Draft V.1 (8/17/2012) Las Posas Basin-Specific Groundwater Management Plan (p. 12).	http://www.calleguas.com/images/docs-water-resources-and-quality/drafts-for-discussion/LP_BSGMP_Final_Draft_V1_081712_Text_Tables.pdf
Existing Groundwater Management Programs							
FCGMA Groundwater In-Lieu Credit Program	FCGMA	This is a program by which credits are issued to the deliverer in equal amounts to the amount of delivered "newly available"/imported water from outside the County, recycled water, or diverted surface water that would otherwise be wasted to the ocean. Delivered water to be used in lieu of pumping.	Groundwater	Yes	PVB, LPVB, and ASRVB	FCGMA. 2015. Calendar Year 2014 Annual Report (p. 23).	http://www.fcgma.org/public-documents/reports

Table 1-11
Pleasant Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameters	Conjunctive Use Program?	Multi-Basin Program	Source	Link
Salinity Management Pipeline	CMWD	A brine disposal pipeline that collects brine generated by desalting facilities in the LPVB, PVB, and Oxnard Subbasin and conveys it to an ocean outfall for disposal. Future construction of the pipeline is expected to serve additional facilities, including those in the PVB, LPVB, and ASRVB.	Groundwater	Yes	Oxnard Subbasin, PVB, LPVB, and ASRVB	CMWD. 2015. UWMP – Final, p. 6-1.	http://www.calleguas.com/images/docs-documents-reports/cmwdfinal2015uwmp.pdf
Groundwater Supply Policy (Formerly Brackish Groundwater Policy)	FCGMA	The FCGMA Board of Directors, adopted Resolution No. 2016-05, a policy for evaluating and authorizing proposals for groundwater supply projects. It allows for consideration of development of brackish groundwater for supply projects subject to monitoring requirements and other constraints and restrictions including compliance with SGMA.	Groundwater	Yes	PVB, LPVB, and ASRVB	FCGMA. Draft Brackish Groundwater Project Pumping Policy.	http://www.fcgma.org/images/phocadownload/groundwater%20supply%20project%20policy%20.pdf http://www.fcgma.org/component/content/article/8-main/1-home
FCGMA Irrigation Allocation Program	FCGMA	Requirement for agricultural irrigation efficiency as compared to FCGMA calculations for required irrigation for specific crop types with consideration of weather conditions.	Groundwater Extractions	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA. 2015. Calendar Year 2014 Annual Report (p. 10).	http://www.fcgma.org/public-documents/reports
FCGMA M&I Allocation Program	FCGMA	The current M&I allocation program, also known as a TEA, was implemented with the passage of Ordinance E in 2014. It was implemented for M&I users, replacing HA and BA.	Groundwater	Yes	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA. 2015. Calendar Year 2014 Annual Report (p. 10).	http://www.fcgma.org/public-documents/reports
FCGMA Groundwater Extraction Reporting Program	FCGMA	Well operators are required to report their groundwater extractions twice per year using FCGMA approved forms or entered "online" at https://www.fcgmaonline.org	Groundwater	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA. 2015. Calendar Year 2014 Annual Report (p. 11).	http://www.fcgma.org/public-documents/reports
Extraction Fee Program	FCGMA	Groundwater extractors are assessed fees per AF of extraction. Fees have been used by the FCGMA to finance its management activities since its enabling legislation in 1983.	Groundwater	No	PVB, LPVB, and ASRVB	Assembly Bill no. 2995, Article 9.	http://www.fcgma.org/fcgma.old/publicdocuments/ordinances/ordinanceAB-2995.pdf
Extraction Surcharge Program	FCGMA	Surcharges are imposed on well operators for groundwater extractions in excess of annual allocation amounts.	Groundwater	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 45).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
Groundwater Extraction Limitation Program	FCGMA	FCGMA has implemented a program of reduced allocations.	Groundwater	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 45).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
Other Programs							
Integrated Regional Water Management Program	Watersheds Coalition of Ventura County	Initiated with Proposition 50 in 2006, the program provides competitive grant funds for projects and studies in accordance with a comprehensive Integrated Regional Water Management Plan.	Groundwater, Surface Water	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	Ventura County Watersheds Coalition. 2016. Watersheds Coalition of Ventura County. Accessed September 15, 2016.	http://www.ventura.org/wcvc/IRWMP/2014IRWMP.htm
FCGMA Irrigation Allocation Program	FCGMA	The current form of this program was implemented with the passage of Emergency Ordinance E in 2014. One or more allocation methods (HA, BA, and TEA) was implemented for agricultural, M&I, and domestic users.	Groundwater, Surface Water	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA. 2015. Calendar Year 2014 Annual Report. Prepared by FCGMA staff (p. 10).	http://www.fcgma.org/public-documents/reports
The Freeman Diversion (1991)	UWCD	Diversion of Santa Clara River flood flows to Saticoy, El Rio, and Noble Basins for groundwater recharge and surface deliveries through the PTP and PVP. The Freeman Diversion allows for surface water supply in place of groundwater pumping, thus reducing the risk of seawater intrusion.		Yes	PVB and Oxnard Subbasin	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 39).	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf

Table 1-11
Pleasant Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameters	Conjunctive Use Program?	Multi-Basin Program	Source	Link
FCGMA extraction reporting requirements	FCGMA	Since 1985, FCGMA has collected extraction records from well operators on a semi-annual basis. Requirements include periodic calibration of meters.	Groundwater	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	FCGMA, UWCD, CMWD. 2007.2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 50).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
Water Conservation Programs	Ventura County, Cities, and Water Districts	There are numerous conservation programs conducted by cities, Ventura County, and other entities within FCGMA jurisdiction that provide education, incentives, and regulations to encourage water savings from both the M&I and agricultural sectors. The exact configuration of these programs change with climate and local and state requirements. Within the PVB, the City of Camarillo has a comprehensive plan for Demand Management measures listed in the Draft 2015 UWMP.	Surface Water, Groundwater	No	PVB, LPVB, ASRVB, and Oxnard Subbasin	City of Camarillo. 2016b. 2015 UWMP for the City of Camarillo. Final. Prepared by Water Systems Consulting Inc. August 2016.	http://www.cityofcamarillo.org/docs/Camarillo%202015%20Final%20Draft%20UWMP.pdf

Notes: AF = acre-foot; AFY = acre-feet per year; AHA = Adjusted Historical Allocation; ASR = Aquifer Storage and Recovery; ASRVB = Arroyo Santa Rosa Valley Basin; BA = Baseline Allocation; City of TO = City of Thousand Oaks; CMWD = Calleguas Municipal Water District; CWD = Camrosa Water District; DWR = California Department of Water Resources; ELPMA = East Las Posas Management Area; HA = Historical Allocation; LPVB = Las Posas Valley Basin; M&I = municipal and industrial; PTP = Pumping Trough Pipeline; PVB = Pleasant Valley Basin; PVP = Pleasant Valley Pipeline; PVCWD = Pleasant Valley County Water District; SGMA = Sustainable Groundwater Management Act; SWP = State Water Project; TEA = Temporary Extraction Allocation; TMDL = Total Maximum Daily Load; UWCD = United Water Conservation District; UWMP = Urban Water Management Plan.

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Table 1-12
FCGMA Public Meetings on Pleasant Valley Basin GSP

Meeting	Date
FCGMA Special Board Meeting	November 8, 2019
TAG Meeting	October 31, 2019
FCGMA Regular Board Meeting	August 28, 2019
GSP Work Shops	August 21,22, 2019
TAG Meeting	August 1, 2019
FCGMA Regular Board Meeting	July 24, 2019
FCGMA Regular Board Meeting	June 26, 2019
FCGMA Special Board Meeting	May 22, 2019
TAG Meeting	May 5, 2019
FCGMA Regular Board Meeting	April 24, 2019
FCGMA GSP Public Workshop No. 4	March 15, 2019
FCGMA Special Board Meeting	March 15, 2019
FCGMA Regular Board Meeting	February 27, 2019
Special TAG Meeting	February 19, 2019
FCGMA Special Board Meeting	February 8, 2019
Special TAG Meeting	February 6, 2019
FCGMA Regular Board Meeting	January 23, 2019
Special TAG Meeting	January 17, 2019
TAG Meeting	December 6, 2018
FCGMA Regular Board Meeting	December 5, 2018
FCGMA Special Board Meeting	November 20, 2018
TAG Meeting	November 1, 2018
FCGMA Regular Board Meeting	October 24, 2018
FCGMA Special Board Meeting	October 12, 2018
TAG Meeting	October 4, 2018
FCGMA Regular Board Meeting	September 26, 2018
FCGMA Special Board Meeting	September 14,2018
TAG Meeting	September 6, 2018
FCGMA Special Board Meeting	August 29, 2018
FCGMA Special Board Meeting Oxnard and Pleasant Valley Pumping Allocation Workshop	July 25, 2018
FCGMA Regular Board Meeting	July 25, 2018
TAG Meeting	July 5, 2018
FCGMA Special Board Meeting	June 20, 2018
Special TAG Meeting	June 19, 2018
TAG Meeting	June 14, 2018
FCGMA Regular Board Meeting	May 23, 2018
TAG Meeting	May 3, 2018
FCGMA Regular Board Meeting	April 25, 2018
TAG Meeting	April 5, 2018
FCGMA Regular Board Meeting	March 28, 2018

Table 1-12
FCGMA Public Meetings on Pleasant Valley Basin GSP

Meeting	Date
FCGMA Special Board Meeting	March 9, 2018
TAG Meeting	March 1, 2018
FCGMA Regular Board Meeting	February 28,2018
FCGMA Special Board Meeting	February 26, 2018
FCGMA GSP Public Workshop No. 3	February 8, 2018
TAG Meeting	February 1, 2018
Special TAG Meeting	January 30, 2018
FCGMA Regular Board Meeting	January 24, 2018
TAG Meeting	January 4, 2018
FCGMA Special Board Meeting	January 3, 2018
Special TAG Meeting	December 14, 2018
FCGMA Special Board Meeting	November 13, 2017
TAG Meeting	November 2, 2017
TAG Meeting	October 6, 2017
FCGMA Special Board Meeting	October 13, 2017
FCGMA Regular Board Meeting	October 25, 2017
FCGMA Regular Board Meeting	September 27, 2017
FCGMA GSP Public Stakeholder Workshop No. 2A – Oxnard and Pleasant Valley	September 20, 2017
FCGMA Operations Committee Meeting	September 14, 2017
TAG Meeting	September 7, 2017
FCGMA Special Board Meeting	August 11, 2017
FCGMA Operations Committee Meeting	August 10, 2017
TAG Meeting	August 3, 2017
Special TAG Meeting – Sustainability Objective Concepts	July 27, 2017
FCGMA Regular Board Meeting	July 26, 2017
FCGMA Fiscal Committee Budget Workshop	July 25, 2017
Water Market Pilot Program Ad Hoc Committee Meeting	July 24, 2017
FCGMA Board Executive Committee Meeting	July 12, 2017
TAG Meeting	July 6, 2017
Special TAG Meeting – Groundwater-Dependent Ecosystems	June 29, 2017
FCGMA Regular Board Meeting	June 28, 2017
FCGMA Board Executive Committee Meeting	June 15, 2017
TAG Meeting	June 1, 2017
FCGMA Regular Board Meeting	May 24, 2017
TAG Meeting	May 4, 2017
Special TAG Meeting – Groundwater Models	April 27, 2017
FCGMA Regular Board Meeting	April 26, 2017
Special TAG Meeting	March 24, 2017
Special TAG Meeting – Groundwater Models	March 24, 2017
FCGMA Regular Board Meeting	March 22, 2017

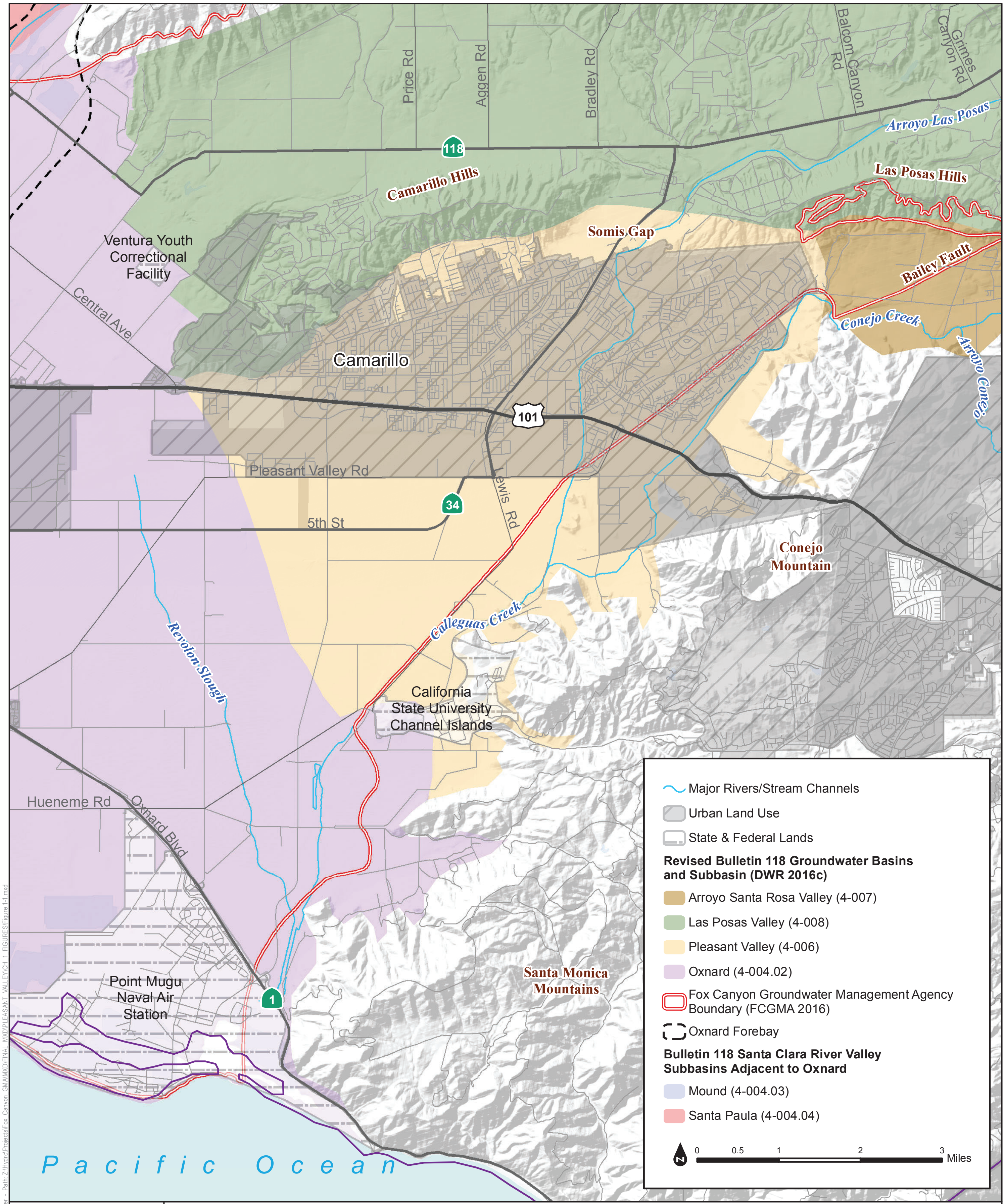
Table 1-12
FCGMA Public Meetings on Pleasant Valley Basin GSP

Meeting	Date
TAG Meeting	March 3, 2017
FCGMA Regular Board Meeting	February 22, 2017
TAG Meeting	February 2, 2017
FCGMA Regular Board Meeting	January 25, 2017
TAG Meeting	December 16, 2016
FCGMA Regular Board Meeting	December 9, 2016
TAG Meeting	November 18, 2016
FCGMA GSP Public Workshop No. 1	November 15, 2016
FCGMA Regular Board Meeting	October 26, 2016
TAG Meeting	October 7, 2016
FCGMA Executive Committee	October 3, 2016
FCGMA Regular Board Meeting	September 28, 2016
TAG Meeting	August 26, 2016
TAG Meeting	July 29, 2016
FCGMA Regular Board Meeting	July 20, 2016
FCGMA Regular Board Meeting	June 22, 2016
TAG Meeting	May 27, 2016
FCGMA Regular Board Meeting	May 25, 2016
FCGMA Special Board Meeting	May 13, 2016
TAG Meeting	April 29, 2016
FCGMA Regular Board Meeting	April 27, 2017
TAG Meeting	March 25, 2016
FCGMA Regular Board Meeting	March 23, 2016
FCGMA Special Board Meeting	March 11, 2016
TAG Meeting	February 26, 2016
TAG Meeting	January 29, 2016
FCGMA Regular Board Meeting	January 27, 2016
TAG Meeting	December 18, 2015
FCGMA Regular Board Meeting	December 11, 2015
TAG Meeting	November 20, 2015
FCGMA Special Board Meeting	November 13, 2015
TAG Meeting	October 30, 2015
FCGMA Regular Board Meeting	October 28, 2015
TAG Meeting	September 25, 2015
FCGMA Regular Board Meeting	September 23, 2015
TAG Meeting	August 28, 2015
FCGMA Special Board Meeting	August 13, 2015
TAG Meeting	July 30, 2015
FCGMA Regular Board Meeting	July 22, 2015
FCGMA Regular Board Meeting	June 24, 2015

Table 1-12
FCGMA Public Meetings on Pleasant Valley Basin GSP

Meeting	Date
FCGMA Regular Board Meeting	May 27, 2015
FCGMA Regular Board Meeting	April 22, 2015
FCGMA Regular Board Meeting	March 25, 2015

Notes: FCGMA = Fox Canyon Groundwater Management Agency; GSP = Groundwater Sustainability Plan; TAG = Technical Advisory Group.



SOURCE: DWR; Ventura County; FCGMA

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FIGURE 1-1

Vicinity Map for the Pleasant Valley Basin

Groundwater Sustainability Plan for the Pleasant Valley Basin

Date: 5/1/2019 - Last saved by: ntucker - Path: Z:\Hydro\Projects\Fox_Canyon_GMA\MXD\FINAL_MXD\PLEASANT_VALLEY\CH_1_FIGURES\Figure 1-1.mxd

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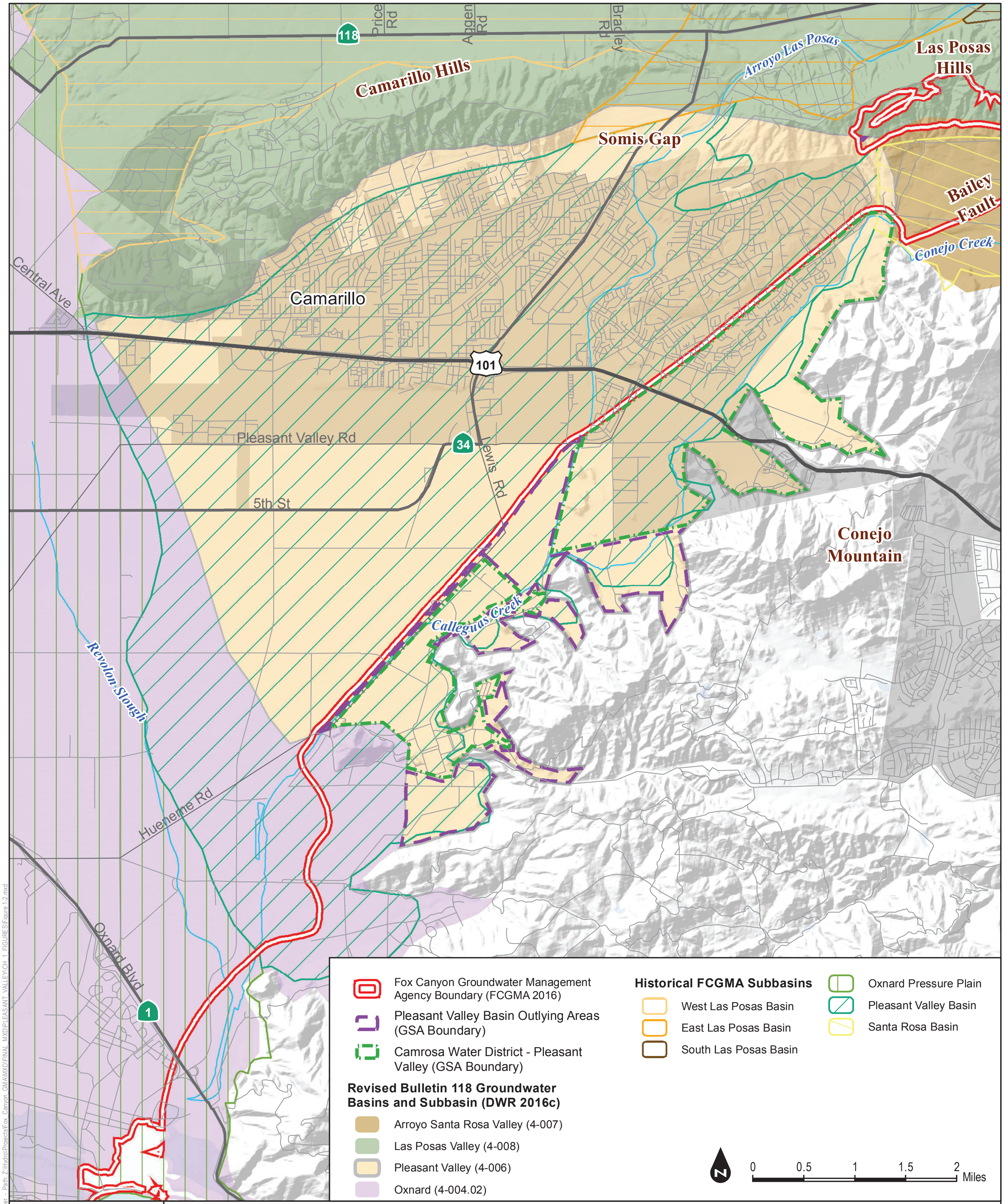

SOURCE: DWR; Santa Barbara County; FCGMA

FIGURE 1-2

Administrative Boundaries for the Pleasant Valley Basin

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Groundwater Sustainability Plan for the Pleasant Valley Basin

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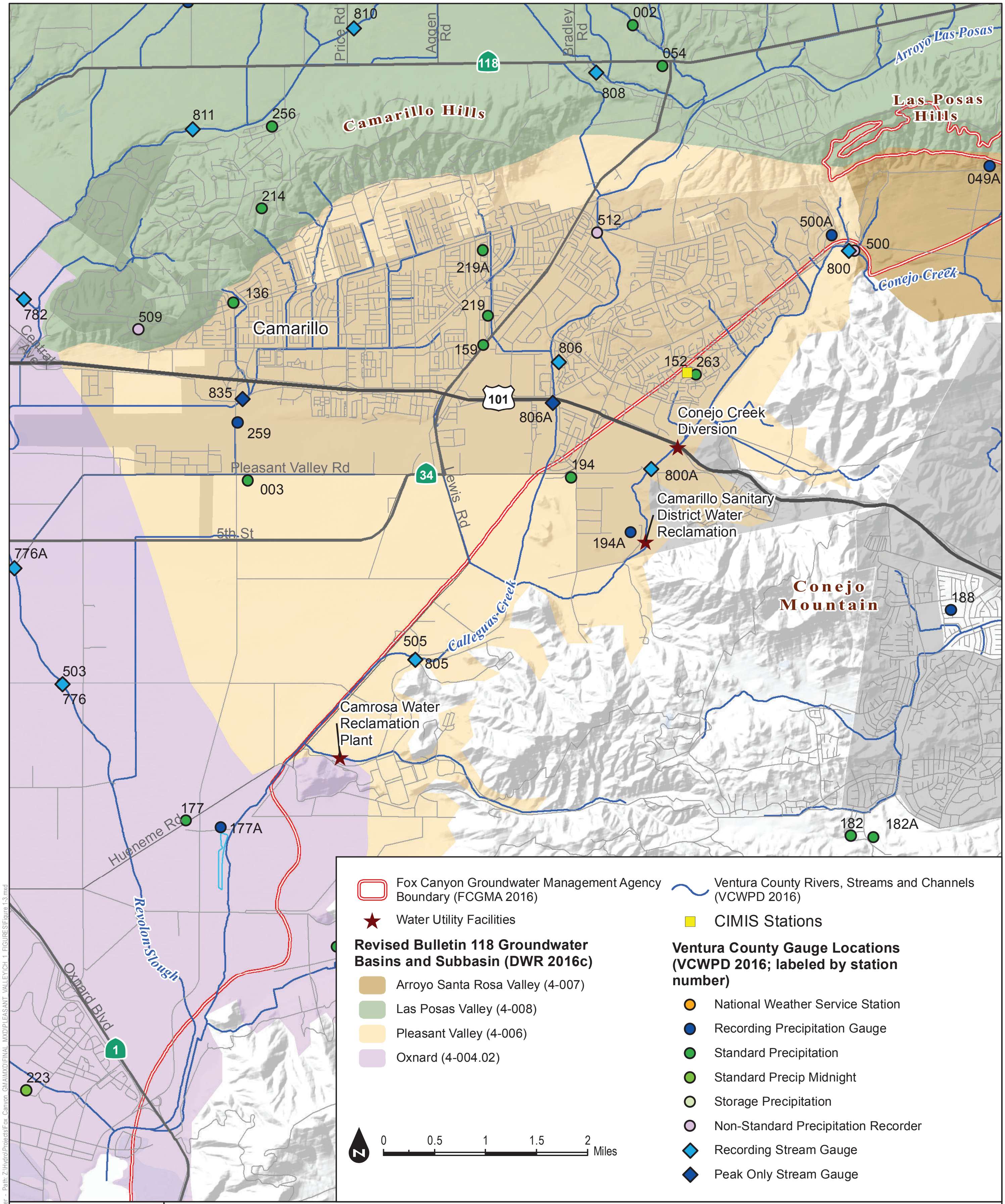

SOURCE: DWR; Santa Barbara County; VCWPD

FIGURE 1-3

Pleasant Valley Basin Weather Station and Stream Gauge Locations

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Groundwater Sustainability Plan for the Pleasant Valley Basin

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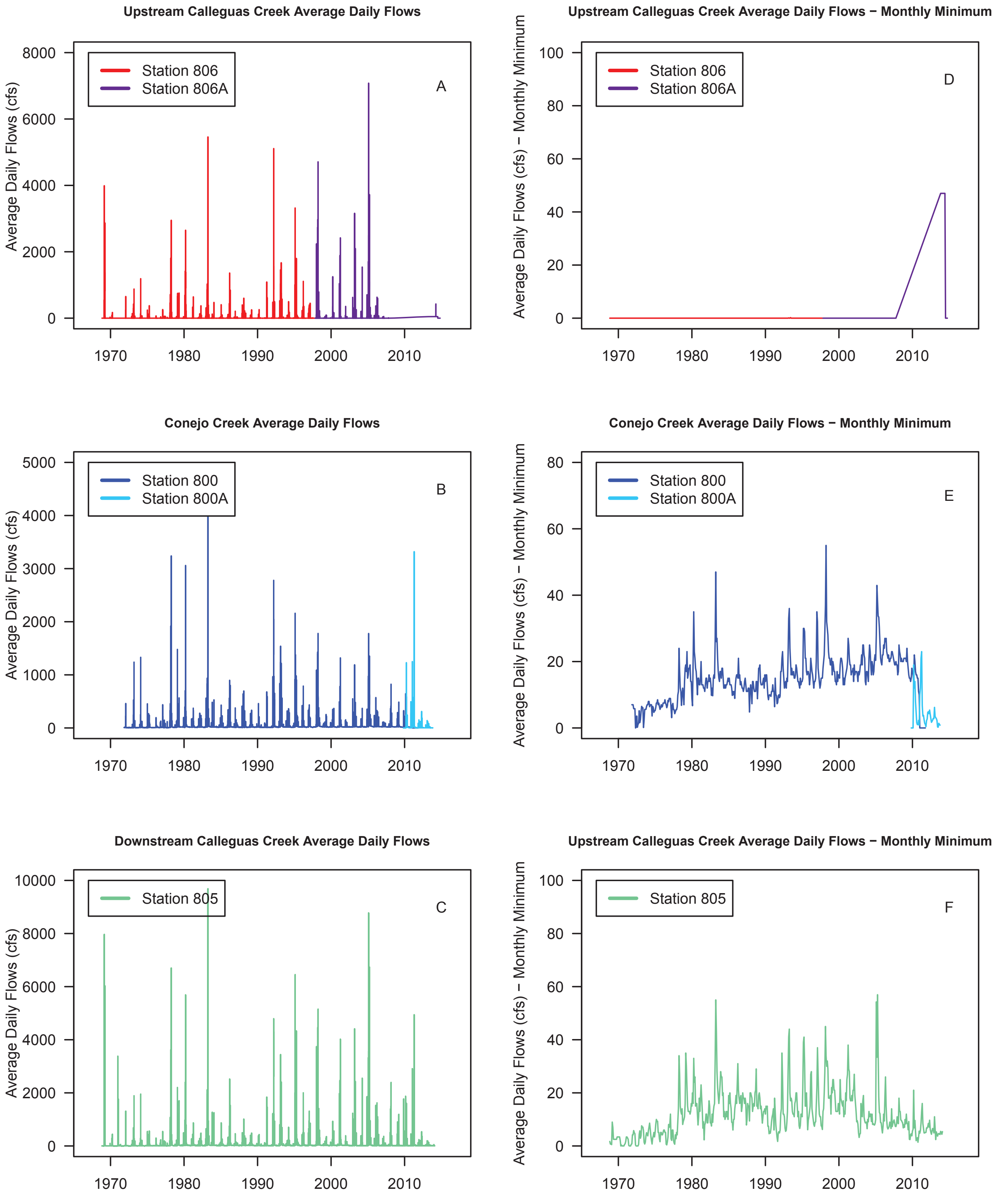

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SOURCE: Ventura County Watershed Protection District

FIGURE 1-4

Average Daily Flows (ADF) and Monthly Minimum ADF in Pleasant Valley Surface Waters

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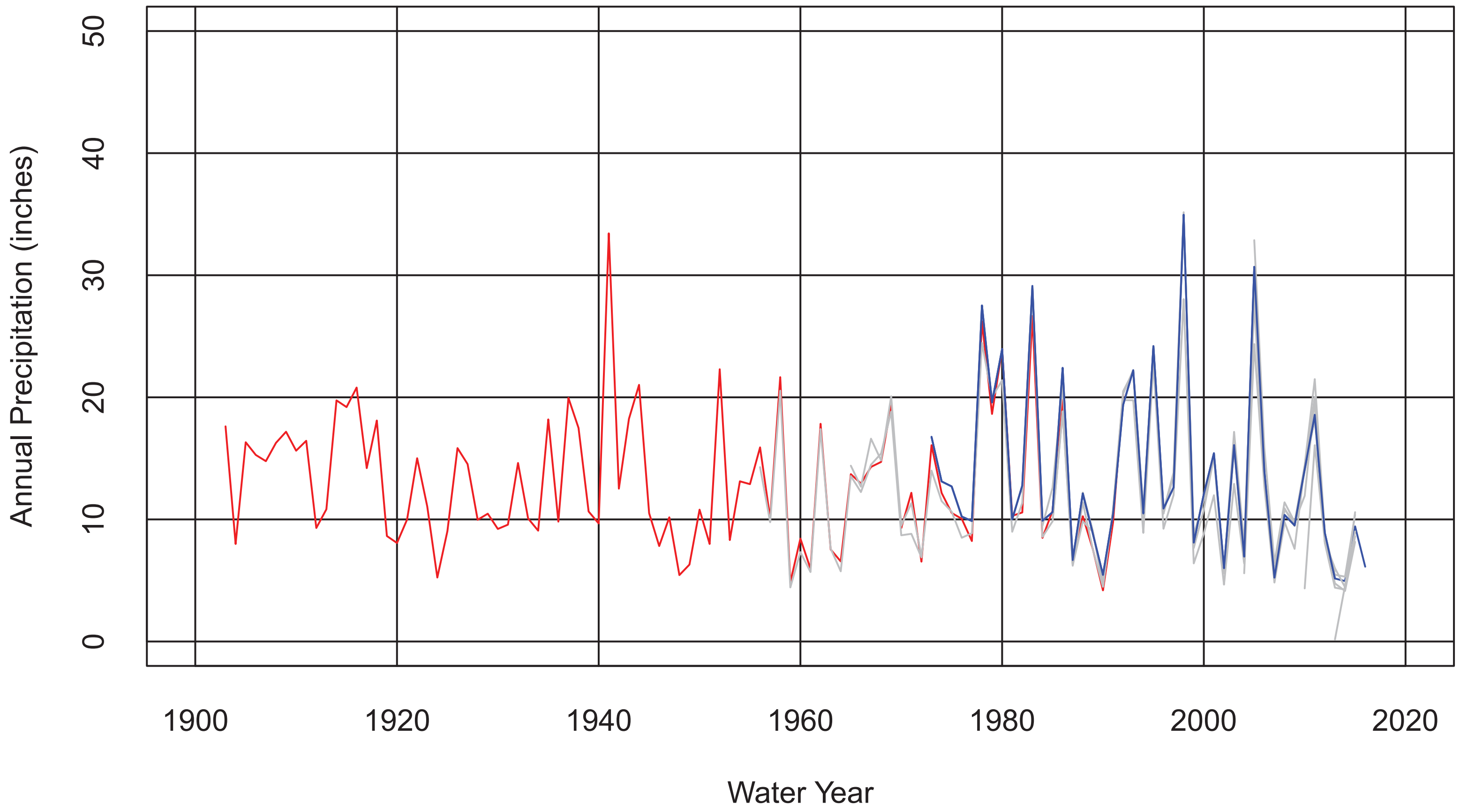
Pleasant Valley Annual Precipitation



Note: Annual precipitation values recorded at rain gauges within Pleasant Valley are shown. The majority of the precipitation records are depicted as gray lines. The two gauges used to create a long-term precipitation record, Stations 3 (Camarillo-Springville Ranch) and 219A (Camarillo-Hauser), are displayed in red and blue, respectively.

DUDEK

SOURCE: Ventura County Watershed Protection District

FIGURE 1-5

Pleasant Valley Annual Precipitation

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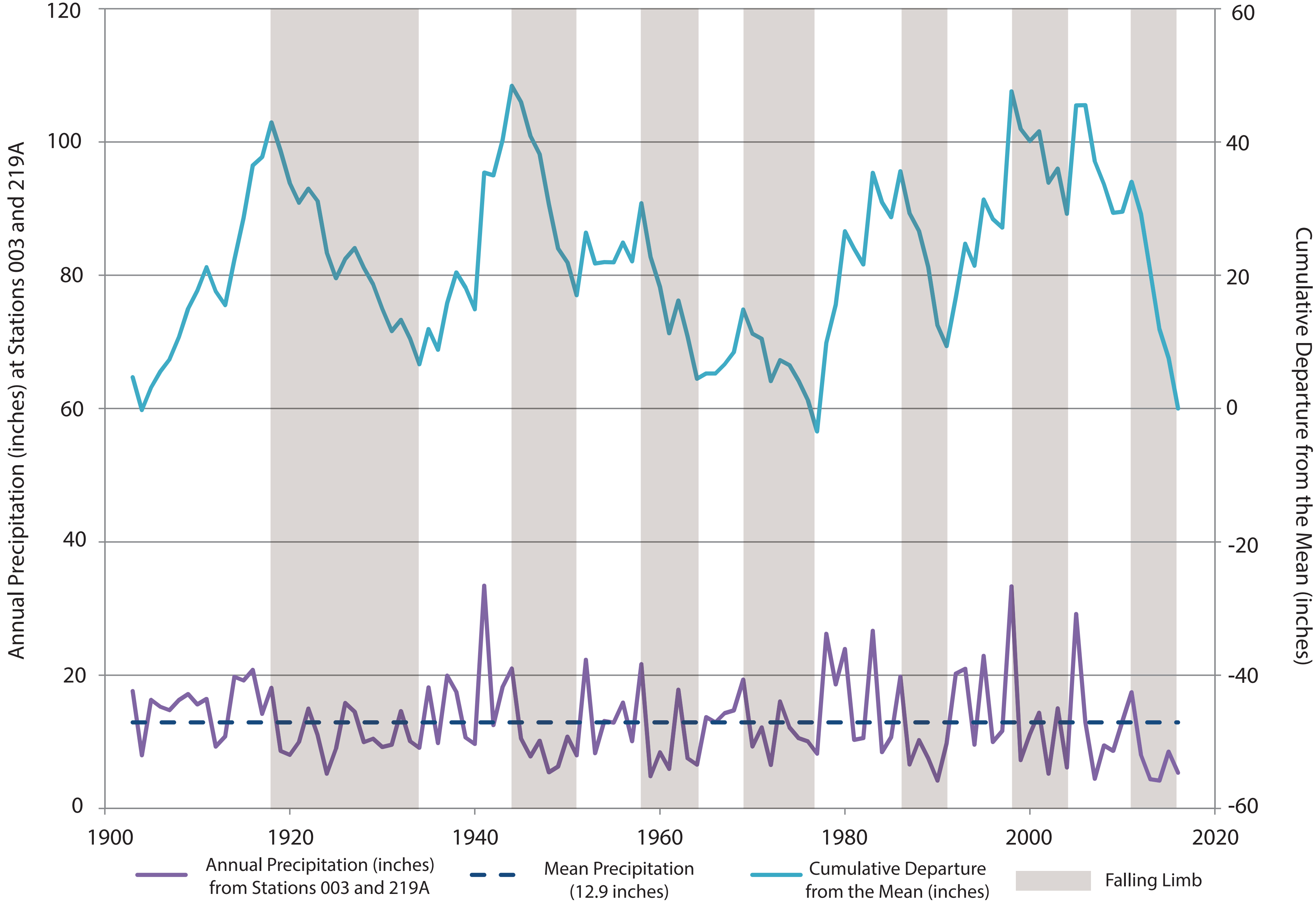

SOURCE: Ventura County Watershed Protection District

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FIGURE 1-6

Long-Term Precipitation Trends in Pleasant Valley

Groundwater Sustainability Plan for the Pleasant Valley Basin

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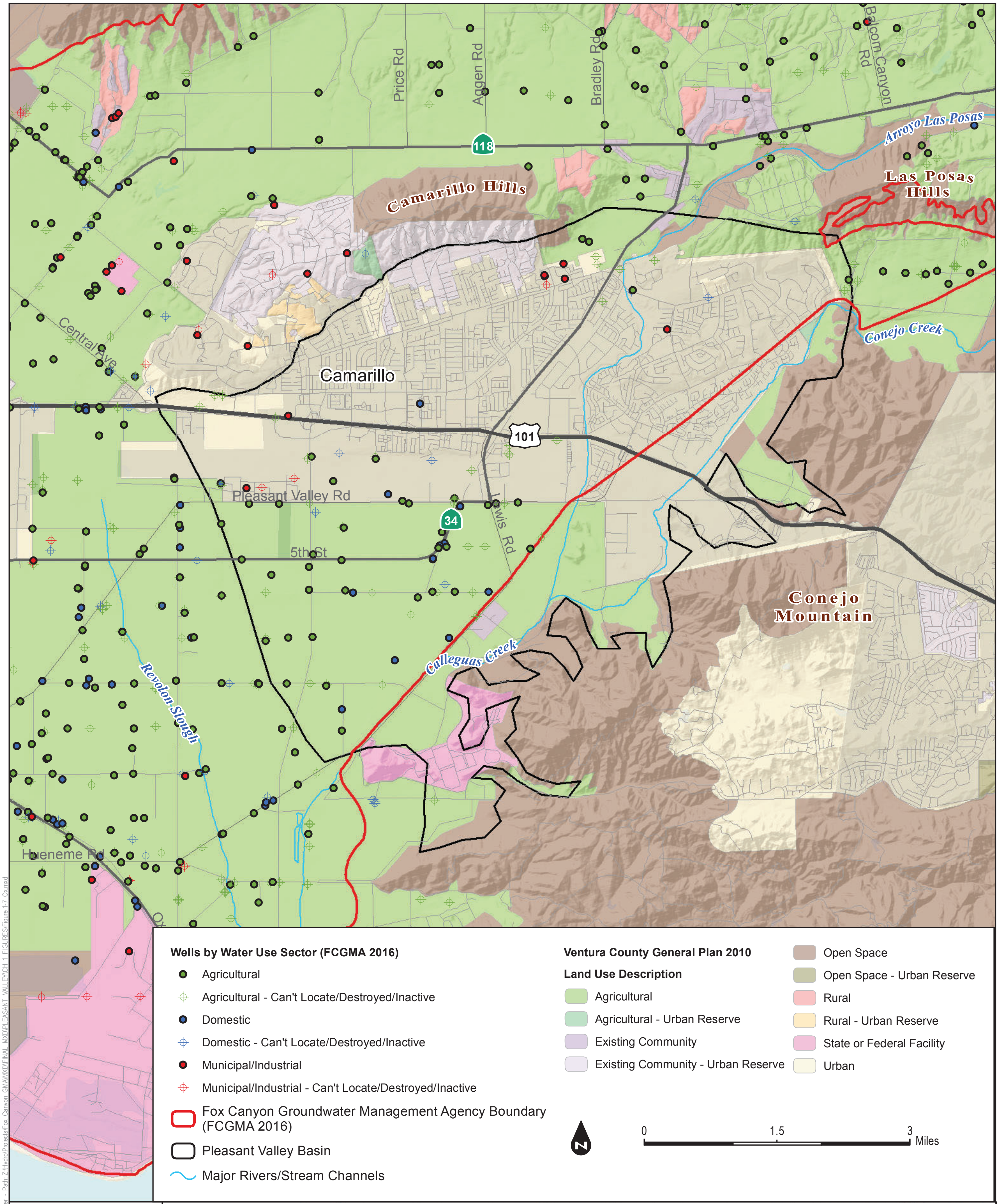

SOURCE: DWR; Ventura County; FCGMA

FIGURE 1-7

Land And Water Use

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Groundwater Sustainability Plan for the Pleasant Valley Basin

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CALLEGUAS WHOLESALE DISTRICT

SUPPLIER	WATER COMPANY
Calleguas (CAL-001)	ACADEMY MWC
Calleguas (CAL-002)	ARROYO LAS POSAS MWC
Calleguas (CAL-003)	BALCOLM BIXBY MWA
Calleguas (CAL-004)	BERYLWOOD HEIGHTS MWC
Calleguas (CAL-005)	BRANDEIS-BARDIN MWC
Calleguas (CAL-006)	CONEJO TRAILER PARK
Calleguas (CAL-007)	CALIFORNIA WATER SERVICE COMPANY
Calleguas (CAL-008)	CALIFORNIA AMERICAN WATER COMPANY
Calleguas (CAL-009)	CALLEGUAS MWD
Calleguas (CAL-011)	CAMROSA WATER DISTRICT
Calleguas (CAL-012)	CITY OF CAMARILLO
Calleguas (CAL-013)	CITY OF OXNARD
Calleguas (CAL-014)	CITY OF THOUSAND OAKS
Calleguas (CAL-015)	CRESTVIEW MWC
Calleguas (CAL-016)	DEL NORTE MWC
Calleguas (CAL-017)	EPWORTH MWC
Calleguas (CAL-019)	FOXFIELD RIDING CLUB
Calleguas (CAL-020)	FULLER FALLS MWC
Calleguas (CAL-022)	SUNSHINE RANCH
Calleguas (CAL-023)	LA LOMA RANCH MWC
Calleguas (CAL-024)	LAKE SHERWOOD CSD
Calleguas (CAL-025)	LAS LOMAS WATER SYSTEM
Calleguas (CAL-026)	MESA WATER COMPANY
Calleguas (CAL-027)	OAK PARK WATER SERVICE
Calleguas (CAL-028)	OXNARD UNION HIGH SCHOOL DISTRICT
Calleguas (CAL-029)	PLEASANT VALLEY MWC
Calleguas (CAL-030)	RANCHO CANADA WATER COMPANY
Calleguas (CAL-031)	TOM GRETHER FARMS, Inc
Calleguas (CAL-035)	GOLDEN STATE WATER CO - Simi Valley
Calleguas (CAL-036)	THERMIC MWC
Calleguas (CAL-038)	VENTURA COUNTY WATERWORKS DISTRICT NO. 1
Calleguas (CAL-039)	VENTURA COUNTY WATERWORKS DISTRICT NO. 8
Calleguas (CAL-040)	VENTURA COUNTY WATERWORKS DISTRICT NO 17
Calleguas (CAL-041)	VENTURA COUNTY WATERWORKS DISTRICT NO 19
Calleguas (CAL-042)	WATERS ROAD USERS GROUP
Calleguas (CAL-044)	ZONE MWC
Calleguas (CAL-179)	BUTLER RANCH MWC
Calleguas (CAL-190)	BALCOM CANYON WATER WELL
Calleguas (CAL-195)	EL CAMPEON RANCH
Calleguas(CAL-196)	COMMANCIA RANCH

CASITAS WHOLESALE DISTRICT

SUPPLIER	WATER COMPANY
Casitas (CAS-046)	CASITAS MWD
Casitas (CAS-047)	CASITAS MWC
Casitas (CAS-048)	CITY OF SAN BUENAVENTURA
Casitas (CAS-049)	DENNISON PARK WATER SYSTEM
Casitas (CAS-051)	GRIDLEY ROAD WATER GROUP*
Casitas (CAS-052)	HERMITAGE MWC
Casitas (CAS-053)	KROTONA INSTITUTE OF THEOSOPHY
Casitas (CAS-054)	MEINERS OAKS CWD
Casitas (CAS-056)	NORTH FORK SPRINGS MWC
Casitas (CAS-057)	OJALA
Casitas (CAS-058)	OLD CREEK ROAD MWC
Casitas (CAS-059)	OVIATT WATER ASSOCIATION
Casitas (CAS-060)	RANCHO del CIELO MWC
Casitas (CAS-061)	RANCHO MATILIJA MWC
Casitas (CAS-062)	RINCON WATER AND ROADWORKS
Casitas (CAS-063)	OJAI WATER CONSERVATION DISTRICT
Casitas (CAS-064)	SENIOR CANYON MWC
Casitas (CAS-065)	SHERIFF'S HONOR FARM
Casitas (CAS-066)	SIETE ROBLES MWC
Casitas (CAS-067)	SISAR MWC
Casitas (CAS-068)	GOLDEN STATE WATER CO - Ojai
Casitas (CAS-069)	SULPHUR MOUNTAIN ROAD WATER ASSOCIATION
Casitas (CAS-070)	TICO MWC
Casitas (CAS-071)	TRES CONDADOS
Casitas (CAS-072)	VENTURA RIVER COUNTY WATER DISTRICT
Casitas (CAS-073)	VILLANOVA ROAD WATER WELL ASSOCIATION

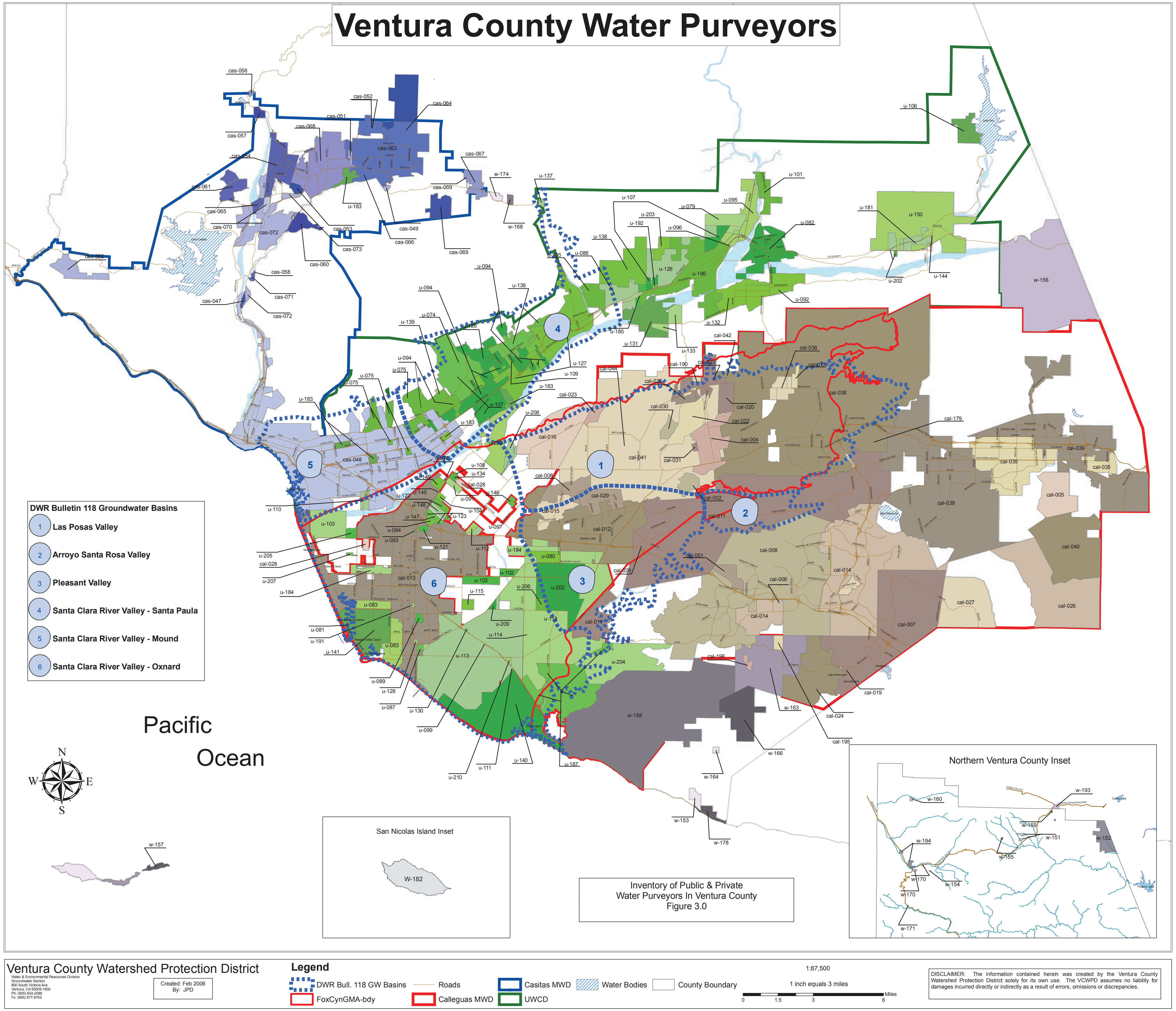
UNITED WHOLESALE DISTRICT

SUPPLIER	WATER COMPANY
United (U-074)	ALISO MWC
United (U-075)	ALTA MWC
United (U-076)	BEEDY STREET WELL
United (U-079)	BROWNSTONE MWC
United (U-080)	CAMARILLO AIRPORT UTILITY ENTERPRISE
United (U-081)	CHANNEL ISLANDS BEACH COMMUNITY SERVICES DISTRICT
United (U-082)	CITY OF FILLMORE
United (U-083)	CITY OF PORT HUENEME
United (U-084)	CLOVERDALE MWC
United (U-086)	COMMUNITY MWC
United (U-087)	CYPRESS MWC
United (U-088)	SUNSHINE TRAILER PARK
United (U-089)	DEMPSEY ROAD MWC
United (U-091)	SEACOAST COOLING
United (U-092)	ELKINS RANCH COMPANY
United (U-093)	EVERGREEN TRAILER PARK
United (U-094)	FARMER'S IRRIGATION COMPANY
United (U-095)	FILLMORE IRRIGATION COMPANY
United (U-096)	FILLMORE WEST MOBILE HOME PARK
United (U-097)	GARDEN ACRES MWC
United (U-099)	GLENNVIEW MOBILE HOME PARK
United (U-101)	GOODENOUGH MWC
United (U-102)	HAILWOOD, INC
United (U-103)	CB SOUTH
United (U-104)	POINSETTIA STOCK FARM
United (U-106)	LAKE PIRU RECREATION AREA
United (U-107)	LIMONEIRA ASSOCIATES
United (U-108)	LINDA VISTA JUNIOR ACADEMY
United (U-109)	MIDDLE ROAD MWC
United (U-110)	MONTALVO MWC
United (U-111)	NAVALAIR MOBILEHOME COURT
United (U-112)	NYELAND ACRES MWC
United (U-113)	OCEAN VIEW MWC
United (U-114)	OCEAN VIEW SCHOOL DISTRICT (LAGUNA VISTA SCHOOL)
United (U-115)	OXNARD LEMON MWC
United (U-118)	PLEASANT VALLEY CWD
United (U-121)	RIO MANOR MWC
United (U-122)	RIO PLAZA WATER COMPANY
United (U-123)	RIO REAL/RIO DEL VALLE SCHOOLS
United (U-126)	SAN CAYETANO MWC
United (U-127)	CITY OF SANTA PAULA
United (U-128)	SAVIERS ROAD MWC
United (U-130)	SILVER WHEEL RANCH MOBILE HOME PARK
United (U-131)	SOUTH MOUNTAIN MWC
United (U-132)	SOUTHSIDE IMPROVEMENT CO
United (U-133)	STORKE MWC
United (U-134)	STRICKLAND MWC
United (U-135)	TEAGUE-McKEVETT CO- LIMONEIRA
United (U-136)	THERMAL BELT MWC
United (U-137)	THOMAS AQUINAS COLLEGE
United (U-138)	TIMBER CANYON MWC
United (U-139)	TOBOCK RANCH MWC
United (U-140)	U.S.N.A.S. - Point Mugu
United (U-141)	U.S.N.C.B.C. - Port Hueneme
United (U-142)	UNITED WCD
United (U-144)	VENTURA COUNTY WATERWORKS DISTRICT NO 16
United (U-145)	G.P. RESOURCES
United (U-146)	VENTURA SCHOOL
United (U-147)	VINEYARD AVENUE ACRES MWC
United (U-148)	THE MUTUAL WATER COMPANY OF VINEYARD AVENUE ESTATES
United (U-149)	VINEYARD MWC
United (U-150)	WARRING WATER SERVICE
United (U-181)	PIRU MWC
United (U-183)	VENTURA COUNTY PROPERTY ADMINISTRATOR
United (U-184)	VENTURA COUNTY DEPT. of AIRPORTS
United (U-185)	HARDSCRABBLE MWC
United (U-186)	SESPE AGRICULTURAL WATER
United (U-187)	GUADALASCA MWC
United (U-191)	SANTA CLARA HIGH SCHOOL
United (U-192)	CITRUS MWC
United (U-200)	LLOYD-BUTLER MWC
United (U-201)	OXNARD MWC
United (U-202)	RANCHO SESPE WORKERS IMPROVEMENT ASSOCIATION
United (U-203)	TOLAND ROAD WATER SYSTEM
United (U-204)	THORNHILL MWC
United (U-205)	SANTA CLARA RESOURCES
United (U-206)	HOUWELING'S NURSERY
United (U-207)	PYRAMID FLOWERS
United (U-208)	SATICOY COUNTRY CLUB
United (U-209)	VUJOVICH RANCH
United (U-210)	BOUQUET MULTIMEDIA

SUPPLIERS WITHOUT WHOLESALE DISTRICT

SUPPLIER	WATER COMPANY
None (W-152)	ANTELOPE VALLEY - EAST KERN WATER AGENCY
None (W-153)	WILSHIRE BLVD. TEMPLE CAMPS & CONFERENCE CENTER
None (W-154)	CAMP SCHEIDECK LODGE
None (W-155)	CAMP THREE FALLS - BSA
None (W-156)	CASTAIC LAKE WATER AGENCY
None (W-157)	CHANNEL ISLANDS NATIONAL MONUMENT
None (W-158)	CHUCHUPATE CAMPGROUND
None (W-159)	CHUCHUPATE RANGER STATION
None (W-160)	COMPTON HUNTING and FISHING CLUB
None (W-163)	HIDDEN VALLEY MWD
None (W-164)	LAZY J RANCH
None (W-166)	CIRCLE X RANCH
None (W-168)	NEW CAMP BARTLETT
None (W-170)	OZENA RANGER STATION
None (W-171)	PINE MOUNTAIN INN
None (W-174)	SWEETWATER SPRING RANCH
None (W-178)	YERBA BUENA WATER COMPANY
None (W-182)	U.S. NAVY - San Nicolas Island
None (W-188)	POINT MUGU STATE PARK
None (W-193)	LAKE OF THE WOODS MWC
None (W-194)	OZENA VALLEY SPORTSMANS CLUB

Plate 1



SOURCE: Ventura County Watershed Protection District;
FCGMA , UWCD, and CMWD. 2007. "2007 Update to the Groundwater Management Agency Groundwater Management Plan." May 2007. Plate 1.

FIGURE 1-8

Ventura County Water Purveyors

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CHAPTER 2
BASIN SETTING

2.1 INTRODUCTION TO BASIN SETTING

Physical Setting and Characteristics

The Pleasant Valley Basin (PVB) is located near the western edge of the Transverse Ranges Geomorphic Province, which extends from the San Bernardino Mountains in the east to the San Miguel, Santa Rosa, and Santa Cruz Islands in the west (Figure 2-1, Pleasant Valley Basin Vicinity Map) (CGS 2002). The Transverse Ranges Geomorphic Province is characterized by a series of east- to west-trending mountain ranges and valleys that are formed by north–south compression across a restraining bend in the San Andreas Fault (Bohannon and Howell 1982; DeVecchio et al. 2012a; Eberhart-Phillips et al. 1990; Hadley and Kanamori 1977; Nicholson et al. 1994; Zoback et al. 1987). Compression across this restraining bend is responsible for rapid, ongoing uplift of the mountain ranges (Feigl et al. 1993; Marshall et al. 2008; Yeats 1988) and extensive folding and faulting of the Pleistocene and older geologic formations in the province (Huftile and Yeats 1995; Rockwell et al. 1988).

The PVB, which underlies the east- to northeast-trending Pleasant Valley in southern Ventura County, is bounded by the Camarillo and Las Posas Hills on the north, the Santa Monica Mountains on the south, the Arroyo Santa Rosa Valley Basin (ASRVB) on the east, and the Oxnard Subbasin (Subbasin) of the Santa Clara River Valley Groundwater Basin on the west (DWR 2003; SWRCB 1956). In general, the PVB is a broad synclinal structure with an east- to west-trending axis that bisects the PVB. The PVB is distinguished from the Oxnard Subbasin by a facies change from generally coarser sediments that host the Oxnard and Mugu Aquifers in the Oxnard Subbasin to generally to finer-grained sediments deposited by Arroyo Las Posas and Calleguas Creek in the PVB (Turner 1975). The Camarillo and Las Posas Hills are part of the Camarillo fold belt, which consists of several active anticlinal folds and faults, including the Camarillo anticline, the Simi–Santa Rosa fault system, and the Springville fault system in Pleasant Valley (DeVecchio et al. 2012a).

The shallowest aquifer in the southern portion of the PVB is a semi-perched aquifer comprising sands and gravels. This unit is underlain by a clay layer, commonly referred to as the “clay cap,” that is nearly continuous throughout much of the Oxnard Subbasin and much of the PVB.

The primary water-bearing formations in the PVB are the San Pedro Formation and the overlying alluvium. The San Pedro Formation is a lower to middle Pleistocene shallow marine deposit that grades upward from a white or gray sand and gravel basal layer into an overlying series of interbedded silts, clays, and gravels (Jakes 1979; SWRCB 1956; Turner 1975; Weber and Kiessling 1976). The lower San Pedro Formation hosts the Fox Canyon Aquifer (FCA) and the Grimes Canyon Aquifer (GCA), the primary aquifers from which the majority of the water in the PVB is produced.

The majority of the PVB lies within the jurisdiction of the Fox Canyon Groundwater Management Agency (FCGMA), although approximately 8.5 square miles, or roughly 25%, of the area of the PVB lies to the southeast of the FCGMA boundary (Figure 2-1). The reason for the discrepancy is that the FCGMA boundary was established by the Fox Canyon Groundwater Management Agency Act in 1982 as the vertical projection of the FCA, whereas the PVB boundary is based on the surface extent of alluvium in Pleasant Valley, and the location of geologic structures and facies changes that impede flow between the PVB and neighboring groundwater basins in the younger sedimentary units (DWR 2003). The trace of the Bailey Fault defines the southern FCGMA boundary in the PVB because the FCA is largely absent in the subsurface to the south and east of this fault. The alluvium, however, extends south and east of the Bailey Fault to the foothills of the Santa Monica Mountains. The geologic and hydrologic descriptions of the PVB in this Groundwater Sustainability Plan (GSP) are based on the boundaries of the PVB, including the area southeast of the Bailey Fault, outside the FCGMA jurisdictional boundary.

2.2 HYDROGEOLOGIC CONCEPTUAL MODEL

The California Department of Water Resources (DWR) defines two water-bearing formations in the PVB: alluvium and the San Pedro Formation (DWR 2003). The medial and basal units of the San Pedro Formation are the FCA and GCA, respectively, which are the primary water-producing units in the PVB (Bachman 2016). Local investigators have identified the underlying Santa Barbara Formation, the upper member of which includes the GCA, and the Shallow Alluvial Aquifer, which comprises alluvial sediments deposited by Arroyo Las Posas, Conejo Creek, and Calleguas Creek as additional water-bearing formations in the PVB (Table 2-1; Bachman 2016). In order to remain consistent with both DWR nomenclature and the work of local investigators (Turner and Mukae 1975; Hanson et al. 2003; Bachman 2016), this GSP includes five hydrostratigraphic units: the Shallow Alluvial Aquifer, older alluvium, the Upper San Pedro Formation, the FCA, and the GCA (Table 2-1).

The majority of the PVB aquifers are confined, and historically it was assumed that little recharge reached the FCA from the north (FCGMA 2007). However, in the vicinity of the Somis Gap in the northern PVB, the Shallow Alluvial Aquifer rests directly on the folded, faulted, and eroded surface of the FCA. Water that recharges the Shallow Alluvial Aquifer via flow in Arroyo Las Posas is able to migrate to the FCA in this area, as demonstrated by rising water levels and rising salinity concentrations measured in two City of Camarillo wells in the northeast PVB (FCGMA 2007; Bachman 2016). However, migration of recharge to the FCA and GCA from Arroyo Las Posas to other parts of the PVB may be limited by extensive faulting and folding in the PVB (Bachman 2016).

Both the stratigraphic units and geologic structures present in the PVB affect the hydrology of the basin. These features are discussed in more detail in Section 2.2.1, Geology.

2.2.1 Geology

The nomenclature of the lower Pleistocene and younger stratigraphic units exposed in outcrop and drilled in the subsurface within the PVB has evolved through time since the first regional-scale mapping was conducted by Kew in 1924 (Table 2-1) (Kew 1924; Jakes 1979; DeVecchio et al. 2012b). Kew (1924) identified the lower Pleistocene stratigraphic unit, which marks the base of the freshwater aquifer in the PVB, as the Saugus Formation. Subsequent investigators identified this unit as either the Las Posas Sand (Pressler 1929, as cited in DeVecchio et al. 2012a; Dibblee 1992a, 1992b; DeVecchio et al. 2012b) or the Santa Barbara Formation (Mukae and Turner 1975). To remain consistent with local investigators (Hanson et al. 2003; Bachman 2016), this GSP refers to the lowermost Pleistocene lithologic unit as the Santa Barbara Formation.

Similarly, the lithologic unit overlying the Santa Barbara Formation is referred to as the San Pedro Formation in this GSP in order to remain consistent with DWR nomenclature. The San Pedro Formation has been referred to in the reviewed literature as both the Las Posas Sand (Pressler 1929, as cited in DeVecchio et al. 2012a; Dibblee 1992a, 1992b; DeVecchio 2012b) and the Saugus Formation (Kew 1924; Jakes 1979). The Saugus Formation is primarily a terrestrial fluvial deposit, whereas the San Pedro Formation is primarily a marine deposit. The older alluvial deposits that overlie the Saugus Formation correspond to the terrace deposits identified by Kew (1924) and are distinguished from the younger, active alluvial deposits by evidence of deformation from ongoing tectonic compression in the region.

The youngest unit, exposed at the surface throughout much of the PVB, is an active alluvial unit that lacks evidence for structural deformation and is called either “recent alluvium” (Kew 1924; Weber and Kiessling 1976; Jakes 1979) or “alluvium” (DeVecchio et al. 2012b). This unit is referred to as recent alluvium in this GSP in order to distinguish it from the underlying, deformed older alluvium.

Tertiary Sedimentary and Igneous Formations

Tertiary sedimentary and igneous rocks that underlie the PVB are generally considered semi-permeable or non-water-bearing (DeVecchio 2012b; Turner 1975). These tertiary formations include the Oligocene/Eocene age Sespe Formation, the lower Miocene Conejo Volcanics, the upper Miocene Modelo and Monterey Formations, and the Pliocene Pico Formation (DeVecchio 2012b; Dibblee 1992a, 1992b; Jakes 1979; Weber and Kiessling 1976). These formations have been sampled in deep wells drilled in the PVB (Weber and Kiessling 1976). These formations are not considered an important source of groundwater in the PVB (Turner 1975).

Quaternary Sedimentary Formations

Santa Barbara Formation (Lower Pleistocene; Marine)

The Santa Barbara Formation typically comprises laminated, poorly indurated blue-gray marine mud and siltstone with sand and gravel (Turner and Mukae 1975). Clay-rich sediments in the Santa Barbara Formation can act as an aquitard between the Santa Barbara Formation and the overlying San Pedro Formation (Weber and Kiessling 1976). The localized basal conglomerate within the upper member of the Santa Barbara Formation hosts the GCA (Weber and Kiessling 1976).

San Pedro Formation (Lower to Middle Pleistocene; Marine and Nonmarine)

The San Pedro Formation is an interbedded, poorly lithified, fine-grained marine, silty sandstone, shale, and mudstone with local pebble conglomerate and an extensive basal consolidated sand unit that thickens to the west (DeVecchio et al. 2012b; Weber and Kiessling 1976). In the PVB, the San Pedro Formation unconformably overlies the Santa Barbara Formation. The pebbles of the San Pedro Formation are plutonic, metamorphic, and metavolcanic clasts. Exposures of the San Pedro Formation are typically poorly consolidated and poorly cemented (Weber and Kiessling 1976).

The lower part of the San Pedro Formation is separated from the upper part of the San Pedro Formation by a regionally extensive clay marker bed (Turner 1975). Below this marker bed, the basal unit of the San Pedro Formation comprises 100- to 600-foot-thick continuous white or gray marine sand and gravel with local silt and clay lenses (Turner 1975).[1] The lower part of the San Pedro Formation hosts the FCA, which is the most important source of groundwater supply in the PVB (Bachman 2016; Turner 1975).

The upper part of the San Pedro Formation in the PVB, corresponds to the Saugus Formation of other investigators (Table 2-1). In the PVB, this unit is characterized by poorly consolidated fluvial deposits of pebbly, coarse sandstone and conglomerate deposited in a nonmarine environment (Weber and Kiessling 1976). Conglomerate clasts are predominantly composed of Miocene Monterey shale and Conejo Volcanics (DeVecchio et al. 2012b). In some locations, the coarse-grained upper fluvial deposits grade downward into a fine-grained estuarine sandstone and siltstone (Weber and Kiessling 1976).

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[1] This marine sand has been identified as both the Saugus Formation (Kew 1924; Jakes 1979) and the Las Posas Sand (DeVecchio et al. 2012b; Dibblee 1992a, 1992b; Pressler 1929, as cited in DeVecchio et al. 2012a). The term San Pedro Formation is used here for consistency with DWR (2003) nomenclature.

Older Alluvium (Upper Pleistocene; Terrestrial)

Unconformably overlying the Saugus Formation is the older alluvium, which comprises gravel, sand, silt, and clay. The older alluvium was deposited in river, floodplain, beach, and terrace environments. The older alluvium has been incised and gently folded (DeVecchio et al. 2012b). Coarse-grained horizons in the older alluvium are a source of groundwater in shallower wells in the PVB.

Recent Alluvium (Holocene; Terrestrial)

The recent alluvium comprises surficial deposits of loose sand, silt, clay, and gravel (Weber and Kiessling 1976). The recent alluvium includes colluvium and slopewash, stream channel, valley fill and floodplain, and alluvial fan deposits. These deposits are distinguished from the older alluvium by the lack of soil horizon development and lack of folding. In some areas, this unit serves as a conduit for surface water recharge in the PVB.

Geologic Structure

Boundary Faults

Springville Fault Zone

The Springville Fault Zone, which is part of the Simi–Santa Rosa Fault zone, trends east-northeast along the southern base of the Camarillo Hills. The Springville Fault Zone is divided into two structural domains that together form the boundary between the PVB to the south and the Las Posas Valley Basin (LPVB) to the north (Figure 2-2, Geology of the Pleasant Valley Basin) (DeVecchio et al. 2012a). The southern Springville Domain extends from the western end of the Camarillo Hills to the inferred Spanish Hills Fault between the Camarillo Hills anticline and the Springville anticline (Figure 2-2) (DeVecchio et al. 2012a). The northern Springville Domain extends from the Spanish Hills Fault to the Somis Fault in the vicinity of the Somis Gap. The Spanish Hills Fault offsets the northern section of the Springville Fault to the north of the southern section of the Springville Fault (Figure 2-2) (DeVecchio et al. 2012a).

In both structural domains, the Springville Fault is a high-angle reverse fault with up-to-the-north displacement that juxtaposes the Upper San Pedro Formation on the north side of the fault and older alluvium on the southern side of the fault (Figure 2-3, Cross Section A–A′, and Figure 2-4, Cross Section B–B′) (DeVecchio et al. 2012a). In the southern Springville Domain, deformation in the hanging wall has resulted in the formation of the Springville anticline. In the northern Springville Domain, deformation in the hanging wall has resulted in the formation of the Camarillo Hills anticline. These structures may restrict groundwater flow between the PVB and the LPVB to the north (DWR 2003).

Simi–Santa Rosa Fault Zone

The Simi–Santa Rosa Fault Zone trends east-northeast along the southern base of the Las Posas Hills (Figure 2-2). This fault is a high-angle reverse fault that dips to the north. Deformation in the hanging wall of the fault is related to the uplift of the Las Posas Hills (DeVecchio et al. 2012a). Displacement on the fault juxtaposes outcrops of the Saugus Formation in the Las Posas Hills and active alluvial fan deposits to the south in the PVB. The Simi–Santa Rosa Fault Zone restricts groundwater flow between the PVB and the LPVB to the north.

Internal Faults

Camarillo Fault

The east-trending Camarillo Fault is located south of downtown Camarillo on the south side of a low, narrow ridge that generally trends east-to-west (Figure 2-2). The low, narrow ridge comprises older alluvium uplifted as a pressure ridge on the north side of the steeply dipping reverse fault (Jakes 1979; Turner 1975). The fault dies out to the west of the pressure ridge where the fault transitions to an anticline in the subsurface (Jakes 1979). There is up to 150 feet of displacement of the San Pedro Formation across the fault, and the fault restricts groundwater movement (Turner 1975).

Bailey Fault

The Bailey Fault trends northeast along the southern edge of the PVB near the Santa Monica Mountains (Figure 2-2) (Jakes 1979). The fault is a near-vertical fault with up to 600 feet of displacement that juxtaposes the San Pedro and Santa Barbara Formations to the northwest of the fault with older non-water-bearing volcanic rocks to the southeast of the fault (Turner 1975). As a result of the subsurface displacement, the Bailey Fault acts as a barrier to groundwater flow (Jakes 1979).

Folds

The PVB is located within the Camarillo fold belt, an area characterized by anticlinal and synclinal folds (DeVecchio et al. 2012a). Within the PVB, the Camarillo fold is an east- to west-trending anticline in the hanging wall of the Camarillo Fault (Figure 2-2) (DeVecchio 2012a; Jakes 1979). This fold uplifts the older alluvium and tilts the older alluvium surface to the north (Jakes 1979). To the north of Camarillo, extensive folding and faulting has caused upwarping of the San Pedro and Santa Barbara Formations in the vicinity of Arroyo Las Posas. The folding of the San Pedro and Santa Barbara Formations in the vicinity of Arroyo Las Posas allows for recharge to these largely confined aquifers from flows in the arroyo (Bachman 2016; CMWD 2008).

2.2.2 Boundaries

The northern boundary of the PVB is defined by the Springville and Simi–Santa Rosa Fault Zones. These faults are associated with uplift of the Camarillo and Las Posas Hills and are thought to restrict groundwater flow between the PVB and the LPVB to the north (DWR 2003; SWRCB 1956).

The western boundary of the PVB is associated with the change in character of the recent and older alluvium between the PVB to the east and the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin to the west (Turner 1975). To the east of the boundary, in the PVB, the recent and older alluvial sediments are more lenticular and finer grained, making them less suitable for groundwater production, although there is still production from these sediments. To the west of the boundary, in the Oxnard Subbasin, the age-equivalent sediments compose the Oxnard and Mugu Aquifers. A similar change is found from west to east in the Upper San Pedro Formation. In the Oxnard Subbasin, the Hueneme Aquifer is found within the Upper San Pedro Formation, but a similar aquifer is not found to the east of the boundary in the PVB. There is no change in the characteristics of the underlying FCA or the GCA across this boundary. The PVB and the Oxnard Subbasin are in hydraulic communication. The boundary between the PVB and the Oxnard Subbasin is based on a change in sediment character, rather than faulting or folding that impedes subsurface flow.

The southern boundary of the PVB is delineated by the contact between the alluvial deposits and surface exposures of bedrock in the Santa Monica Mountains (DWR 2003). The eastern boundary of the PVB is formed by a constriction in Arroyo Santa Rosa (DWR 2003; SWRCB 1956).

2.2.3 Basin Bottom

The bottom of the PVB is defined by either the contact between the Santa Barbara Formation and the underlying Pliocene and older formations or, where the Santa Barbara Formation is absent, the contact between the San Pedro Formation and the underlying Pliocene and older formations. The contact between the Pliocene and older formations and the overlying Pleistocene and younger formations coincides with the base of the freshwater aquifer (Turner 1975). To the west of the Bailey Fault, the base of the freshwater aquifer occurs at the base of the Santa Barbara Formation. East of the Bailey Fault, however, the base of the freshwater aquifer coincides with the base of the alluvium.

In general, the depth to the bottom of the PVB increases from east to west. At the eastern end of the PVB, adjacent to the ASRVB, the PVB is less than 800 feet thick, and the base of the PVB is approximately 400 feet below mean sea level (−400 msl; Turner 1975). To the west, the thickness of the PVB can exceed 1,200 feet, and the base of the PVB is approximately −1,200 feet msl (Turner 1975). Perpendicular to the extensive east- to northeast-trending faulting in the PVB, the depth of the basin is highly variable.

2.2.4 Principal Aquifers and Aquitards

Semi-Perched Aquifer

River-deposited sands and gravels interbedded with minor silt and clay compose the semi-perched aquifer in the Oxnard Subbasin and much of the PVB (DWR 1965; Turner 1975). The term *semi-perched aquifer* is used in this GSP as the name for the uppermost unit of the older alluvium, which overlies the extensive clay cap in much of the PVB. This name was used in the State Water Resources Control Board's Bulletin 12 (SWRCB 1956) to distinguish the water-bearing sedimentary units in the Oxnard Subbasin from those in the Oxnard Forebay area, and this terminology has been adopted by subsequent investigators (Mukae and Turner 1975; Turner 1975; Hanson et al. 2003; DWR 2006). Water-level data indicate that the sediments underlying the semi-perched aquifer are potentially saturated. Therefore, the term *semi-perched aquifer* is used in this GSP to denote the limited migration of water from the uppermost aquifer to the underlying aquifers in the PVB. It is not used to denote a discontinuity in saturation. Furthermore, there is limited groundwater production (<50 acre-feet per year (AFY)) from this unit. Therefore, although this unit is referred to as the *semi-perched aquifer*, it is not considered to be a principal aquifer in the PVB.

This aquifer extends from the base of developed soil horizons to a depth of approximately 75 feet below ground surface (bgs) throughout most of the Oxnard Subbasin and part of the PVB (Turner 1975).

Agricultural return flows affect both groundwater quality and groundwater elevation in the semi-perched aquifer (Mukae and Turner 1975). The highest water levels in the aquifer, which are typically within a few feet of land surface, are found in heavily irrigated areas (Turner 1975). Tile drains are used throughout the Oxnard Subbasin and in part of the PVB to alleviate the high groundwater conditions. Agricultural return flows that cause the high water conditions have resulted in high concentrations of total dissolved solids (TDS) and chloride in the semi-perched aquifer (Turner 1975). Few production wells are screened solely in the semi-perched aquifer. Water quality is highly variable in the semi-perched aquifer (UWCD 1999).

Clay Cap

Underlying the semi-perched aquifer is a clay layer that separates the semi-perched aquifer from the alluvium below. The thickness of the clay cap is approximately 160 feet adjacent to the Pacific Ocean, and thins to nonexistent in the PVB. Although the clay cap functions as an aquitard, water can migrate vertically through the clay cap under conditions of differential head (Turner 1975), and in some cases, through casings of wells that have been improperly abandoned.

Shallow Alluvial Aquifer

The alluvial deposits that compose the Shallow Alluvial Aquifer include loose sand and gravel adjacent to Arroyo Las Posas in the northern PVB, Conejo Creek in southeastern PVB, and Calleguas Creek in southwestern PVB (Bachman 2016; Jakes 1979; SWRCB 1956; Weber and Kiessling 1976). This aquifer coincides with the Holocene-age recent alluvium lithologic unit defined in Section 2.2.1. The maximum thickness of this unit in the PVB is approximately 200 feet adjacent to Arroyo Las Posas (Bachman 2016).

The Shallow Alluvial Aquifer is unconfined (Bachman 2016). Recharge to the Shallow Alluvial Aquifer is typically from native and non-native flows within Arroyo Las Posas, including urban runoff of applied water into upstream branches of Conejo Creek (Bachman 2016; CMWD 2008). The non-native flows also consist of discharges from the Simi Valley Water Quality Control Plant, dewatering wells operated by the City of Simi Valley, and discharges from the Moorpark Wastewater Treatment Plant (MWTP) percolation ponds adjacent to Arroyo Simi–Las Posas in the LPVB (Bachman 2016; CMWD 2008). Recharge from these non-native flows in Arroyo Simi–Las Posas has resulted in degraded water quality in the Shallow Alluvial Aquifer. Groundwater adjacent to Arroyo Las Posas in northern PVB is characterized by concentrations of TDS greater than 1,200 milligrams per liter (mg/L), chloride greater than 150 mg/L, and sulfate greater than 600 mg/L (Bachman 2016).

Flows in Conejo Creek and Calleguas Creek in southern PVB also provide recharge to the Shallow Alluvial Aquifer. This recharge is typically from native and non-native flows. The non-native flows consist of discharges from the Hill Canyon Wastewater Treatment Plant (WWTP) and the Camarillo Sanitary District (CSD) Water Reclamation Plant (WRP).

The Shallow Alluvial Aquifer is not a principal aquifer, with only a few wells that produce water, which is likely a result of the poor-quality water. Well yields within the Shallow Alluvial Aquifer range from less than 100 to 1,000 gallons per minute (gpm). The average well yield is approximately 400 gpm (Turner 1975).

Older Alluvium

The older alluvium underlies the Shallow Alluvial Aquifer. It is found primarily in a northeast- to southwest-trending band through the center of the PVB (Figure 2-5, Cross Section C–C′) (Bachman 2016). On both the northern and southern edges of the PVB, upwarping of the underlying sediment and subsequent erosion have removed the older alluvium (Bachman 2016). This unit is age equivalent to the Mugu and Oxnard Aquifers in the Oxnard Subbasin to the west, which compose the Upper Aquifer System (UAS) in that Subbasin, but is highly lenticular with a large quantity of low-permeability sediments (Turner 1975). The low-permeability sediments were deposited by Calleguas Creek, in the PVB, while the age-equivalent sediments of the Mugu and

Oxnard Aquifers were deposited by the Santa Clara River. Water-bearing sediments within the older alluvium are confined throughout the PVB; the older alluvium has a limited hydraulic connection with the Mugu and Oxnard Aquifers across the western boundary of the PVB.

Because of the lenticular nature of the deposits, and the high percentage of fine-grained material, the older alluvium is not considered a primary aquifer in the PVB. However, there are wells that produce water from this unit, and well yields within the unit are variable, ranging from less than 100 gpm to 1,000 gpm (Turner 1975). The average well yield is approximately 400 gpm (Turner 1975). Water quality is generally poor and has been affected by recharge from non-native flows in Calleguas Creek, characterized by elevated concentrations of TDS, chloride, and sulfate (Bachman 2016).

Upper San Pedro Formation

The sediments that compose the Upper San Pedro Formation are primarily interbedded silts, clays, and gravels with minor sand layers (SWRCB 1956; Weber and Kiessling 1976; Turner 1975; Jakes 1979). The thickness of the Upper San Pedro Formation ranges from less than 200 feet along the boundary between the PVB and the ASRVB to more than 600 feet in the western part of the basin (Turner 1975). This unit is not found to the southeast of the Bailey Fault (Turner 1975). In the Oxnard Subbasin to the west, the Upper San Pedro Formation is age equivalent to the Hueneme Aquifer, which is the uppermost aquifer in the Lower Aquifer System (LAS) of that Subbasin.

Throughout the PVB, the Upper San Pedro Formation is confined because lenses of permeable sediments within the Upper San Pedro Formation are laterally discontinuous and not well connected (Turner 1975). As a result, the Upper San Pedro Formation is not considered an aquifer, and few wells are known to pump from the Upper San Pedro Formation. This formation may, however, function as a leaky aquitard providing additional water to the underlying FCA.

Fox Canyon Aquifer

The FCA is the primary aquifer in the PVB. This aquifer occurs at the base of the Upper San Pedro Formation and is laterally continuous within the boundaries of the PVB, except to the southeast of the Bailey Fault, where it has been removed through uplift and erosion. The FCA also extends to the west into the Oxnard Subbasin, where it is part of the LAS. The water produced from the FCA is used for agricultural, domestic, industrial, and municipal purposes.

The sediments that compose the FCA are white or gray sand and gravel with some clay and silt lenses (SWRCB 1956; Turner 1975). These sediments were deposited under shallow marine conditions and have been extensively folded and faulted since deposition (Turner 1975). In general, the PVB is a broad synclinal structure with an east- to west-trending axis that bisects the PVB. Along the axis of the syncline in the western portion of the PVB, the depth to the upper surface of the FCA is approximately 800 feet bgs, and the thickness of the aquifer reaches approximately 600 feet (Turner 1975; Bachman 2016). At the western boundary of the PVB, the FCA is in hydraulic communication with the Oxnard Subbasin to the west. To the northeast, the FCA is folded and faulted by the Simi–Santa Rosa Fault Zone, where uplift and erosion have placed the FCA in direct communication with the overlying Shallow Alluvial Aquifer (Bachman 2016). To the east, near the boundary with the ASRVB, the FCA shallows and thins. In this area, the FCA is approximately 100 feet thick and the upper surface of the FCA is less than 200 feet bgs. On the south side of the PVB, the FCA is faulted by the Bailey Fault Zone (Turner 1975) and abuts the Conejo Volcanics, which are classified as non-water-bearing rocks by DWR and local investigators (Figure 2-2) (Turner 1975; Bachman 2016).

The FCA occurs under confined conditions in the PVB (Turner 1975). The average specific yield of the FCA is 10.5% and the average yield of wells that are at least partially completed in the FCA is 1,000 gpm (Turner 1975; DWR 2003). Aquifer tests were conducted on the City of Camarillo’s production wells A and B, which are located in northern PVB and screened in the FCA (Bachman 2016). The results of these tests indicate the transmissivity of the FCA is 4,000 to 10,300 feet squared per day, the storativity of the FCA is 3.1E-06 to 4.5E-04, and the horizontal hydraulic conductivity of the FCA is 11 to 30 feet per day.

Water quality in the FCA is generally acceptable for most beneficial uses (Turner 1975), although chloride concentrations adjacent to Arroyo Las Posas and in the main part of the PVB exceed 200 mg/L (UWCD 2003; Izbicki et al. 2005a). These concentrations can be problematic for irrigation of several crop types. Additionally, concentrations of TDS exceed 500 mg/L and concentrations of sulfate exceed 250 mg/L in several wells in the FCA (CMWD 2008; Bachman 2016).

Grimes Canyon Aquifer

The GCA is present throughout much of the PVB southwest of the Somis Gap, and northwest of the Bailey Fault (Turner 1975; Bachman 2016). To the southeast of the Bailey Fault, in the eastern part of the PVB, the GCA is absent. This aquifer extends across the western boundary of the PVB into the Oxnard Subbasin, where it is the lowest unit in the LAS in that Subbasin.

In the PVB, the GCA comprises 50 to 500 feet of sand with some gravel and clay within the Santa Barbara Formation (Turner 1975). Similar to the FCA, the GCA has been extensively folded and faulted since deposition (Turner 1975). Faulting and folding of the GCA has resulted in changes to the transmissive properties of the aquifer similar to those described for the FCA. Where present in the PVB, the GCA is in hydraulic communication with the overlying FCA (Turner 1975).

Wells screened in the GCA are typically also screened in the overlying FCA, and groundwater production wells are not solely screened in the GCA. As a result, the yield of the GCA is not well defined (Turner 1975). Depth-discrete flow sampling of wells in the PVB indicates that between

12% and 36% of the flow in wells screened in both the GCA and FCA comes from the GCA, although this percentage varies with groundwater elevation and pumping during drought cycles (CMWD 2008; Izbicki et al. 2005b). Depth-discrete water quality sampling suggests that water in the GCA has higher chloride than that in the overlying FCA, likely as a result of upward vertical migration of brackish water from deeper formations, upwelling of brackish water along fault zones, and release of interstitial water from marine clays (Bachman 2016; CMWD 2008; Izbicki et al. 2005a). Chloride concentrations in the GCA range from 127 to 508 mg/L, with the highest concentrations detected in the deepest intervals (Izbicki et al. 2005b).

2.2.5 Data Gaps and Uncertainty

The primary data gaps in the hydrogeologic conceptual model are as follows:

- Distributed measurements of aquifer properties from wells screened solely in a single aquifer
- Distributed measurements of groundwater quality from wells screened solely in a single aquifer
- Measurements of groundwater quality that distinguish the sources of high TDS concentrations in the FCA and the GCA
- Sufficient water level measurements from wells screened in a single aquifer to delineate the effects of faulting on groundwater flow in northern Pleasant Valley

The data gaps listed above create uncertainty in the understanding of the impacts of water level changes on change in storage in the aquifer. Additional aquifer tests and groundwater quality sampling in the future would help reduce the uncertainty associated with these data gaps. Additional monitoring wells in northern Pleasant Valley would help define the effects of faulting on groundwater elevations.

2.2.6 Maps and Cross Sections

Geologic maps and cross sections are provided in Figures 2-2 through 2-5.

2.3 GROUNDWATER CONDITIONS

2.3.1 Groundwater Elevation Data

Groundwater elevations in the PVB were first measured in agricultural wells in the 1920s. An annual groundwater monitoring program was initiated in the PVB by the County of Ventura (County), the United Water Conservation District (UWCD), and the U.S. Geological Survey in the 1990s (FCGMA 2007). The County's annual groundwater monitoring program includes production wells and multiple-completion nested monitoring wells. Many of the production wells included in the monitoring program are screened across multiple aquifers (Figure 2-6, Upper

Aquifer System 2015 Extraction [acre-feet] in Oxnard and Pleasant Valley, and Figure 2-7, Lower Aquifer System 2015 Extraction [acre-feet] in Oxnard and Pleasant Valley). Historically, the FCGMA annual reports have included potentiometric surface maps for wells screened in the UAS and wells screened in the LAS (FCGMA 2016).

To conform with DWR GSP Regulations, Section 354.14, the following discussion of groundwater elevation is limited to wells screened in a single aquifer. Water level measurements collected between March 2 and March 29, 2015, are used to represent groundwater elevations in the spring of 2015. Water level measurements collected between October 2 and October 29, 2015, are used to represent groundwater elevations in the fall of 2015.

Because many production wells within the PVB are screened across multiple aquifers and there is a limited number of dedicated monitoring wells, the ability to depict representative regional potentiometric surfaces in each aquifer is limited. Groundwater pumping data were mapped to provide context for interpreting the potentiometric surfaces presented in this section (Figures 2-6 and 2-7). Self-reported groundwater extraction data for 2015 are shown in Figures 2-6 and 2-7 for wells screened in the UAS and the LAS, respectively.

The volume of groundwater extracted from the LAS is substantially greater than that extracted from the UAS in the PVB. In 2015, 12,826 acre-feet (AF) was pumped from the LAS and 1,535 AF was pumped from the UAS in the PVB. Groundwater production in the LAS is higher than in the UAS because the aquifers of the UAS are generally absent or much less developed in the PVB compared to the Oxnard Subbasin. In the UAS, extraction occurs to the south of the City of Camarillo (Figure 2-6). The majority of the production from the LAS occurs in the southwestern portion of the basin, near the boundary between the PVB and the Oxnard Subbasin, although some also occurs to the north near the Somis Gap (Figure 2-7).

A pumping depression is evident in the area of highest extraction from the LAS; however, because groundwater elevation measurements are clustered in the northeastern and southwestern areas of the PVB, the impacts of pumping on groundwater elevations in much of central PVB are not entirely clear (see Sections 2.3.1.1 through 2.3.1.4).

Current and historical groundwater elevations are discussed in Sections 2.3.1.1 through 2.3.1.4 by aquifer. Full hydrographs for all Pleasant Valley wells are included in Appendix C, Water Elevation Hydrographs.

2.3.1.1 Shallow Alluvial Aquifer

Spring and Fall 2015 Groundwater Elevations

The Shallow Alluvial Aquifer comprises the recent alluvial deposits that line Arroyo Las Posas, Arroyo Santa Rosa, Conejo Creek, and Calleguas Creek in the PVB. Few wells produce from this aquifer, and no production wells are screened solely within this aquifer. Groundwater elevations were not measured in 2015 for any wells screened solely within the Shallow Alluvial Aquifer in the PVB. Flow in this aquifer is assumed to parallel the creek channels, although monitoring wells would need to be installed to determine the direction and magnitude of flow in the Shallow Alluvial Aquifer.

Vertical Gradient

There are no multiple-completion nested monitoring wells screened in the Shallow Alluvial Aquifer, so vertical gradients cannot be calculated for this aquifer. However, groundwater elevations in this aquifer are below the bottom of Arroyo Las Posas and Conejo Creek and there is no evidence that groundwater discharges from the aquifer to these watercourses. Where permeable pathways exist, water in the Shallow Alluvial Aquifer can move downward to the underlying older alluvium (Bachman 2016).

Historical Groundwater Elevation Trends

Groundwater elevation adjacent to Arroyo Las Posas was measured in a shallow groundwater monitoring well (T0611100253) at the intersection of Highway 101 and Santa Rosa Road from 1993 through 2011 (Figure 2-8, Groundwater Elevation Hydrographs in the Shallow Alluvial Aquifer). The shallow groundwater monitoring well was screened from 51 to 80 feet bgs. The trends in groundwater elevation in this well are similar to the climatic trends in precipitation observed in the PVB (Figure 2-8). The well was destroyed in 2011 (ExxonMobil Environmental Services 2011).

2.3.1.2 Older Alluvium

Spring and Fall 2015 Groundwater Elevations

Groundwater elevations were measured in two wells (02N21W34G05S and 02N21W34G04S) in the older alluvium in the spring and fall of 2015. These wells are two completions within a multiple-completion nested monitoring well in northwestern Pleasant Valley (Figure 2-9, Groundwater Elevation Contours in the Oxnard Aquifer [Older Alluvium], March 2–29, 2015, and Figure 2-10, Groundwater Elevation Contours in the Mugu Aquifer [Older Alluvium], March 2–29, 2015). Well 02N21W34G05S is screened from 170 to 190 feet bgs, and Well 02N21W34G04S is screened from

360 to 380 feet bgs. In the spring of 2015, the groundwater elevations in Wells 02N21W34G05S and 02N21W34G04S were 10.1 feet msl and −56.5 feet msl, respectively (Figures 2-9 and 2-10). In the fall of 2015, the groundwater elevations in Wells 02N21W34G05S and 02N21W34G04S were −14.8 feet msl and −86.6 feet msl, respectively (Figure 2-11, Groundwater Elevation Contours in the Oxnard Aquifer [Older Alluvium], October 2–29, 2015, and Figure 2-12, Groundwater Elevation Contours in the Mugu Aquifer [Older Alluvium], October 2–29, 2015).

Because these wells are the only two wells screened solely within the older alluvium and because both wells are located within a single borehole, the horizontal hydraulic gradient in the older alluvium cannot be calculated for the PVB. The older alluvium is age equivalent to the Oxnard and Mugu Aquifers in the Oxnard Subbasin, west of the PVB. Water levels in the Mugu Aquifer in the Oxnard Subbasin suggest that there may be flow from the Oxnard Subbasin into the PVB (Figure 2-12). There are no wells screened solely in the Mugu Aquifer east of the Revolon Slough and west of Well 02N21W34G04S. Therefore, there is a data gap in this area.

Vertical Gradient

Within the older alluvium there was a downward vertical hydraulic gradient of approximately 0.37 feet/feet in the spring and fall of 2015. This downward gradient within the older alluvium is greater than that between the older alluvium and the underlying FCA. The vertical gradient between Well 02N21W34G04S in the older alluvium and Well 02N21W34G03S in the FCA was approximately 0.07 feet/feet in the spring of 2015 and 0.09 feet/feet in the fall of 2015 (Table 2-2). These two aquifers are separated by the Upper San Pedro Formation (see Section 2.2.4, Principal Aquifers and Aquitards).

Historical Groundwater Elevation Trends

Groundwater elevation in the older alluvium has tracked climatic trends in the PVB (Figure 2-13, Groundwater Elevation Hydrographs in the Older Alluvium). In general, groundwater elevations recovered between 1990 and 2006, a period of above-average precipitation, due to inflow of water along the Arroyo Las Posas and surface water/groundwater/imported water/in-lieu water deliveries, including those associated with the Pleasant Valley Pipeline (PVP), Pumping Trough Pipeline, and Conejo Creek Projects. Groundwater elevations were stable between 2006 and 2011. Between 2012 and 2015, groundwater elevations declined approximately 40 feet in Well 02N21W34G05S and approximately 60 feet in Well 02N21W34G04S (Figure 2-13) in response to the period of drought. Groundwater elevations in both wells remain above the elevations measured in 1990, 1991, and 1992. At this time, groundwater elevations rose in response to increased recharge along Arroyo Las Posas from non-native sources of flow, including WWTP discharges. Perennial surface water flow from WWTP discharges in Arroyo Las Posas no longer reaches Pleasant Valley, cutting off the source of recharge to the groundwater.

2.3.1.3 Fox Canyon Aquifer

Spring and Fall 2015 Groundwater Elevations

In the spring of 2015, recorded groundwater elevations in the PVB within the FCA ranged from –129.3 feet msl to 38.62 feet msl (Figure 2-14, Groundwater Elevation Contours in the Fox Canyon Aquifer, March 2–29, 2015). In the fall of 2015, groundwater elevations ranged from −125.12 feet msl to 15.16 feet msl (Figure 2-15, Groundwater Elevation Contours in the Fox Canyon Aquifer, October 2–29, 2015). The highest groundwater elevation was measured in northeastern PVB, and the lowest groundwater elevation was measured in northwestern PVB. The apparent direction of flow in the spring of 2015 was to the west-southwest, and the hydraulic gradient was approximately 0.008 feet/feet. The apparent direction of flow within the aquifer in the fall of 2015 was to the west/southwest, and the horizontal hydraulic gradient was approximately 0.011 feet/feet. The apparent direction of flow in the FCA reflects the location of the primary pumping area in the western PVB (Figure 2-7). The majority of the groundwater production in the LAS occurs west of Lewis Road and south of Highway 101.

In addition to the location of the groundwater pumping centers, multiple faults in the PVB also influence groundwater elevations and direction of groundwater flow (Bachman 2016). The current distribution of wells screened solely in the FCA is insufficient to determine the influence of many of these faults, although the difference in groundwater elevation between wells in the western PVB (e.g., Wells 02N21W34G03S and 02N21W03C01S) and those in the northern and eastern PVB (e.g., Wells 02N20W19M05S and 02N20W29B02S) likely reflects the cumulative influence of faulting, increased recharge along Arroyo Las Posas, and pumping on groundwater elevations in the PVB (CMWD 2008). The northern wells are the only wells in the FCA in the PVB with groundwater elevations that are above sea level.

Vertical Gradient

Groundwater elevations in the FCA are lower than groundwater elevations in the overlying older alluvium. The downward vertical hydraulic gradient from the older alluvium to the FCA was approximately 0.072 feet/feet in the spring of 2015, and 0.088 feet/feet in the fall of 2015 (Table 2-2). The vertical hydraulic gradients reflect the groundwater depression caused by pumping within the FCA (Figure 2-12).

In contrast, within the FCA, the vertical hydraulic gradient was directed upward in both the spring and fall of 2015. In the spring, the vertical hydraulic gradient within the FCA was approximately 0.043 feet/feet. In the fall, the vertical hydraulic gradient within the FCA was approximately 0.022 feet/feet.

Historical Groundwater Elevation Trends

The historical trends in groundwater elevation in the FCA are similar throughout the PVB, although absolute groundwater elevations vary across the PVB (Figure 2-16, Groundwater Elevation Hydrographs in the Fox Canyon Aquifer). Groundwater elevation trends in Well 01N21W03C01S, the well with the longest historical groundwater elevation record in the FCA, mimic the trends observed in the record of cumulative departure from the mean precipitation for Pleasant Valley. The correlation with the cumulative departure curve occurs for two reasons. First, during periods of above-average rainfall, UWCD is able to recharge groundwater in the Oxnard Subbasin, which is hydraulically connected to the PVB, and is also able to deliver surface water to the PVB to reduce groundwater production in the basin. Second, recharge in the PVB increased in the 1980s and 1990s as perennial wastewater flows in Arroyo Las Posas reached the PVB in 1990. These flows exerted the primary influence on the rising trend in groundwater elevations between 1990 and 2011 (Figure 2-16).

Groundwater elevation in Well 01N21W03C01S declined between 1985 and 1991, coincident with a period of lower-than-average precipitation in Pleasant Valley (Figure 2-16). Groundwater elevations in this well recovered from 1991 to 2006, as a result of wetter-than-average climate conditions and recharge of non-native surface water along Arroyo Las Posas. Groundwater elevations were relatively stable between 2006 and 2011. In 2011, with the onset of the drought, groundwater elevations declined again. In 2015, groundwater elevations remained approximately 50 feet higher than the lowest groundwater elevation recorded in the FCA in 1991, as a result of the additional recharge of surface water along Arroyo Las Posas (Figure 2-16).

Other wells in the western PVB have similar responses to that of Well 01N21W03C01S (Figure 2-16). Groundwater elevations in the northeastern portion of the PVB were influenced by the inflow of water along the Arroyo Las Posas. Groundwater levels in the south and western portions of the basin were influenced by in-lieu water deliveries. The City of Camarillo also received imported water, which impacted groundwater elevations in the PVB.

2.3.1.4 Grimes Canyon Aquifer

There are no wells screened solely within the GCA in the PVB.

2.3.2 Estimated Change in Storage

Estimated monthly change in storage values for the PVB were generated by the numerical groundwater flow model prepared by UWCD (2018, provided with this GSP as Appendix D, UWCD Model Report). Model data for change in storage was reported by aquifer system (semi-perched, UAS, and LAS), and the total change in storage for the PVB was calculated by summing the change in storage for all aquifer systems. It should be noted that the names of the aquifer systems for the

Oxnard Subbasin are carried over to the PVB in the UWCD model for consistency in discussion as well as model continuity. This highlights the interconnectedness of these basins but is not a substitute for the naming conventions of the principal aquifers and aquitards discussed in Section 2.2.4. The semi-perched aquifer is modeled as an area of approximately 14,000 acres with a thickness ranging from approximately 10 to 100 feet in the PVB in order to incorporate the tile drains in the western portion of the PVB that connect with the Oxnard Subbasin. The UAS is also a continuous layer in the UWCD model, although that layer represents the older alluvium of the PVB.

Monthly data reported from the model were summed to reflect the annual change in storage for water year 1986 through water year 2015. The average annual change in storage in the semi-perched aquifer was an increase in storage of approximately 515 AFY, with a maximum increase in storage of approximately 8,000 AF in water year 1998 and a maximum decrease in storage of approximately 7,500 AF in water year 2014. In the UAS, the average annual change in storage was an increase of approximately 1,320 AFY, with a maximum increase in storage of approximately 10,000 AF in water year 1993 and a maximum decrease in storage of approximately 5,440 AF in water year 2014. The LAS had an average annual increase in storage of approximately 445 AFY, with a maximum increase in storage of approximately 4,240 AF in water year 1998 and a maximum decrease in storage of approximately 2,970 AF in water year 1987. The total average annual change in storage for the PVB was an increase in storage of approximately 2,280 AFY, with a maximum increase in storage of approximately 21,850 AF in water year 1998 and a maximum decrease in storage of approximately 15,370 AF in water year 2014 (Figure 2-17, Annual Change in Storage). The cumulative change in storage in the model over the period of record for the semi-perched aquifer, the UAS, and the LAS was an increase of approximately 15,410 AF, 39,600 AF, and 13,390 AF, respectively, for a total cumulative increase in storage of approximately 68,400 AF (Figure 2-18, Cumulative Change in Storage). Pumping in FCGMA jurisdiction is reported on a calendar-year basis, so pumping shown in the figures is per calendar year, while change in storage is per water year.

Modeled change in storage is dependent on several input parameters to the model, which include groundwater pumping, interbasin flows, recharge from precipitation and irrigation returns, stream leakage, and groundwater discharge to streams. The UWCD model inputs were estimated using the best available data and calibrated to measured water levels to the greatest extent possible. Changes in calculations for these input values, along with continued model calibration, will result in changes in the model estimate of change in storage in the future.

2.3.3 Seawater Intrusion (Baseline)

The aquifers of the PVB have not experienced direct seawater intrusion. Although seawater intrusion has not occurred within the PVB, seawater intrusion in the FCA and the GCA in the Oxnard Subbasin is directly related to groundwater pumping in the PVB. Groundwater pumping from the FCA and the GCA in the PVB lowers the potentiometric head in these aquifers, which can result in landward gradients that induce seawater intrusion. Additionally, pumping in the FCA and the GCA in the PVB can increase groundwater flow from the UAS of the Oxnard Subbasin to the FCA and the GCA in both the Oxnard Subbasin and the PVB. This increase in downward groundwater flow decreases the water level in the UAS, thereby potentially inducing seawater intrusion.

2.3.4 Groundwater Quality (Baseline)

FCGMA has adopted Basin Management Objectives for chloride in the PVB (FCGMA 2007; Table 2-3). Additionally, the Water Quality Control Plan: Los Angeles Region (Basin Plan) specifies Water Quality Objectives (WQOs) for TDS, chloride, nitrate (mg/L as nitrate, or NO_3), sulfate (SO_4) and boron (LARWQCB 2013; Table 2-3). The current and historical distribution of these five constituents are discussed below based on aquifer system, rather than individual aquifer. There are too few measurements of water quality in wells screened solely within a single aquifer to allow for meaningful discussion of water quality by aquifer. Additionally, as discussed in Section 2.3.1, Groundwater Elevation Data, the majority of the groundwater production in the PVB occurs in wells that are screened across multiple aquifers. Therefore, impacts to groundwater quality in the PVB should be considered based on aquifer system, rather than individual aquifer.

The primary water quality concerns in the PVB are inflows of poor-quality water from discharges from the Simi Valley Water Quality Control Plant, dewatering wells operated by the City of Simi Valley, and discharges from the MWTP percolation ponds adjacent to Arroyo Simi–Las Posas, discharges from the Hill Canyon WWTP and the CSD WRP to Conejo Creek, and saline intrusion in the FCA and the GCA from brine migration along the Bailey Fault. The inflows of poor-quality water percolate through the Shallow Alluvial Aquifer and recharge both the older alluvium and the FCA. Increases in the concentration of TDS and chloride have impaired municipal use of groundwater in the northern part of the PVB (City of Camarillo 2015). Non-marine saline intrusion may affect the FCA and the GCA if groundwater level declines cause compaction of aquitards and create low-pressure conditions that promote the migration of brines along faults and the upwelling of brines from deeper formations (FCGMA 2007; UWCD 2016a). However, a direct correlation between groundwater elevation and TDS concentration has not been established.

Groundwater quality monitoring within the PVB occurs at different intervals for different wells. To assess the current groundwater quality conditions within the PVB, the most recent concentration of each of the constituents listed above was plotted for samples collected from 2011 through 2015 (Figures 2-19 through 2-28).[2] Historical groundwater quality hydrographs are

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[2] Note: The Salt Nutrient Management Plan (SNMP) for the Calleguas Creek Watershed uses the median concentration measured at a well over a 5-year period.

presented in Appendix E, Water Quality Hydrographs. Statistics on the most recent sample concentration and date; the maximum, minimum, median, and standard deviations of measured concentrations; the number of times sampled; and the number of samples with concentrations that exceeded the Basin Plan WQOs (LARWQCB 2013) are presented in Appendix F, FCGMA Water Quality Statistics.

2.3.4.1 Total Dissolved Solids

The WQO for TDS is 700 mg/L in the confined aquifers (LARWQCB 2013). There is no WQO for the unconfined aquifers in the PVB (LARWQCB 2013).

Upper Aquifer System

TDS concentration was measured in six UAS wells in the PVB from 2011 through 2015. The concentration of TDS over this period ranged from 704 to 4,340 mg/L (Figure 2-19, Upper Aquifer System – Most Recent Total Dissolved Solids [mg/L] Measured 2011–2015). Of the wells sampled, the southern wells had higher concentrations of TDS than the northern wells (Figure 2-19).

Lower Aquifer System

TDS concentration was measured in 15 wells in the LAS from 2011 through 2015 (Figure 2-20, Lower Aquifer System – Most Recent Total Dissolved Solids [mg/L] Measured 2011–2015). The concentration ranged from 630 to 1,930 mg/L, with the highest concentration measured in Well 02N20W19M06S and the lowest in Well 02N21W33R02S. Well 02N21W33R02S was the only well in the LAS with a TDS concentration below the WQO.

2.3.4.2 Chloride

The WQO for chloride is 150 mg/L in the confined aquifers, and the Basin Management Objective for chloride is less than 150 mg/L (FCGMA 2007; LARWQCB 2013).

Upper Aquifer System

Chloride concentration was measured in seven wells in the UAS from 2011 through 2015. The concentration ranged from 50 to 660 mg/L (Figure 2-21, Upper Aquifer System – Most Recent Chloride [mg/L] Measured 2011–2015). Of the seven wells measured, two had concentrations below 150 mg/L. The highest concentration of chloride was measured in Well 01N21W15H01S in the southwestern PVB (Figure 2-21). Groundwater from this well also had the highest concentration of TDS.

Lower Aquifer System

Chloride concentration was measured in 15 wells in the LAS from 2011 through 2015. The concentration ranged from 59 to 224 mg/L, with eight wells having concentrations less than 150 mg/L (Figure 2-22, Lower Aquifer System – Most Recent Chloride [mg/L] Measured 2011–2015). The highest concentration of chloride was measured in Well 01N21W03R01S in the western PVB (Figure 2-22). The lowest concentration of chloride was measured in Well 02N21W33R02S in the northwestern part of the PVB (Figure 2-22). In general, chloride concentrations in the LAS were lower than those in the UAS.

2.3.4.3 Nitrate

The WQO for nitrate as NO_3 is 45 mg/L for the PVB (LARWQCB 2013).

Upper Aquifer System

Nitrate as NO_3 concentration was measured in seven wells in the UAS from 2011 through 2015 (Figure 2-23, Upper Aquifer System – Most Recent Nitrate [mg/L as nitrate] Measured 2011–2015). Four of the seven wells had concentrations below 45 mg/L, and concentrations in the other three wells ranged from 52 to 171 mg/L. The lowest concentrations of nitrate as NO_3 were found in southwestern PVB (Figure 2-23).

Lower Aquifer System

Nitrate as NO_3 concentration was measured in 15 wells in the LAS from 2011 through 2015. The concentration ranged from below the detection limit to 31 mg/L (Figure 2-24, Lower Aquifer System – Most Recent Nitrate [mg/L as nitrate] Measured 2011–2015). All of the wells measured had concentrations below the WQO for nitrate as NO_3.

2.3.4.4 Sulfate

The WQO for sulfate is 300 mg/L in the confined aquifers (LARWQCB 2013).

Upper Aquifer System

The concentration of sulfate was measured in seven wells in the UAS from 2011 through 2015 (Figure 2-25, Upper Aquifer System – Most Recent Sulfate [mg/L] Measured 2011–2015). Of these, only Well 02N21W34G04S had a sulfate concentration below 300 mg/L. The remaining wells had sulfate concentrations ranging from 350 to 2,130 mg/L.

Lower Aquifer System

The concentration of sulfate was measured in 15 wells in the LAS from 2011 through 2015 (Figure 2-26, Lower Aquifer System – Most Recent Sulfate [mg/L] Measured 2011–2015). The concentration ranged from 155 to 920 mg/L, and 8 of the 15 wells measured concentrations of sulfate exceeding 300 mg/L. These wells are distributed throughout the PVB, with the highest concentration measured in Wells 02N20W19M06S and 02N20W19L05S. The wells with the highest concentration of sulfate are in the area of the recharge mound created by surface water inflows entering the PVB along Arroyo Las Posas. The Northern Pleasant Valley Desalter Project will extract the mounded poor-quality groundwater in this area in an effort to limit migration. The lowest concentration was measured in Well 02N20W29B02S (Figure 2-26).

2.3.4.5 Boron

The WQO for boron is 1 mg/L (LARWQCB 2013).

Upper Aquifer System

Boron concentrations were measured in seven UAS wells from 2011 through 2015 (Figure 2-27, Upper Aquifer System – Most Recent Boron [mg/L] Measured 2011–2015). The concentration ranged from 0.3 to 2.0 mg/L. Two wells, 01N21W02J01S and 01N21W15H01S, had concentrations that exceeded the WQO. The remaining five wells were below the WQO.

Lower Aquifer System

Boron concentrations were measured in 15 LAS wells from 2011 through 2015 (Figure 2-28, Lower Aquifer System – Most Recent Boron [mg/L] Measured 2011–2015). The concentration ranged from 0.3 to 0.9 mg/L. The concentration of boron in all LAS wells was below the WQO.

2.3.4.6 Map of Oil and Gas Deposits

According to records from the County (County of Ventura 2016), two oil fields (the Las Posas and the Conejo) falls partially within the PVB (Figure 2-29, Oil Fields in the Vicinity of FCGMA Groundwater Basins). Petroleum extraction in the FCGMA basins occurs below the deepest freshwater aquifer (Hopkins 2013). While no evidence of impacts of petroleum extraction on beneficial use of groundwater in the FCGMA basins has been identified, there are limited available data. Few wells exist in deep aquifers near oil fields that could be monitored for potential impact. However, trace amounts of organic compounds have been found in deeper wells in the southeastern PVB (Izbicki et al. 2005), and there have been anecdotal reports of trace petroleum hydrocarbons observed in irrigation wells near some oil fields.

2.3.4.7 Maps of Locations of Impacted Surface Water, Soil, and Groundwater

Impaired surface waters (i.e., Clean Water Act Section 303(d) Listed Reaches) that overlie the PVB include Arroyo Las Posas, Calleguas Creek, and Conejo Creek where those surface water bodies fall within the boundaries of the PVB (Figure 2-30, Impaired Surface Waters in the Vicinity of FCGMA Groundwater Basins) (SWRCB 2012). The names of the reaches used by the State Water Resources Control Board, and the impairments listed for each, are included in tabulated form in Appendix G, Pleasant Valley Basin 303(d) List Reaches.

Locations of impacted soil and groundwater were assessed on a basin-wide scale by reviewing information available on the California State Water Resources Control Board's GeoTracker website (SWRCB 2017) and the California Department of Toxic Substances Control's EnviroStor website (DTSC 2017). Cases that were closed by the supervisory agency were not considered.

Of the 290 open cases located within the boundaries of the FCGMA basins, groundwater was impacted in 77. Dudek reviewed and catalogued the constituents of concern (COCs) present on site in these 77 cases, 6 of which fell within the PVB boundary.

Of the six open cases in the PVB in which groundwater is, or is potentially, impacted, the following COCs were identified as present at the following number of sites (Figure 2-31, Constituents of Concern at Open GeoTracker Cases with Impacted Groundwater within FCGMA Groundwater Basin Boundaries; Appendix H, GeoTracker Open Sites):

- Chlorinated volatile organic compounds (VOCs), including COCs marked as *solvents*, *VOCs*, and *chlorinated hydrocarbons* were present at two sites
- Gasoline and diesel, including COCs marked *TPH* and *petroleum*, were present at three sites
- Metals were present at one site
- PCBs were present at zero sites
- Benzene, toluene, ethylbenzene, and/or xylenes (BTEX) were present at one site
- The pesticide chlordane was present at two sites
- Methyl tert-butyl ethylene (MTBE) and/or tert-butyl alcohol (TBA) were present at one site

These cases are under active management by the Department of Toxic Substances Control and/or State Water Resources Control Board. Based on a review of the files available on GeoTracker for each of the cases in the PVB, it appears that in none of the cases were any liable parties required to investigate deeper than 50 feet bgs, indicating that impacts to groundwater in the UAS were not a concern for regulatory agencies.

2.3.5 Subsidence (Baseline)

Inelastic, or irrecoverable, land subsidence (subsidence) can be a concern in areas of active groundwater extraction, including Pleasant Valley. Active causes of land subsidence in Pleasant Valley include tectonic forces, petroleum reservoir compaction, and fine sediment compaction (Hanson et al. 2003). Significant water level declines in the FCGMA groundwater basins since the early 1900s suggest that fluid extraction rather than tectonic activity is the major cause of land subsidence (Hanson et al. 2003). Subsidence resulting from any of these sources can cause increased flood risk, well casing collapse, and a permanent reduction in specific storage.

Direct measurement of historical subsidence in Pleasant Valley is limited geographically and temporally. UNAVCO monument CSCI (California State Channel Islands) is located immediately adjacent to the southern boundary of PVB in the foothills of the Santa Monica Mountains (Figure 2-2).[3] There has been no net subsidence at this monument since its installation in November 2000. Because of the placement of this monument in the foothills of the Santa Monica Mountains, elevations measured there reflect tectonic forces rather than the influence of groundwater withdrawals.

Potential subsidence was modeled for southwestern Pleasant Valley and for the west part of the East Las Posas Management Area using different future water production scenarios (Hanson et al. 2003). The scenarios included consideration of proposed water projects and ordinances for the FCGMA basins. The model results suggest that southwestern Pleasant Valley may experience an additional 0.1 to 1 foot of subsidence by 2040 (Hanson et al. 2003). DWR designated the PVB as an area that has a low potential for future subsidence (DWR 2014). The amount of future subsidence will depend on whether future water levels decline below previous maximum declines for a sufficient time to cause compaction, or remain above these previous low levels (Hanson et al. 2003). Maintaining water levels above the previous low water levels will limit the potential for future subsidence.

From March 2015 to June 2016, the Jet Propulsion Laboratory (JPL) analyzed interferometric synthetic aperture radar (InSAR) data from the European Space Agency's satellite-borne Sentinel-1A and NASA's airborne UAVSAR along with similar previous studies from 2006 to 2015 to examine subsidence in areas of California. The study included the south-central coast of California areas of Ventura and Oxnard (Farr et al. 2017). The map generated from this study for the south-central coast of California area (Farr et al. 2017, Figure 23) showed less than 1 foot of subsidence for the PVB area.

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[3] A monument is a physical object for which one is trying to collect data for a determination of position, velocity, and/or acceleration for one or more survey points on or very near that object (UNAVCO 2019).

2.3.6 Groundwater–Surface Water Connections

As discussed in Section 2.2.4, flows in Arroyo Las Posas, Conejo Creek, and Calleguas Creek may be connected to groundwater in the Shallow Alluvial Aquifer. However, shallow groundwater elevation data and information about gaining and losing reaches within the PVB are extremely limited, with no monitoring sites near enough to surface water bodies to provide meaningful information about the connection between surface water and groundwater. Examination of County historical air photos indicated that Arroyo Simi–Las Posas in the LPVB was dry without adjacent vegetation before the 1970s. The best available information comes from model simulated values for groundwater/surface water connections in the UWCD numerical groundwater flow model, which used available data from stream gauges and estimated aquifer properties to estimate the recharge (Appendix D). The UWCD model estimated stream leakage from Arroyo Las Posas, Calleguas Creek, and Conejo Creek into the underlying semi-perched aquifer and Shallow Alluvial Aquifer. Numbers from the model represent net stream leakage, and do not necessarily indicate direct connection between surface water bodies and groundwater in the Shallow Alluvial Aquifer system.

The calculated stream percolation for water years 1986 to 2015 are provided in Table 2-4. These values are from the UWCD groundwater model, which is discussed in greater detail in the water budget section (Section 2.4, Water Budget). Arroyo Las Posas had net recharge to groundwater in all years modeled by UWCD, with an average net recharge to groundwater of approximately 4,400 AFY. Conejo Creek exhibited net recharge to groundwater in all years modeled, with an average net recharge to groundwater of approximately 8,200 AFY. Calleguas Creek exhibited net recharge to groundwater in all years modeled, with an average net recharge to groundwater of approximately 3,600 AFY.

2.3.7 Groundwater-Dependent Ecosystems

The dominant surface water bodies in the PVB are Arroyo Las Posas, Calleguas Creek, and Conejo Creek, all of which drain watersheds that extend beyond the boundaries of the PVB (Figure 2-32, Groundwater-Dependent Ecosystems and Stream Reaches in Pleasant Valley). Within the PVB, Arroyo Las Posas is ephemeral, although upstream of the boundary between the PVB and the LPVB, flow in Arroyo Las Posas is generally perennial (VCWPD 2009). Flow in Arroyo Las Posas is from both native and non-native flow sources (Bachman 2016; CMWD 2008). The non-native flows consist of discharges from the Simi Valley Water Quality Control Plant, dewatering wells operated by the City of Simi Valley, and discharges from the MWTP percolation ponds adjacent to Arroyo Simi–Las Posas in the LPVB (Bachman 2016; CMWD 2008). Perennial flow is observed in Conejo Creek and in Calleguas Creek downstream of the confluence with Conejo Creek. The primary sources of perennial flow to Conejo Creek are urban runoff from Thousand

Oaks in upstream branches of Conejo Creek, the Hill Canyon WWTP, and the CSD WRP.[4] Both the WWTP and the WRP provide non-native sources of flow to the creek. Irrigation water from agriculture and/or landscaping may also serve as a source of flow in both channels during some parts of the year. Water from Conejo Creek is diverted for nonpotable (agricultural and landscaping) uses from a diversion structure near Highway 101 (CWD 2017).

Calleguas Creek, Conejo Creek, and the lower reach of Arroyo Las Posas were identified as potential groundwater-dependent ecosystems (GDEs) on the statewide potential GDE map (TNC 2017). Of these potential GDEs, only lower Arroyo Las Posas north of Pleasant Valley Road lies within FCGMA jurisdiction. All three watercourses are connected to the Shallow Alluvial Aquifer, although the extent of gaining or losing reaches for these streams is not clear in the PVB (see Section 2.2.4).

Calleguas Creek, Arroyo Las Posas, and Conejo Creek include both reaches with natural channel consisting of riparian woodland/wetland habitat and confined channel with riprap on the sides and a soft bottom (VCWPD 2009). The soft bottom in the riprapped reaches is maintained in a largely vegetation-free state by the Ventura County Watershed Protection District (VCWPD 2009). Ecosystem functions and values are lower in the portions of the creeks and tributaries that have been channelized (CMWD 2004).

The Basin Plan (LARWQCB 2011) for the PVB portions of Calleguas Creek (Reaches 3 and 6), the lower reach of Arroyo Las Posas (Reach 6), and Conejo Creek (Reaches 9A and 9B) lists the following beneficial uses (Figure 2-32): groundwater recharge, warm freshwater habitat, and wildlife habitat. Conejo Creek supports the native arroyo chub (*Gila orcuttii*) and northwestern pond turtle (*Actinemys marmorata*) (CDFW 2017). Willow/mulefat riparian scrub with giant reed (*Arundo donax*) along the banks of Conejo Creek, downstream from the CSD WRP provides habitat for the state- and federally listed endangered least Bell's vireo (*Vireo bellii pusillus*) (CDFW 2017). An adult and a juvenile were observed in this area in 2009, and a breeding adult was observed in 2010 (Figure 2-33, Species Occurrences in Pleasant Valley) (CDFW 2017). The vegetation downstream of the CSD WRP is supported by discharges from the WRP that have resulted in perennial flow in Conejo Creek. In addition to the species listed above, in 2013, a single female steelhead (*Oncorhynchus mykiss irideus*) was found, dead, in Conejo Creek, downstream of Howard Road, in a "highly disturbed riparian corridor" (CDFW 2017). Steelhead are a state- and federally listed endangered species. It does not appear, however, that Conejo Creek provides ongoing steelhead habitat, as the California Department of Fish and Wildlife branch biologist found no records for steelhead in Conejo Creek before 2013, and no additional steelhead sightings have been reported since 2013 (CDFW 2017). There is no U.S. Fish and Wildlife Service critical habitat in the PVB (CDFW 2017).

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[4] The Hill Canyon WWTP is located outside the PVB boundaries in Thousand Oaks. The WWTP discharges to Arroyo Conejo, a tributary of Conejo Creek, approximately 3.5 miles upstream of where Conejo Creek enters the PVB.

In general, the connection between surface water and groundwater along Conejo Creek and Calleguas Creek is not well characterized. There was one well screened solely in the Shallow Alluvial Aquifer adjacent to the GDEs (Figure 2-34, Water Level Record for Well Locations Adjacent to Arroyo Las Posas). This well, which was destroyed in 2011, was adjacent to lower Arroyo Las Posas. There are no existing wells screened solely in the Shallow Alluvial Aquifer adjacent to Conejo Creek or Calleguas Creek, and none of the wells are screened shallower than 50 feet bgs. As the depths to groundwater in the Shallow Alluvial Aquifer increase to greater than 30 feet, the riparian vegetation is unlikely to use groundwater to sustain growth during the dry season (Stromberg 2013).

The depth to groundwater adjacent to lower Arroyo Las Posas, downstream of the intersection with Highway 101, has varied from approximately 45 to 65 feet bgs from the early 1990s to 2011 (Figure 2-34). In general, groundwater elevations recovered between 1992 and 2011 (see Section 2.3.1). The shallow groundwater monitoring well was screened from 51 to 80 feet bgs, and has had annual variations in groundwater depth of less than 10 feet since 1992 (Figure 2-33). These data appear to indicate that groundwater does not occur shallowly enough to support riparian habitat in this reach of Arroyo Las Posas.

As described above, the ecohydrology of the lower Arroyo Las Posas, Calleguas Creek, and Conejo Creek potential GDEs is complex, and the connection between these potential GDEs and groundwater in the PVB is not well characterized. The degree to which the vegetation is reliant on groundwater versus unsaturated soil water is unknown. Better understanding of the hydrology along lower Arroyo Las Posas, Calleguas Creek, and Conejo Creek would aid in determining the impacts of decreasing groundwater levels on the riparian habitat. Until this connection between groundwater and the potential GDEs is established, lower Arroyo Las Posas, Calleguas Creek, and Conejo Creek cannot be conclusively determined to be GDEs. The future monitoring network would be improved by including wells dedicated to monitoring water levels in the potential GDEs to assess the degree to which existing habitat is reliant on groundwater (see Section 4.6.5, Shallow Groundwater Monitoring near Surface Water Bodies and GDEs).

2.3.8 Potential Recharge Areas

To evaluate potential future recharge areas within the PVB, soil types were obtained from the Web Soil Survey, available online at https://websoilsurvey.nrcs.usda.gov/ (USDA 2019). Soil Ksat rates (saturated hydraulic conductivity rates) for soils of 92 micrometers per second or greater were plotted. Figure 2-35 (Pleasant Valley Potential Recharge Areas) shows the results of this evaluation and areas with the most favorable soil recharge rates. The most favorable areas are along Arroyo Las Posas, Conejo Creek, and Calleguas Creek.

2.4 WATER BUDGET

This section presents the water budget that has been prepared for the aquifer systems in the PVB. This water budget analysis has been completed in accordance with DWR GSP Regulations. The water budget has been prepared for the 31-year period from 1985 through 2015 and is described in units of AF or AFY. Two water-bearing formations are recognized in the PVB (Section 2.2.4): alluvium and the San Pedro Formation (DWR 2003). The water-bearing alluvium can be divided into a semi-perched aquifer, a Shallow Alluvial Aquifer, and older, low-permeability alluvium (older alluvium), which are not considered to be primary groundwater sources in the PVB. Groundwater in the Upper San Pedro Formation is limited to lenses of permeable sediments that are laterally discontinuous (Turner 1975). As a result, the Upper San Pedro Formation is not considered an aquifer, and few wells are known to pump from the Upper San Pedro Formation (Section 2.2.4). This formation may, however, function as a leaky aquitard providing additional water to the underlying FCA (in the LAS). The medial and basal units of the San Pedro Formation are the FCA and the GCA, respectively, which are primary water-producing units in the PVB.

UWCD (2018; see Appendix D to this GSP) developed the “Ventura Regional Groundwater Flow Model (VRGWFM),” a MODFLOW numerical groundwater flow model, for the Oxnard Subbasin, the Mound Basin, the western part of the LPVB, and the PVB. Details of the UWCD modeling effort are included in Appendix D. The groundwater budget analysis for the PVB is based on the DWR Bulletin 118 basin boundary for the PVB, and does not incorporate the remainder of the model domain. As with all groundwater flow models, the UWCD model has undergone several revisions and will continue to be revised as additional data are collected and the understanding of the hydrogeologic interactions in the model domain improves. This GSP uses the version of the model finalized in June 2018, which was developed in part to support the GSP process. This version of the model was used for the current and historical water budget analysis as well as for the future projected groundwater scenarios discussed in Section 2.4.5, Projected Water Budget and Sustainable Yield.

2.4.1 Sources of Water Supply

The aquifer systems in the PVB receive water from several sources. These include rainfall infiltration within the PVB and along its margins (mountain-front recharge) and subsurface inflows from the adjacent Oxnard Subbasin and the LPVB. Additional sources include streambed seepage from Arroyo Las Posas where it enters the PVB from the adjoining LPVB; streambed seepage from Conejo Creek where it enters the PVB from the adjoining ASRVB; deep percolation of a portion of the irrigation water that is applied to agricultural, commercial, residential, and to public open spaces; and leakage from water distribution systems and septic system return flows.

Water supplies for the PVB consist of locally pumped groundwater; imported water provided by UWCD and CMWD; surface water provided by UWCD from its Freeman Diversion on the Santa

Clara River and delivered to agricultural users in the PVB via the PVP; water supplied by the Camrosa Water District (CWD) to municipal and industrial (M&I) and agriculture users; surface water provided by CWD to the Pleasant Valley County Water District (PVCWD) from a diversion on Conejo Creek; tertiary-treated recycled water produced by CWD and CSD; and fully advanced treated recycled water produced by the City of Oxnard (through the Groundwater Recovery Enhancement and Treatment (GREAT) Program) that began to be delivered to PVCWD in early 2016. CWD also delivers pumped groundwater from Santa Rosa and Tierra Rejada Basins, and from wells at its Round Mountain Desalter Facility, and PVCWD groundwater pumping in the Oxnard Subbasin.

The predominant municipal water suppliers in the PVB are the City of Camarillo and CWD, which service portions of the City of Camarillo, and the Pleasant Valley Mutual Water Company (PVMWC). PVMWC serves a suburban area on the north side of the City, and the Camarillo Utility Enterprise serves the Camarillo Airport.[5] Figure 1-8 shows a map of water purveyors with service areas within the PVB.

- The City of Camarillo's water supplies consist of groundwater pumped from City-owned municipal supply wells located exclusively within the PVB, imported water supplied by the CMWD, and recycled water produced by CSD.
- CWD's sources consist of its Woodcreek and University wells, water imported into the basin consisting of a blend of imported water (purchased from CMWD) and groundwater pumped from wells in the ASRVB and the Tierra Rejada Basin, and nonpotable tertiary-treated recycled water produced at the Camrosa Water Reclamation Facility (CWRF).
- PVMWC's water supplies consist of groundwater pumped from its wells within the PVB, and imported water purchased from CMWD.
- Camarillo Utility Enterprise's water supplies consist of groundwater pumped from its wells within the PVB.

The predominant agricultural water suppliers in the PVB are PVCWD and CWD. PVCWD receives water from the UWCD (via the PVP) and from CWD (surface water from the Conejo Creek Diversion, which began in 2002). Prior to 2002, some farmers diverted directly from Conejo Creek for agricultural uses. CWD also distributes a portion of its diversions from Conejo Creek to other agricultural water users in the PVB and in the ASRVB.

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[5] PVMWC's service area extends into the Camarillo Hills and the southern fringe of the LPVB. This portion of the PVMWC service area consists of undeveloped land and contains a large water storage tank for PVMWC's distribution system.

2.4.1.1 Surface Water Flows

Arroyo Las Posas, Conejo Creek, and Calleguas Creek are the primary streams in the PVB. Figure 2-36 (Pleasant Valley Basin Stream Gauges and Water Infrastructure) shows the locations of streams and primary drainage systems in and around the PVB, as well as the locations of stream gauges, and the two diversion structures (Freeman and Conejo Creek) that provide a portion of the water supply for the PVB. Table 2-5 summarizes the available stream flow data in Arroyo Las Posas and Conejo Creek at the stream gauge locations shown on Figure 2-36, the estimated amounts of Conejo Creek surface water diverted for agriculture prior to 2002, and the amounts of surface water diverted by CWD to PVCWD and to others for agriculture and M&I since creek diversions began in 2002 at the Conejo Creek Diversion near Highway 101. Figure 2-37 (Pleasant Valley Basin Stream Flows) shows plots of stream flow data collected at the stream gauge locations in Arroyo Las Posas and Conejo Creek.

Arroyo Las Posas is generally perennial (average or wet years) in its most downstream reach within the LPVB, then fully infiltrates its baseflow upon crossing into the PVB. As described by Bachman (2016), baseflow in Arroyo Simi–Las Posas is a mixture of natural dry-weather flows, discharges from WWTPs, discharge from dewatering wells in Simi Valley, and agricultural tailwaters. The terminus of the baseflow originally occurred in the LPVB, but in the early 1990s it began to move downstream as the LPVB Shallow Alluvial Aquifer began to fill as a result of higher baseflow contributions from Simi Valley. Bachman (2016) reports that the baseflow crossing into the PVB infiltrates along a 1,400-foot-long reach of Arroyo Las Posas at the northern margin of the PVB. Bachman (2016) also estimated that the next 5,500 feet of the creek can infiltrate some or all of the storm flow in the creek that crosses into the PVB during an individual storm event. Bachman (2016) estimated that this lower reach has an infiltration capacity of approximately 89 AF per day. However, surface flows from the LPVB have not occurred during dry weather since about 2012 due to drought conditions.

Conejo Creek is perennial in the upstream adjoining the ASRVB and remains perennial over its entire reach within the PVB. The source of water to Conejo Creek is mostly wastewater discharge from the City of Thousand Oaks Hill Canyon WWTP upstream of the ASRVB, and CSD wastewater discharge flows to Conejo Creek south of the Conejo Creek Diversion near Highway 101 (Figure 2-36). In 2015, CSD discharged 2,274 AFY of tertiary-treated water to lower reaches of Conejo Creek, and provided 1,703 AFY of recycled water supply to agricultural users and urban landscape irrigation (CSD 2016, as cited in DBS&A 2017). CSD has historically discharged an average of about 2,700 AFY (Table 2-5). Urban runoff and seepage, as well as native runoff, contribute to flow in the stream. Since 2002, CWD has operated the Conejo Creek Diversion to provide agricultural and M&I water supplies in the PVB and the ASRVB. CWD is required to maintain 6 cubic feet per second of flow in the stream below the diversion for habitat maintenance purposes. Table 2-5 shows the amounts of water diverted by CWD via the Conejo Creek Diversion and delivered within the PVB based on records presented by CWD, stream flows in Arroyo Las Posas and Conejo Creek, and discharges from CSD into Conejo Creek. Conejo Creek diversions by agricultural users prior to 2002 were estimated by CWD. Figure 2-38 (Conejo Creek Diversions) shows the volume of CWD's diversions from Conejo Creek.

Calleguas Creek extends from the confluence of Arroyo Las Posas and Conejo Creek downstream to the Pacific Ocean at the Mugu Lagoon. Stream flows from Calleguas Creek into the adjacent Oxnard Subbasin are perennial because of treatment discharges, and flow can potentially increase downstream due to inflows from agricultural field tile drains and from the Revolon Slough, which enters Calleguas Creek downstream of Highway 1 in the Oxnard Subbasin.

CWD produces recycled water from its CWRF. During 2015, recycled water deliveries from CWD totaled 1,263 AF for agricultural irrigation on nearby land parcels and landscape irrigation at California State University Channel Islands. Because of high demands and CWD's 300 AFY capacity recycled water storage ponds, CWD has discharged treated water to Calleguas Creek only once since 2000 (approximately 90 AF was discharged during a high-rainfall period in early 2005).

Surface Water Recharge

The UWCD (2018; see Appendix D) groundwater model used the MODFLOW STR stream package to simulate recharge for Arroyo Las Posas, Conejo Creek, and Calleguas Creek in the PVB. Calleguas Creek in the PVB does not have hydraulic communication with the underlying UAS, but modeling indicates that recharge to the semi-perched aquifer from 1985 to 2015 averaged 3,616 AFY (see Tables 2-6a through 2-6c for UWCD water budget data).

According to the UWCD groundwater model stream flow percolation from Conejo Creek and Arroyo Las Posas provide recharge to both the semi-perched aquifer and the Shallow Alluvial Aquifer. Tables 2-6a and 2-6b indicate that from 1985 to 2015 the average inflows from Conejo Creek to the semi-perched aquifer and the Shallow Alluvial Aquifer were 6,320 AFY and 1,831 AFY, respectively, and the average inflows from Arroyo Las Posas to the semi-perched aquifer and the Shallow Alluvial Aquifer were 563 AFY and 3,697 AFY, respectively.

Table 2-6b summarizes the calendar year subsurface inflows from the LPVB in Arroyo Simi–Las Posas as estimated by the CMWD (2018) groundwater model. The average inflow from 1985 to 2015 was 1,646 AFY, and has ranged from 148 AFY to 2,207 AFY (Table 2-6b).

2.4.1.2 Imported Water Supplies

Table 2-7 provides the historical deliveries and uses of imported water purchased from the CMWD by PVB water retailers: the City of Camarillo, CWD, and the PVMWC. CWD provides imported water supplied by CMWD for both M&I and agricultural uses. Figure 2-39 (Imported Water Deliveries) shows the amounts of water imported to the PVB.

Table 2-8 summarizes historical diversions and usage of Santa Clara River water by UWCD. UWCD diverts surface water from the Santa Clara River in the Santa Paula Basin, just upstream of the Oxnard Subbasin and the adjacent Mound Basin. Diverted Santa Clara River water may include imported water held for UWCD in Lake Piru. This water is used for groundwater recharge in UWCD spreading basins within the Oxnard Forebay (the Forebay) and for direct delivery to water users. UWCD-recharged and diverted Santa Clara River water can be supplied via the Pumping Trough Pipeline to service agricultural water users in the Oxnard Plain, or to the PVP for agricultural water users in both the PVB and the Oxnard Plain. As shown in Table 2-8, the water supply delivered in the PVP supply pipeline is a mixture of diverted Santa Clara River water and groundwater pumped by UWCD from its Saticoy wellfield in the Forebay of the Oxnard Subbasin.

PVCWD uses a combination of pumped groundwater from the Oxnard Subbasin and the PVB, delivered UWCD water from the PVP, and CWD-delivered water from Conejo Creek. FCGMA groundwater pumping records indicate that from 1985 to 2015, approximately 41% and 59% of PVCWD’s pumped groundwater has come from the PVB and Oxnard Subbasin, respectively. A geographic information system (GIS) calculation of the area of the PVCWD in Figure 1-8 indicates that about 44% of the area is in the PVB and 56% is in the Oxnard Subbasin. For purposes of estimating PVCWD water deliveries, a ratio of 44% PVB and 56% Oxnard Subbasin was used for PVCWD water supplies. As shown in Table 2-8, during some years groundwater pumping in the PVB for PVCWD is less than this ratio, resulting in a positive import from the Oxnard Subbasin. Conversely, in some years, groundwater pumping in the PVB is more than this ratio, resulting in a negative import (an export) to the adjacent Oxnard Subbasin. Figure 2-40 (Other Water Deliveries) shows the amounts of other imported water into the PVB.

In addition to CWD’s Conejo Creek Diversion water, imported water deliveries, and groundwater pumped near their Round Mountain Water Treatment Plant, CWD provides water to the PVB for agriculture, M&I, and groundwater storage from other sources, including ASRVB, the Tierra Rejada Basin, and tertiary-treated recycled water produced at the CWRF. These supplies are summarized in Table 2-8. Figure 2-41 (Other Camrosa Water District Water Deliveries) shows the other sources and uses of CWD water in the PVB.

M&I Recharge (Urban Return Flows)

In Tables 2-6a through 2-6c, percolation of M&I applied water is estimated with other recharge. However, the total recharge from M&I is reported separately in Table 2-9. In the UWCD model, it is assumed that 5% of M&I delivered water recharges groundwater. The average return flow from M&I for calendar years 1985 to 2015 was 702 AFY.

2.4.1.3 Recycled Water Supplies

Two sources of recycled water supply are used within the PVB. These sources are provided by CWD and CSD. Section 2.4.1.1, Surface Water Flows, provides a description for recycled water releases to Conejo Creek and Calleguas Creek by CSD and CWD, respectively. Table 2-8 provides the available recycled water amounts used in the PVB.

CWD produces Title 22 recycled water from its 1.5 million gallon per day (mgd) CWRF, which is delivered via a separate distribution system than its nonpotable surface water supply distribution system. As discussed in the Draft 2015 Urban Water Management Plan (CWD 2015), the CWRF produces approximately 1,500 AF of tertiary-treated recycled water annually and provides this recycled water supply to land parcels adjacent to and surrounding the California State University Channel Islands campus, including the campus itself and neighboring farmland.

CSD provides wastewater treatment for most of the City of Camarillo at its Camarillo WRP on Howard Road next to Conejo Creek (and within CWD’s jurisdictional boundaries). The WRP currently treats about 4 mgd (approximately 4,480 AFY) for agriculture use and as discharge to Conejo Creek, and has a capacity of 6.75 mgd (CWD 2015).Construction of tertiary-treatment processes at the WRP was completed in 2005. CSD constructed an effluent discharge line that eliminates most, if not all, current discharges to Conejo Creek. This pipeline will connect to CWD’s recycled water distribution system to provide additional recycled water supply for agriculture. CSD recycled water deliveries for agriculture are shown in Table 2-8 and CSD discharges to Conejo Creek are presented in Table 2-5.

Recycled Water Recharge

The UWCD model does not have a separate estimate of the amount of recharge from recycled water. Recycled water used for agriculture and M&I purposes was included in the UWCD model. This includes the annual average of 1,587 AFY from the CSD delivered to agriculture and the 669 AFY from the CWD for agriculture and M&I (Table 2-8).

2.4.1.4 Percolation of Precipitation

Much of the rain that falls in the PVB quickly returns to the atmosphere via evaporation, or runs off to creeks, storm drains, and ultimately the ocean; the remainder percolates into the soil, where it is subject to evapotranspiration (ET) and soil absorption. However, some precipitation can percolate into the soil and downward past the plant root zone and reach an underlying aquifer. This recharge process is referred to as deep infiltration (or percolation) of precipitation.

Deep percolation of precipitation depends on many factors, including precipitation rate and duration, evaporation rate, ambient temperature, texture and slope of land surface, soil type and texture, antecedent soil moisture, vegetation cover, seasonal plant activity, and others, and is highly variable over time and location (Appendix D). Thus, estimates of the percolation of precipitation are subject to substantial uncertainty.

UWCD downloaded monthly precipitation data for 180 rainfall gauge stations across the model domain from the Ventura County Watershed Protection District (at http://www.vcwatershed.net/hydrodata/) (Appendix D, p. 80). UWCD used the Kriging method of geostatistical analysis to generate monthly precipitation distributions across model area, and the areal recharge from deep infiltration of precipitation was input to the model using the recharge package, and was calculated as follows:

- If monthly precipitation is less than 0.75 inches, the precipitation is lost to ET.
- If monthly precipitation is 0.75 to 1 inch, then recharge is assigned from 0% to 10% of precipitation (on a sliding scale).
- If monthly precipitation is 1 to 3 inches, then recharge is assigned from 10% to 30% of precipitation.
- If monthly precipitation is greater than 3 inches, then recharge is assigned as 30% of precipitation.
- Urban (non-agricultural) land use, including residential, commercial, and industrial areas: 5% of the total water precipitation.
- Undeveloped land: 10% of the total water precipitation.

Precipitation Recharge

Recharge from the percolation of precipitation is include with recharge in Table 2-6a and Table 2-6b, but identified individually in Table 2-9. Of the average annual recharge shown in Table 2-9 (6,564 AFY), percolation of precipitation accounts for 2,702 AFY, or 41.2%.

2.4.1.5 Basin Groundwater Subsurface Inflow and Outflow

UWCD (2018; see Appendix D) provided model monthly groundwater inflows and outflows between the PVB, the Oxnard Subbasin and the LPVB. These inflows and outflows were combined to generate the annual estimates used for the groundwater budget. Additionally, Table 2-6b shows the subsurface flows between the older alluvium and the semi-perched aquifer as well as between the older alluvium and the LAS.

2.4.1.6 Mountain-Front Recharge

UWCD (2018; see Appendix D) used the MODFLOW WEL package to input mountain-front recharge specified flux amounts into model grid cells adjacent to each small drainage system (sub-watershed) along the margins of the model area, and to the base of elevated bedrock or mountain areas. In the PVB, mountain-front recharge was applied at the base of the Santa Monica Mountains and along the base of the outcrops of San Pedro Formation (in the FCA) in the Camarillo Hills and the eastern margin of the PVB. Recharge rates were calculated from monthly precipitation rates for the area receiving the precipitation. The monthly mountain-front-recharge rate inputs to the model followed the precipitation/recharge-percentage relationship used for agricultural return flows (see Section 2.4.1.9, Percolation of Agricultural Irrigation Water (Agricultural Return Flows)). For the PVB, mountain-front recharge is shown in Table 2-6b and averages 1,599 AFY.

2.4.1.7 Septic Systems Recharge

The number and locations of septic systems in the Oxnard Subbasin were estimated by DBS&A (2017) based on the Ventura County septic database. If septic systems were present within any parcel within a tract, it was assumed that all parcels in the tract contained septic systems. A total of 745 septic systems were assumed in the PVB (DBS&A 2017).

Household water use and annual disposal was estimated to decrease from 0.21 AFY per household for 1985 to 1997, 0.20 AFY per household for 1988 to 2010, and 0.16 AFY per household from 1998 to 2015 based on DeOreo and Mayer (2012, as cited in DBS&A 2017). The resulting estimated percolation from all septic systems was estimated to decrease from 156 AF in 1985 to 115 AFY in 2015 (DBS&A 2017).

The UWCD groundwater model (Appendix D) assumed that septic system recharge was widespread and small relative to other recharge sources and incorporated septic system return flows implicitly as a component of agricultural and municipal return flows.

2.4.1.8 Recharge from Water System Losses

Recharge from leakage of water delivery systems was assumed to be 5% of all deliveries (Sharp 2010, as cited in DBS&A 2017), including locally extracted water and imports. Delivered water included local pumping and water deliveries by CWD, City of Camarillo, PVMWC, Ventura County Waterworks Districts, and Conejo Creek Diversions. DBS&A (2017) estimated the percolation of leakage from distribution systems in the PVB to average 1,146 AFY (DBS&A 2017, Table 12). However, using 5% of the total average water delivery values in Tables 2-7 (8,698 AFY) and Table 2-8 (7,727 AFY), the estimated leakage of water delivery systems is 821 AFY.

The UWCD groundwater model (Appendix D) did not consider water system losses as a distinct source of water separate from other urban return flows.

2.4.1.9 Percolation of Agricultural Irrigation Water (Agricultural Return Flows)

Groundwater pumping is discussed in Section 2.4.2.1; only recharge from agricultural return flow is discussed in this section. The UWCD groundwater model used the following water sources, which were applied to irrigated land, and assumed an agricultural return flow of 14%:

- Extracted groundwater from wells for agricultural use
- Groundwater and surface water delivered via the PVP to PVCWD
- Surface water diverted from Conejo Creek to PVCWD

If the precipitation is more than 1 inch per month, the agricultural return flow ratio is compared with the precipitation recharge ratio. If the precipitation recharge ratio is larger than 14%, the agricultural return flow is replaced by the precipitation recharge ratio.

Agricultural Recharge

Recharge from the agricultural return flow is included with recharge in Tables 2-6a through 2-6c, and identified individually in Table 2-9. Of the total annual recharge shown in Table 2-9 (6,564 AFY), agricultural return flow accounts for 2,118 AFY, or 32.3%.

2.4.2 Sources of Water Discharge

Sources of groundwater discharge predominantly include groundwater pumping, tile drain discharges, and ET. Groundwater pumped and used for agricultural, M&I, and domestic purposes can produce return, and subsurface groundwater flows (interbasin flows) can discharge groundwater from the PVB to the adjacent groundwater (Section 2.4.1.5, Basin Groundwater Subsurface Inflow and Outflow).

2.4.2.1 Groundwater Pumping

Table 2-10 shows the amount of groundwater pumped for agricultural, M&I, and domestic uses by aquifer systems from the UWCD model. The UWCD modeled groundwater withdrawals used the multi-node well package. The FCGMA database provides reported groundwater extraction data for the PVB within the FCGMA boundary. The amount of unreported groundwater extraction within the PVB is not known but is expected to be minor, because the FCA does not occur to the southeast of the Bailey Fault outside the FCGMA boundary, where it has been removed through uplift and erosion (Section 2.4). The extraction amounts in Table 2-10 were combined with well types from the FCGMA database to distinguish the amounts extracted by type. Figure 2-42 (Pleasant Valley Basin Groundwater Pumping) shows the amounts of agricultural, M&I, domestic, and total groundwater pumped from the PVB. Groundwater pumping is also shown in the PVB groundwater budget in Tables 2-6a through 2-6c.

Model input indicates that during the calendar year 2015, a total of 17,849 AF of groundwater was pumped, of which 16,284 AF (or 91%) was for agricultural use, 1,357 AF or (7.6%) was for M&I use, and 209 AF (or 1.2%) was for domestic use. The PVB covers an area of about 19,840 acres and the FCGMA database contains 140 known wells, of which 74 are currently listed as active use, 44 have been destroyed, 21 are inactive, and 1 could not be located.

2.4.2.2 Tile Drain Recharge Losses

Tile drains are used beneath many agricultural lands in the PVB to maintain a sufficiently deep groundwater table in areas where poorly drained soils create perched groundwater conditions or the water table of the semi-perched aquifer is high and saturates the root zone. Tile drains are present beneath many agricultural land parcels in the PVB and the Oxnard Subbasin. These drains discharge to local waterways and then to surface water bodies (Revolon Slough and Calleguas Creek). These flows are not metered. The UWCD model (Appendix D) has calculated losses to tile drains based on groundwater model water levels; the results are provided in Table 2-6a. Average annual loss of groundwater to tile drains was estimated in the model as 1,080 AFY (Table 2-6a).

2.4.2.3 Evapotranspiration

The UWCD model used the U.S. Fish and Wildlife Service’s online “Wetlands Mapper” (https://www.fws.gov/wetlands/data/mapper.html) to indicate areas of riparian vegetation along stream channels. These areas, together with parts of the Santa Clara River (including its estuary), Revolon Slough/Beardsley Wash, McGrath Lake, Ormond Beach wetlands, and Mugu Lagoon wetlands, were used to estimate ET (Appendix D). ET is the discharge of groundwater from the saturated zone where the water table is present at very shallow depths. Such conditions mostly occur in the PVB in areas where the semi-perched aquifer and the Shallow Alluvial Aquifer interact with Arroyo Las Posas, Conejo Creek, and Calleguas Creek. Additional detailed discussions about these areas are in Section 2.3.6, Groundwater–Surface Water Connections, and Section 2.3.7, Groundwater-Dependent Ecosystems.

UWCD (2018; see Appendix D) applied U.S. Geological Survey estimates for ET rates from 1.1 to 5.2 feet per year to calculated long-term annual average groundwater discharge as ET. UWCD implemented ET using MODFLOW’s ET package, EVT. Model grid cells corresponding to areas of mapped wetlands with shallow groundwater were simulated. The maximum ET flux was 0.010 feet per day (3.65 feet per year) for model grid cells subject to ET over their entire area. The maximum ET flux is scaled down proportionally for grid cells that are only partially occupied by wetlands. The ET surface elevation was set at 3 feet bgs, and the ET extinction depth was set at 5 feet (Appendix D, p. 84).

According UWCD model results, the estimated annual loss from ET is 1,261 AFY, with 280 AFY coming from the semi-perched aquifer (Table 2-6a) and 981 AFY from the Shallow Alluvial Aquifer (Table 2-6b).

Riparian ET losses from the PVB were estimated by DBS&A (2017) for the 274 acres of riparian vegetation estimated by The Nature Conservancy in the PVB. In the absence of basin-specific data, a 20% giant reed coverage was assumed, which was similar to the 23% measured by The Nature Conservancy in the Oxnard Subbasin. The resulting estimated groundwater riparian ET averaged 1,741 AFY and ranged from 1,296 to 2,189 AFY (DBS&A 2017, Table 12).

2.4.3 Current and Historical Water Budget Analysis

2.4.3.1 Water Year Types

Water year type is based on the percentage of the water year precipitation compared to the 30-year precipitation average. Types are defined in this GSP as wet (> 150% of average), above normal (> 100% to <150% of average), below normal (> 75% to <100% of average), dry (> 50% to <75% of average), and critical (<50% of average). Figures 2-17 and 2-18 show the water year type from 1986 to 2015. The water type year for 2015 is dry.

2.4.3.2 Historical Water Budget Analysis

DWR has designated the PVB as a high-priority basin. GSP Regulations, Section 354.18, Water Budget, states: “If overdraft conditions occur, as defined in Bulletin 118, quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions.” According to DWR Bulletin 118, “A basin is subject to critical overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts” (DWR 2006). Bulletin 118 Interim Update 2016 (October 18, 2016) lists the PVB (4-006) as being in critical overdraft (DWR 2016).

Because of the Bulletin 118 listing of the PVB as being in critical overdraft, GSP Regulations, Section 354.18(b)(5), requires a quantification of the overdraft over a period of years during which water years and water supply conditions approximated average conditions. Using the water year types discussed in Section 2.4.3.1, Water Year Types, and the above normal (> 100% to <150% of average) and the below normal (> 75% to <100% of average) water year types to bracket water supply conditions approximating average conditions, the following years have near average conditions: 1988, 1991, 1994, 1996, 1997, 2000, 2001, 2003, 2006, 2008, 2010, and 2011.

The change in storage during these years was an increase of 1,758 AFY in the older alluvium and an increase of 860 AFY in the LAS (Tables 2-6b and 2-6c). Total groundwater pumping during these years averaged 999 AFY in the older alluvium and 7,145 AFY in the LAS, for a total of 8,144 AFY

(Tables 2-6b and 2-6c). This quantification of the overdraft over a period of years during which water years and water supply conditions approximated average conditions would indicate that PVB was not in overdraft and had a storage increase of about 2,618 AFY (1,758 AFY (older alluvium) + 860 AFY (UAS)). It should be noted that except for 2011, the adjacent Oxnard Subbasin showed net seawater intrusion in the UAS (equivalent to the older alluvium) and in the LAS for each of the years that approximated average conditions (FCGMA 2019). The Oxnard Subbasin seawater intrusion analysis suggests that based on the historical pumping patterns and pumping amounts in the Oxnard Subbasin and the PVB, there was an overdraft in the Oxnard Subbasin.

The above-average water year types from >100% to <150% (above normal) and >75% to <100% (below normal) have a wide range. The increase in storage during these years is also related to the timing of when the PVB started getting additional recharge from Arroyo Las Posas. Water levels increased fairly steadily between 1990 and 2008, coincident with the additional recharge along Arroyo Las Posas. Of the 12 years for the average-year change in storage calculation, only 3 (1988, 2010, and 2011) were outside of the 1990–2008 window. Because the timing of the recharge and the timing of the average years coincide, it is difficult to distinguish a pure climate signal in the observed record.

GSP Regulations, Section 354.18(c)(2), requires that the historical water budget information be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. Historically, the PVB has received surface water supply deliveries directly from several sources: the Santa Clara River by the UWCD PVP; from Calleguas Creek and Arroyo Las Posas streambed percolation; from imported water delivered by the CMWD; and from Conejo Creek diversions and streambed percolation. Table 2-5 shows the average amount of Conejo Creek water delivered by CWD (3,562 AFY). Table 2-7 shows the average amount of imported water delivered by the CMWD (8,698 AFY). Table 2-8 provides the average amounts of Santa Clara River water supplied by the UWCD via the PVP (4,010 AFY), and Tables 2-6a and 2-6b show the amounts of Calleguas Creek, Arroyo Las Posas, and Conejo Creek percolation (3,616 AFY, 4,260 AFY, and 8,151 AFY, respectively). However, some of the Calleguas Creek, Arroyo Las Posas, and Conejo Creek percolation to the semi-perched aquifer is discharged by the tile drains (up to 1,080 AFY; see Table 2-6a) and does not benefit the usable PVB aquifers. The total annual average from these sources is about 32,297 AFY. This would indicate the following surface water contributions to the PVB: Conejo Creek water delivered by CWD (11%); imported water delivered by CMWD (27%); Santa Clara River water (12%); and Calleguas Creek, Arroyo Las Posas, and Conejo Creek percolation (11%, 13%, and 25%, respectively). Figure 2-43 (Total Pleasant Valley Basin Surface Water Supplies) shows the amounts of these water sources from 1985 to 2015. Based on the overall trends in Figure 2-43, the Santa Clara River source is the most variable. It should be noted that the Santa Clara River water supply is used for agricultural uses, and the loss of this water during drought conditions can directly lead to an increase in groundwater pumping.

This similar Section 354.18(c)(2) analysis for the Oxnard Subbasin (FCGMA 2019, Section 2.4.3.2, Historical Water Budget Analysis) indicated that diversions from the Santa Clara River vary widely depending on climate conditions. High-diversion years were wet years and low-diversion years were critical or dry years. Diversions of surface water by UWCD from the Santa Clara River are critical to the surface water supplies of the Oxnard Subbasin, and make up 12% of the surface water sources for the PVB. Dry-weather stream flows into the PVB from Arroyo Las Posas stopped around 2012. This could be permanent because of the significant decrease in discharges from Simi Valley and the MWTP, which has already occurred and is not expected to be reversed.

2.4.3.3 Current (2015) Water Budget Analysis

Groundwater level data presented in Section 2.3, Groundwater Conditions, and the change in storage estimates for the calendar year 2015 from Tables 2-6a through 2-6c indicate that the PVB had greater groundwater outflows than inflows in 2015. The estimated 2015 groundwater change in storage is a loss of about 13,657 AF (a storage decrease; see Tables 2-6a through 2-6c). Groundwater change in storage and cumulative change in storage are discussed in Section 2.3.2, Estimated Change in Storage. Table 2-9 indicates that since 2012, the PVB has had a decline in groundwater storage. Groundwater extractions for calendar years 2012–2015 averaged 17,304 AFY (Table 2-10), which is higher than the average of 15,671 AFY for 1985–2011 and the 15,429 AFY average from 1985–2011. This is because of the dry and critical water years from 2012 to 2015 (Figures 2-17 and 2-18). This corresponds to the decrease in the delivery of Santa Clara River water from an average of 4,382 AFY from 1985 to 2011 (Table 2-8). Except for the percolation of Arroyo Las Posas water, the other water sources listed in Section 2.4.3.2—Conejo Creek water delivered by CWD, imported water, Calleguas Creek, and Conejo Creek percolation—remained about the same from 2012 to 2015. As noted in Section 2.4.3.2, dry weather stream flows into the PVB from Arroyo Las Posas stopped around 2012 and are likely permanently lost due to the significant decrease in discharges from Simi Valley and the MWTP, which has already occurred and is not expected to be reversed.

2.4.3.4 Estimates of Historical Sustainable Yield

Historical estimates for the PVB sustainable yield have also included the Oxnard Subbasin.[6] These historical sustainable yield estimates include the following:

- FCGMA, 1985a, Groundwater Management Plan
- FCGMA, 2007, 2007 Update to the Fox Canyon Groundwater Management Agency Groundwater Management Plan

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[6] SGMA requests that an estimate of the "sustainable yield" be made for the PVB based on historical data. However, as used in this section the sustainable yield does not address undesirable results, which are discussed in Chapter 3, Sustainable Management Criteria.

- UWCD and CMWD, 2012, Preliminary Draft Yield Analysis (UWCD 2016b)
- UWCD, 2016, Proposed Method for Estimating Sustainable Yield (UWCD 2016b)

All of these historical estimates for combined PVB and Oxnard Subbasin sustainable yield are about 65,000 AFY, and do not demonstrate that this groundwater pumping rate would prevent seawater intrusion in the Oxnard Subbasin. Even if seawater intrusion is not a problem in the PVB, groundwater pumping in the PVB during drought years contributes to seawater intrusion in the Oxnard Subbasin, and groundwater pumping in the PVB will need to be managed under a coordination agreement with the Oxnard Subbasin to prevent seawater intrusion. Thus, the following discussion is highly relevant to the estimated sustainable yield of the PVB.

The UWCD Open-File Report 2017-02 (UWCD 2017a) Scenario D estimated that if there were no groundwater pumping in what the report refers to as the “Saline Intrusion Management Area,” and that if groundwater pumping were reduced by about 70% in the LAS in the PVB and the Oxnard Plain (excluding the Forebay), and if there was no reduction in UAS pumping, that seawater intrusion would be halted. However, this scenario assumed that groundwater for irrigation in the Saline Intrusion Management Area would be supplied by some type of project to be implemented in the future. The estimated sustainable yield under Scenario D was 59,900 AFY for the PVB and the Oxnard Subbasin (excluding the Saline Intrusion Management Area).

To estimate the sustainable yield under historical conditions where no future project is implemented, the UWCD conducted Scenario F in the Addendum to Open-File Report 2017-02a (2017b). In Scenario F, the Saline Intrusion Management Area was eliminated, and a uniform reduction in groundwater pumping was simulated to achieve sustainable yield. The scenario defined a sustainable yield as maintaining groundwater elevations along the coast at levels sufficiently high to prevent seawater intrusion and other forms of saline water intrusion. In the Port Hueneme area, where the UAS and LAS are believed to have direct hydraulic connection with the Pacific Ocean, they assume minimum thresholds as defined in Open-File Report 2017-02a.[7] However, they assume minimum threshold for the LAS near Mugu Lagoon to be −20 feet msl instead of 18.5 feet msl, as assumed in Open-File Report 2017-02 (UWCD 2017a). This is because the UWCD Saline Intrusion Update Report (UWCD 2016a) interpreted the source of elevated chloride concentrations in the LAS near Mugu Lagoon to be saline water yielded from marine clays and/or from adjacent Tertiary age sedimentary rocks, as a result of large declines in potentiometric head in the LAS over the past several decades, and not directly the result of current seawater intrusion. Both the U.S. Geological Survey and UWCD models included faults in the Mugu Lagoon area that limit the hydraulic connection of the LAS in the Oxnard Basin to the Pacific Ocean (Hanson et al. 2003; Appendix D).

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[7] *Minimum threshold* used here is in reference to the Open File Report 2017-02 usage and not to the minimum threshold discussed in Chapter 3 of this GSP.

Based on the results from UWCD Scenario F (2017b, Table 2-2), the sustainable yield under historical conditions with no changes from the current pumping locations (i.e., without water supply or infrastructure projects) for the PVB would be a total of 10,000. Based on the results from UWCD Scenario F (UWCD 2017b, Table 2-2), the sustainable yield under historical conditions with no changes from the current pumping locations (i.e., without water supply or infrastructure projects) for the Oxnard Subbasin would be a total of 39,000 AFY (27,000 AFY from the Oxnard Plain and 12,000 AFY from the Oxnard Forebay area).

2.4.4 Uncertainties in the Water Budget

There are several limitations and uncertainties associated with some historical water budget terms due to necessary simplifying of assumptions and data gaps. Uncertainties about the groundwater models used are discussed in Section 2.4.5.8, Uncertainty Analysis. Some of the general water budget limitations and/or uncertainties include the following:

1. The reporting of groundwater pumping outside the FCGMA boundaries is limited and there is a possibility of underreporting of pumping within the FCGMA boundaries due to metering equipment errors or malfunctions. Additional future data collection is needed to fill this data gap. However, the amount of pumping outside the FCGMA boundary is expected to be minor given the limited number of wells (estimated at fewer than 12).
2. The hydrologic base period (calendar years 1985–2015, DWR's 31-year base period) may not necessarily be representative of long-term average conditions. As shown on Figure 1-6, Long-Term Precipitation Trends in the Oxnard Plain, this was a generally wetter-than-average period. However, the future water budget analysis in Section 2.4.5, which used a model 50-year period with an average precipitation period (1939 to 1979), does not suggest that the historical sustainable yield estimate based on this wetter-than-average period is too high. The sustainable yield for the future water budget ranged from 11,600 AFY to plus or minus 1,200 AFY for the older alluvium and the LAS. The estimated historical sustainable yield using UWCD Scenario F (Section 2.4.3.2) of 10,000 AFY is close to the low end of this range. The uncertainty associated with the future water budget and the sustainable yield are discussed in Section 2.4.5.8, Uncertainty Analysis, and Section 2.4.5.9, Estimates of Future Sustainable Yield, respectively.
3. Conclusions regarding uncertainties in the UWCD model are discussed in Section 2.4.5.8, and in the Dudek peer review of the UWCD model (Appendix I, UWCD Model Peer Review).
4. Subsurface inflows and outflows across basin boundaries are not measurable. The groundwater level data in these areas by themselves do not provide a clear indication of groundwater flow directions because of the limited water level measurements and the variation in time between measurements. The UWCD model provides a significantly

improved understanding of these boundary fluxes and their variability under different pumping and recharge conditions in the region, but checking model values with observations and calculating the gradient with three-point groundwater flow problems should be considered to verify model estimates. Estimating inflows and outflows across basin boundaries using well groundwater level data was attempted for this GSP, but data gaps and limited well locations screened in one aquifer made the results unreliable.

5. Semi-perched groundwater in the PVB is captured by tile drains, rather than recharging the UAS. This uncertainty could be reduced through installation of instrumentation and measurement of discharges from the tile drains.
6. Currently, aquifer-specific water level maps are not reliable to estimate aquifer change in groundwater storage due to the limited number and distribution of aquifer-specific water wells. Dedicated monitoring wells could be installed and equipped with water-level measuring data loggers in all of the aquifers. This would help decrease uncertainty in estimates of future changes in groundwater storage by enabling use of aquifer-specific water-level maps to check groundwater model change in storage calculations.

2.4.5 Projected Water Budget and Sustainable Yield

Several model scenarios were developed in accordance with Sustainable Groundwater Management Act (SGMA) guidelines to assess the future sustainable yield of the PVB, the Oxnard Subbasin, and the West Las Posas Management Area (WLPMA) of the LPVB. Each future scenario covered a 50-year time frame, from 2020 to 2069 (the “model period”). In this GSP, the period from 2020 to 2039 is referred to as the implementation period, and the period from 2040 to 2069 is referred to as the sustaining period. The sustainable yield was determined from the model scenarios that did not result in a net flux of seawater into either the UAS or the LAS in the Oxnard Subbasin, within the level of the model uncertainty, during the 30-year sustaining period (Figure 2-44, Coastal Flux from the UWCD Model Scenarios).

Because the PVB is hydraulically connected to the Oxnard Subbasin, the sustainable yield of the PVB is influenced by groundwater production and projects in the Oxnard Subbasin. The UWCD model used to assess the sustainable yield of the PVB, the Oxnard Subbasin, and the WLPMA in the model domain, and the modeling assumptions associated with each scenario discussed below include the assumptions made for these adjacent basins.

The model scenarios developed for the Oxnard Subbasin, the PVB, and the WLPMA all included existing projects and the 2070 DWR climate-change factor applied to the 1930–1970 historical precipitation and hydrology base period. The model scenarios are the following:

- Future Baseline Simulation (2015–2017 average production rates adjusted for surface water deliveries). Future surface water deliveries were estimated by UWCD using Santa Clara River flows for historical periods, the 1930–1979 climate period adjusted for future

DWR climate-change factors, and estimated diversions based on similar historical Santa Clara River flows. UWCD also considered current allowable diversions, which accounts for current environmental restraints and diversion operating conditions, and optimization of water deliveries for the PVP and spreading basins. Additional details about the UWCD future model scenarios are included in Appendix J.

- Future Baseline Simulation With Projects (2015–2017 average production rates adjusted for surface water deliveries; potential future projects that met the DWR conditions for incorporation in the GSP)
- Reduction With Projects (35% reduction of 2015–2017 average production rates adjusted for surface water deliveries for the UAS and LAS in the Oxnard Subbasin, 20% reduction for the UAS and the LAS in the PVB; and 20% in the LAS in the WLPMA; potential future projects that met the DWR conditions for incorporation in the GSP)
- Reduction Without Projects 1 (reduction of 2015–2017 average production rates adjusted for surface water deliveries by 25% in the UAS, 60% in the LAS, and 45% for wells screened in both aquifer systems in the Oxnard Subbasin; 25% reduction for the UAS and the LAS in the PVB; and 25% in the LAS in the WLPMA)
- Reduction Without Projects 2 (reduction of 2015–2017 average production rates adjusted for surface water deliveries by 55% in the UAS and the LAS in the Oxnard Subbasin; 20% reduction for the UAS and the LAS in the PVB; and 20% in the LAS in the WLPMA)
- Reduction Without Projects 3 (reduction of 2015–2017 average production rates adjusted for surface water deliveries by 55% in the UAS and the LAS in the Oxnard Subbasin; 0% reduction for the UAS and the LAS in the PVB; and 0% in the LAS in the WLPMA)

Two model scenarios listed above, the Future Baseline Simulation With Projects Scenario and the Reduction With Projects Scenario, incorporated projects that were approved for inclusion in the GSP model scenarios by the FCGMA Board. The Board’s approval of these projects only indicates that they were sufficiently defined by the project proponent to be analyzed as part of the GSP. It does not indicate that these specific projects will necessarily be constructed or, conversely, that other projects will not be developed in the future. The projects included are discussed in more detail with the description of each scenario below.

An initial set of four modeling simulations were conducted using the future baseline conditions with two 50-year average climate cycles (1930–1979 and 1940–1989), and two DWR climate-change factors (2030 and 2070) applied to each of the 50-year periods. The 1930–1979 50-year period with the 2070 DWR climate-change factor was found to be the most conservative and was used for the comparison with the other modeling simulations conducted. Additional details about the selection of the two 50-year average climate cycles is provided in Section 2.4.5.7, Alternative Climate and Rainfall Patterns.

In addition to the initial set of four modeling simulations and the six model scenarios listed above, the Reduction Without Projects Scenario 1 was simulated with the DWR 2030 climate-change factor and with a historical precipitation and hydrology base period from 1940 to 1989. These simulations were conducted to better understand the potential impact of precipitation patterns and climate change factors on the model results.

Over the next 5 years, as additional projects are developed, the model assumptions discussed below will need to be altered and incorporated into the 5-year GSP evaluation.

2.4.5.1 Future Baseline Model Simulation

SGMA requires that the GSP include an assessment of the "future baseline" conditions. In the Future Baseline Scenario, in order to assess whether or not groundwater extractions from the PVB, the Oxnard Subbasin, and the WLPMA were sustainable at their current rates, the average annual 2015–2017 production rates were simulated. For the PVB, this rate is approximately 14,000 AFY (Table 2-11).

Future Baseline Scenario Model Assumptions

The Future Baseline model simulation included the following:

- Constant pumping at the 2015–2017 average rate of approximately 14,000 AFY in the PVB, 68,000 AFY in the Oxnard Subbasin (39,000 AFY in the UAS; 29,000 AFY in the LAS), and 13,000 AFY in the WLPMA
- Starting water levels equal to the final 2015 water levels from the historical simulations
- Precipitation and streamflow for two 50-year periods (1930–1979 and 1940–1989), with an average precipitation that equaled the average precipitation for the entire historical record
- Estimates of Santa Clara River surface water available for diversion prepared by UWCD staff using climate-change factors provided by DWR and historical measured flow in the river for the 50-year periods
- East Las Posas Management Area outflows to Arroyo Las Posas to the PVB from the CMWD model
- Projects that are currently operating in the PVB or currently under development

The historical measurements of precipitation for the two 50-year periods were modified using the DWR 2030 and 2070 climate-change factors. Stream flows were estimated using the adjusted rainfall. UWCD estimated Santa Clara River flow and the volume of water diverted to direct delivery and spreading. Pumping was decreased where the water is delivered to account for the surface water delivered. Future streamflow in Conejo and Calleguas Creeks in the PVB were estimated by regression.

No projects currently under development were identified in the Oxnard Subbasin, but two projects under development in the PVB were incorporated into the future baseline simulation because these projects affect inflows to the Oxnard Subbasin. The two projects in PVB are the City of Camarillo's North Pleasant Valley Desalter (desalination) Project and Conejo Creek Diversion deliveries to PVCWD. The North Pleasant Valley Desalter Project was simulated by dividing the total project pumping of 4,500 AFY between project extraction wells 02N20W19L05 and 02N20W19F04.

In this scenario, Conejo Creek diversions will increase deliveries to agriculture by an additional 2,200 AFY to make the total deliveries in the PVB 4,500 AFY starting in 2020. The Conejo Creek Project allows CWD to increase pumping by up to 4,500 AFY based on credits for surface water delivered to PVCWD. In running the future simulations, however, it became apparent that the model cells identified for production from the CWD wells were not able to extract the full amount. The amount of simulated CWD pumping that was achievable in the future baseline simulation was therefore limited to 2,816 AFY.

It is important to remember that groundwater extractions are not the only source of water to the PVB. Surface water deliveries vary between the model scenarios because the model adjusts the deliveries of Santa Clara River water based on simulated groundwater elevations in the Oxnard Forebay. Additionally, although the model calculates the groundwater extractions and surface water deliveries with precision, the values reported in Table 2-11 have been rounded to the nearest 1,000 AFY to reflect the uncertainty in the model calculations.

Future Baseline Scenario Model Results

Both the modeled flux of seawater and the particle tracks from the Future Baseline Scenario indicate that continuing the 2015–2017 extraction rate for the PVB and the Oxnard Subbasin over the next 50 years would cause net seawater intrusion in both the UAS and the LAS, as well as ongoing inland migration of the 2015 saline water impact front. Because the model showed the saline water impact front continuing to migrate landward throughout the sustaining period, even during wetter-than-average climate periods, the current areal and aquifer-system distribution of groundwater production at the extraction rates in the PVB and the Oxnard Subbasin was determined not to be sustainable.

2.4.5.2 Future Baseline With Projects Model Simulation

Future Baseline With Projects Scenario Model Assumptions

Modeling of future conditions included all of the assumptions incorporated into the Future Baseline simulation, and also incorporated potential future projects approved for inclusion by the FCGMA Board. Incorporation of the potential future projects in the Future Baseline With

Projects Scenario neither represents a commitment by FCGMA to impose pumping reductions in the amounts specified at the wells identified below nor a commitment to move forward with each project included in the future model scenarios. Assumptions about projects and project implementation may have changed since the modeling was conducted and will continue to change over the next 5 years. These changes should be incorporated into the modeling for the 5-year GSP evaluation.

In the PVB, a proposed temporary fallowing project was simulated near the pumping trough (in Model Parameter Zone 11; Figure 2-45, Pleasant Valley Basin Management Areas). This project would generate a 2,407 AFY reduction in pumping; however, actual simulated fallowing totaled 2,234 AFY due to considerations of existing contracts for the delivery of surface water from the Santa Clara River. Pumping was preferentially reduced in wells in the LAS within the PVB to the extent possible. These projects are discussed in detail in Chapter 5, Projects and Management Actions, of this GSP.

In the Oxnard Subbasin, simulated future projects included delivery of 4,600 AFY of recycled water to farmers in the vicinity of Hueneme Road, expansion of the GREAT Program to increase groundwater recharge by 4,500 AFY in the Saticoy Spreading Grounds, and a 504 AFY reduction of pumping through temporary fallowing.

To simulate the delivery of 4,600 AFY of recycled water to farmers in the vicinity of Hueneme Road, pumping from wells near the coast in the pumping depression area (UWCD Model Parameter Zone 4; Figure 2-45) was reduced uniformly and proportionally by 4,600 AFY. Additionally, pumping from Wells 02N22W23C05S and 02N22W23C07S in the Forebay was adjusted to allow the City of Oxnard to pump up to 8,000 AFY of accumulated credits for 2,600 AF recycled agricultural water delivered annually from the GREAT Program.

To simulate the expansion of the GREAT Program, spreading recharge was increased by 4,500 AFY starting in 2025. To simulate the 504 AFY reduction of pumping through fallowing, pumping from Wells 01N22W26K04S, 01N22W27H02S, 01N22W26M03S, 01N22W26K03S, 01N22W26P02S, 01N22W26Q03S, and 01N22W26D05S was reduced uniformly and proportionally by 504 AFY. It should be noted that these wells were selected for modeling purposes only and use of these wells in the model simulations was not intended to represent any planned pumping restrictions or limitations on these wells.

In the WLPMA, future projects included the purchase of 1,762 AFY of water to be delivered to the eastern portion of WLPMA in lieu of groundwater extraction. Simulated pumping was reduced in Zone Mutual Water Company Wells 02N20W07R03, 02N20W07R02, 02N20W08M01, 02N20W08E01, and 02N20W08F01, as well as Ventura County Waterworks District No. 19 Wells

02N20W06R01 and 02N20W08B01. The pumping reductions of 1,762 AFY were applied uniformly and proportionally across the wells.

After incorporating the potential future projects, the average groundwater production rate for the PVB was 4,300 AFY in the UAS and 7,600 AFY in the LAS. In the WLPMA, the average production rate in the LAS was 11,200 AFY. The average pumping rate for the UAS in the Oxnard Subbasin was 41,000 AFY and the average groundwater production rate for the LAS in the Oxnard Subbasin was 24,000 AFY for the Future Baseline With Projects Scenario.

Because the projects that were incorporated into the Future Baseline With Projects Scenario included temporary fallowing in the PVB and the Oxnard Subbasin, the groundwater extractions in the LAS of the PVB decreased by approximately 1,000 AFY, relative to the Future Baseline Scenario. At the same time, the groundwater extractions from the older alluvium decreased by approximately 2,000 AFY, relative to the Future Baseline Scenario, in the Future Baseline With Projects Scenario (Table 2-11). The total water available to the PVB in the Future Baseline Plus Projects Scenario was approximately 12,000 AFY, with the reduction in groundwater production being offset by the addition of approximately 2,000 AFY of project water.

Future Baseline With Projects Scenario Model Results

Although the shift in groundwater extractions from the LAS to the UAS in the Oxnard Subbasin and the reduction in the total extractions helped reduce the flux of seawater into the Oxnard Subbasin, overall the Future Baseline With Projects Scenario resulted in approximately 3,000 AFY of seawater flux into the UAS and 2,700 AFY into the LAS during the sustaining period (FCGMA 2019). Particle tracks for the Future Baseline With Projects Scenario also showed net landward migration of the saline water impact front during the sustaining period (FCGMA 2019). Based on these factors, the current areal and aquifer-system distribution of groundwater production at the extraction rates modeled in the Future Baseline With Projects Scenario was determined not to be sustainable.

2.4.5.3 Reduction With Projects Scenario

Reduction With Projects Scenario Model Assumptions

The Reduction With Projects Scenario included all of the assumptions incorporated into both the Future Baseline simulation and the Future Baseline With Projects Scenario. The Reduction With Projects Scenario also included a 35% reduction of 2015–2017 average production rates for the UAS and the LAS in the Oxnard Subbasin, 20% reduction for the UAS and the LAS in the PVB, and 20% in the LAS in the WLPMA. Groundwater production rates were reduced linearly over the implementation period and held constant during the sustaining period. In the PVB, the older alluvium simulated groundwater production rate in model year 2020 (the beginning of the implementation period) was 6,800 AFY. The production rate in model year 2040, at the beginning of the sustaining period, was 3,000 AFY.[8] The average production from the older alluvium for the sustaining period was 2,000 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 11,400 AFY and the simulated groundwater production rate in model year 2040 was 9,800 AFY. The average production rate from the LAS for the sustaining period was 7,000 AFY.

Reduction With Projects Model Scenario Results

Reducing groundwater production in the UAS and the LAS, and shifting some groundwater extractions from the LAS to the UAS via the potential future projects in the Reduction With Projects Scenario, resulted in an average flux of groundwater out of the UAS into the Pacific Ocean of approximately 3,300 AFY during the sustaining period. In the LAS, the Reduction With Projects Scenario resulted in an average flux of approximately 1,200 AFY of seawater into the LAS during the sustaining period (FCGMA 2019). Particle tracks for the Reduction With Projects model Scenario indicate that the location of the 2015 saline water impact front would likely migrate toward the Pacific Ocean in the UAS as freshwater diluted saline concentrations, while it would experience some landward migration in the LAS (FCGMA 2019). The continued landward migration of the saline water impact front in the LAS suggests that groundwater production in the LAS may need to be reduced further than it was in this model scenario, while at the same time the groundwater production rate in the UAS was likely lower than it needed to be, as groundwater left the aquifers of the UAS and entered the Pacific Ocean.

2.4.5.4 Reduction Without Projects Scenario 1

Reduction Without Projects Scenario 1 Model Assumptions

The Reduction Without Projects Scenario 1 included all of the assumptions incorporated into the future baseline simulation but did not include the projects that were incorporated into the Future Baseline With Projects and Reduction With Projects Scenarios. In the Oxnard Subbasin, the Reduction Without Projects Scenario 1 also included a 25% reduction of 2015–2017 average production rates for wells screened solely in the UAS, a 60% reduction of the 2015–2017 average production rates for wells screened solely in the LAS, and a 45% reduction of the 2015–2017 average production rates for wells screened in both aquifer systems. The 2015–2017 average pumping rate was reduced by 25% in the UAS and the LAS in the PVB, and 25% in the LAS in the WLPMA. Groundwater production rates were reduced linearly over the implementation period and held constant during the sustaining period.

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[8] Modeled extraction rates depend on climate, surface water availability, and simulated groundwater elevations for each model year. The reductions implemented reflect a reduction in overall water demand for the PVB and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate from the older alluvium in 2040 is 45% of the extraction rate in 2020, rather than the 35% specified in the model scenario description.

In the PVB older alluvium, the simulated groundwater production rate in model year 2020 (the beginning of the implementation period) was 7,500 AFY. The production rate in model year 2040, at the beginning of the sustaining period, was 3,500 AFY.[9] The average production from the older alluvium for the sustaining period was 3,000 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 13,000 AFY and the simulated groundwater production rate in model year 2040 was 10,000 AFY. The average production rate from the LAS for the sustaining period was 7,000 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 10,000 AFY for the 30-year sustaining period (Table 2-11).

Reduction Without Projects Scenario 1 Model Results

The fluxes in the UAS and the LAS in the Reduction Without Projects Scenario 1 were similar to those simulated in the Reduction With Projects Scenario (Figure 2-44). There was an average flux of groundwater out of the UAS into the Pacific Ocean of approximately 2,800 AFY during the sustaining period in the Reduction Without Projects Scenario 1. In the LAS, the Reduction Without Projects Scenario 1 resulted in an average flux of approximately 1,300 AFY of seawater into the LAS during the sustaining period. Particle tracks for this scenario indicate that the 2015 saline water impact front would likely migrate toward the Pacific Ocean in the UAS as freshwater diluted saline concentrations in the UAS, while it would migrate farther landward in the LAS than in the Reduction With Projects Scenario (FCGMA 2019). As in the Reduction With Projects Scenario, the continued landward migration of the saline water impact front in the LAS suggests that groundwater production in the LAS may need to be reduced further than it was in the Reduction Without Projects Scenario 1, while at the same time the groundwater production rate in the UAS was likely lower than it needed to be, as groundwater left the aquifers of the UAS and entered the Pacific Ocean.

2.4.5.5 Reduction Without Projects Scenario 2

Reduction Without Projects Scenario 2 Model Assumptions

The Reduction Without Projects Scenario 2 included all of the assumptions incorporated into the Future Baseline simulation but did not include the projects that were incorporated into the Future Baseline With Projects and Reduction With Projects Scenarios. In the Oxnard Subbasin, the Reduction Without Projects Scenario 2 also included a 55% reduction of 2015–2017 average production rates for the UAS and the LAS. The 2015–2017 average pumping rate was reduced by 20% in the UAS and the LAS in the PVB, and by 20% in the LAS in the WLPMA. Groundwater production rates were reduced linearly over the implementation period and held constant during the sustaining period.

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[9] Modeled extraction rates depend on climate, surface water availability, and simulated groundwater elevations for each model year. The reductions implemented reflect a reduction in overall water demand for the PVB and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate from the older alluvium in 2040 is 47% of the extraction rate in 2020, rather than the 25% specified in the model scenario description.

In the PVB, the older alluvium simulated groundwater production rate in model year 2020 (the beginning of the implementation period) was 6,800 AFY. The production rate in model year 2040 (at the beginning of the sustaining period) was 3,000 AFY.[10] The average production from the UAS for the sustaining period was 3,000 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 12,000 AFY and the simulated groundwater production rate in model year 2040 was 11,000 AFY. The average production rate from the LAS for the sustaining period was 8,000 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 11,000 AFY for the 30-year sustaining period (Table 2-11).

Reduction Without Projects Scenario 2 Model Results

Model results indicate that under this scenario, the groundwater flux in the LAS between the PVB and the Oxnard Subbasin is mostly reversed from the above scenarios from about model year 2027 to model year 2055. The groundwater flow during this period (2027–2055) in the LAS is from the Oxnard Subbasin to the PVB. This increased the seawater intrusion in the LAS in the Oxnard Subbasin, exacerbating the Oxnard Subbasin’s seawater intrusion problem.

There was an average flux of groundwater out of the UAS into the Pacific Ocean of approximately 4,700 AFY during the sustaining period in the Reduction Without Projects Scenario 2 and an average flux of approximately 900 AFY of seawater into the LAS. As in the Reduction With Projects Scenario 1, the continued inflow of seawater into the LAS suggests that groundwater production in the LAS may need to be reduced further than it was in the Reduction With Projects Scenario 2, while at the same time the groundwater production rate in the UAS was likely lower than it needed to be, as groundwater left the aquifers of the UAS and entered the Pacific Ocean.

2.4.5.6 Reduction Without Projects Scenario 3

Reduction Without Projects Scenario 3 Model Assumptions

The Reduction Without Projects Scenario 3 included all of the assumptions incorporated into the Future Baseline simulation but did not include the projects that were incorporated into the Future Baseline With Projects and Reduction With Projects Scenarios. In the Oxnard Subbasin, the Reduction Without Projects Scenario 3 also included a 55% reduction of 2015–2017 average production rates for the UAS and the LAS. The 2015–2017 average pumping rate was not reduced in the UAS and the LAS in the PVB, and was not reduced in the LAS in the WLPMA. Groundwater

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[10] Modeled extraction rates depend on climate, surface water availability, and simulated groundwater elevations for each model year. The reductions implemented reflect a reduction in overall water demand for the PVB and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate from the older alluvium UAS in 2040 is 44% of the extraction rate in 2020, rather than the 55% specified in the model scenario description.

production rates were reduced in the Oxnard Subbasin linearly over the implementation period and held constant during the sustaining period.

In the PVB, the older alluvium simulated groundwater production rate in model year 2020 (at the beginning of the implementation period) was 7,000 AFY. The production rate in model year 2040 (at the beginning of the sustaining period) was 5,000 AFY. The average production from the older alluvium for the sustaining period was 5,000 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 12,000 AFY and the simulated groundwater production rate in model year 2040 was 13,000 AFY. The average production rate from the LAS for the sustaining period was 9,000 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 14,000 AFY for the 30-year sustaining period (Table 2-11).

Reduction Without Projects Scenario 3 Model Results

Model results indicate that under this scenario the groundwater flux in the LAS between the PVB and the Oxnard Subbasin is reversed from model year 2027 to the end of the model period (2069). The groundwater flow during this period (after 2027) in the LAS is from the Oxnard Subbasin to the PVB. This significantly increases the seawater intrusion in the LAS in the Oxnard Subbasin, exacerbating the Oxnard Subbasin's seawater intrusion problem.

There was an average flux of groundwater out of the UAS into the Pacific Ocean of approximately 3,700 AFY during the sustaining period in the Reduction Without Projects Scenario 3, and an average flux of approximately 1,400 AFY of seawater into the LAS. As in the Reduction Without Projects Scenarios 1 and 2, the continued inflow of seawater into the LAS suggests that groundwater production in the LAS may need to be reduced further than it was in the Reduction With Projects Scenario 3, while at the same time the groundwater production rate in the UAS was likely lower than it needed to be, as groundwater left the aquifers of the UAS and entered the Pacific Ocean.

2.4.5.7 Alternative Climate and Rainfall Patterns

To begin to assess the potential impacts on model predictions from alternate climate change assumptions and precipitation patterns, two additional simulations were conducted using the Reduction Without Projects Scenario 1. These additional simulations changed the scenario assumptions in two ways. First, the Reduction Without Projects Scenario 1 was simulated using the DWR 2030 climate-change factors, rather than the more conservative 2070 climate-change factors. This revised scenario is referred to as the Reduction Without Project Scenario 1a. Second, the Reduction Without Projects Scenario 1 was simulated with the DWR 2030 climate-change factors applied to the historical precipitation and hydrology period from 1940 to 1989, rather than the original period from 1930–1979. This revised scenario is referred to as the Reduction Without Projects Scenario 1b.

The 50-year periods from 1930 to 1979 and 1940 to 1989 were selected because they were the two periods from the entire historical record with the closest mean, or average, precipitation to the mean precipitation for the entire historical record of 14.4 inches. The mean precipitation for the historical period from 1930 to 1979 is also 14.4 inches and the mean precipitation from the historical period from 1940 to 1979 is 14.6 inches. These periods also have a similar distribution of precipitation years to the historical record and a similar average drought length to the average drought length in the historical record. The primary difference between the two periods is the timing of the dry periods in the records. The period from 1930 to 1979 begins with a 7-year dry period from 1930 to 1936 (model years 2020–2026), while the period from 1940 to 1989 begins with a 5-year wetter-than-average period (model years 2020–2024). The differences between these scenarios are discussed below.

Reduction Without Projects Scenario 1a

The Reduction Without Projects Scenario 1a had approximately 2,200 AFY of freshwater flowing out of the UAS to the Pacific Ocean and 1,500 AFY of seawater intrusion into the LAS during the sustaining period. Compared to the Reduction With Projects Scenario 1, there was approximately 600 AFY less flow out of the UAS and approximately 200 AFY more flow into the LAS from the Pacific Ocean (Figure 2-44). This is the result of lower water levels in the UAS and the LAS under this scenario than the Reduction With Projects Scenario 1. The 2030 climate-change factor showed lower potential water levels and more seawater intrusion than the 2070 climate-change factor; however, the difference between the simulated fluxes in the two scenarios is within the uncertainty of the model predictions and is not significant compared to other uncertainties in the future simulations, including the actual precipitation pattern that will prevail over the period from 2020 to 2069.

Reduction Without Projects Scenario 1b

The Reduction Without Projects Scenario 1b had approximately 4,300 AFY of freshwater flowing out of the UAS to the Pacific Ocean and 760 AFY of seawater intrusion into the LAS during the sustaining period. Compared to the Reduction Without Projects Scenario 1a discussed above, the Reduction Without Projects Scenario 1b had 2,100 AFY more freshwater leaving the UAS and 800 AFY less seawater intrusion in the LAS during the sustaining period (Figure 2-44). The reduced seawater intrusion and increased freshwater outflow are the result of higher simulated groundwater levels during the sustaining period than in the Reduction Without Projects Scenario 1a. The groundwater elevations in the Reduction Without Projects Scenario 1b rise faster in response to the wetter-than-average precipitation pattern that occurs at the beginning of the model period (model years 2020–2024) and remain higher during the sustaining period (model years 2040–2069) than they do in the Reduction Without Projects Scenario 1a. The differences in seawater intrusion and water levels between the Reduction Without Projects Scenarios 1a and 1b show that the model is more sensitive to actual precipitation patterns than it is to the predicted relative changes in climate between 2030 and 2070. The actual climate and precipitation patterns over the next 5 years should be used to revise the model simulations and refine the estimated potential for net seawater intrusion during the sustaining period.

2.4.5.8 Uncertainty Analysis

A peer review of the UWCD model was conducted to provide an independent evaluation of the model for use in the context of developing a GSP and to quantify the uncertainty associated with the modeling estimates of the sustainable yield for the basins in the model domain (Appendix I). UWCD conducted a *local* sensitivity analysis of its model prior to this review, in order to evaluate how the model input parameters obtained via the model calibration affect the model outputs. The peer review conducted an additional *global* sensitivity analysis that keys off their local sensitivity analysis and allows for a quantitative assessment of uncertainty in seawater flux and sustainable yield.

General Results

Results of the model scenarios discussed above indicate that changes to groundwater production rates or to extraction locations for the Oxnard Subbasin are needed to avoid seawater intrusion in the LAS during the sustaining period. Understanding the uncertainties in the model predictions underscores the desirability of making gradual changes in production rates while additional monitoring and studies help to reduce these uncertainties.

The largest potential sources of uncertainty in the model were found to be hydraulic properties for a given precipitation pattern. As discussed in Section 2.4.3, Current and Historical Water Budget Analysis, precipitation and surface water availability are a critical input parameter for predictive simulations. Critical areas of hydraulic properties were constrained in the historical simulations by aquifer testing. In particular, the model parameters that accounted for the most variance (approximately 37% of total variance) in minimizing error between observed groundwater levels and model simulated heads throughout the model were the horizontal hydraulic conductivities assigned to the Oxnard and Mugu Aquifers in the Forebay. The values assigned in the model were consistent with horizontal hydraulic conductivities determined from aquifer testing in that area. The fact that the most sensitive parameter assignments were well constrained by observations reduces uncertainty and provides good confidence in model predictions of groundwater levels overall.

Additionally and importantly, these same zones of horizontal hydraulic conductivity accounted for approximately 24% of total variance in model calculations of seawater flux across the ocean boundary. In contrast, the conductance of the ocean general head boundaries only accounted for approximately 3% of the variance in seawater flux. This indicates that the movement of artificially recharged groundwater from the Forebay to the coast is key in seawater flux. Additionally, the amount of Forebay recharge that enters the WLPMA rather than moving toward the coast was found to affect the seawater flux more than the conductance of the general head boundaries representing the ocean outcrops at the model boundary.

Stream infiltration, a parameter that was estimated based on the correlation between predicted and observed water levels, accounted for approximately 5% of the variance in seawater flux. Horizontal and vertical hydraulic conductivity of the aquitard separating Layer 5 (Mugu Aquifer) from Layer 7 (the Hueneme Aquifer) in the PVB accounted for approximately 3% of the variance in seawater flux. This sensitivity is associated with the flux across the basin boundary and the flow between the UAS and the LAS. Again, these parameters in the PVB accounted for more seawater flux than that accounted for by the conductance of the aquifer outcrops beneath the ocean.

Quantifying Uncertainty

For the Oxnard Subbasin, the uncertainty associated with model simulations of seawater flux was calculated by determining the relationship between simulated groundwater levels in wells near the coast and simulated seawater flux at the ocean boundary for the six model scenarios described in Section 2.4.5. The relationship was established by calculating the mean errors between observed and simulated groundwater levels at the coastal wells and applying the relationship between simulated groundwater levels and seawater flux to determine what the flux would have been had the model exactly reproduced observed groundwater levels. The analysis was conducted for both the entire model period (from 2020 to 2069) and the sustaining period (from 2040 to 2060).

The Oxnard Subbasin uncertainty analysis indicated that the uncertainty estimate for groundwater pumping in the Oxnard Subbasin was plus or minus 6,000 AFY in the UAS and 3,000 AFY in the LAS, for a total of plus or minus 9,000 AFY. The Oxnard Subbasin uncertainty analysis was used to interpolate the uncertainty for the PVB. This was done by using the uncertainty estimate for the Oxnard Subbasin and the ratio of model pumping in the PVB to the total model pumping for the three model basins: the Oxnard Subbasin, the PVB, and the WLPMA. This produced an uncertainty in PVB pumping of plus or minus 1,200 AFY for both the Shallow Alluvial Aquifer and the LAS.

The relationship between seawater flux and water levels will continue to be refined through data collection and analysis over successive 5-year periods for the GSP evaluations, and these uncertainty estimates are anticipated to contract accordingly.

2.4.5.9 Estimates of Future Sustainable Yield

The sustainable yield for PVB was assessed by examining the modeled flux of seawater into the UWCD future water scenarios over the 50-year model period and the 30-year sustaining period predicted for the UWCD model for the Oxnard Subbasin, the PVB, and the WLPMA. Only the sustaining period was assessed because SGMA recognizes that undesirable results may occur during the 20-year implementation period, as basins move toward sustainable groundwater management. In addition to the flux of seawater, particle tracks from the model runs were analyzed to evaluate the potential migration of the current extent of saline water impact in the UAS and the LAS. The particles were placed along the approximate inland extent of the zone of saline water impact in 2015. Scenarios that minimize the net flux of seawater into the Oxnard Subbasin and the landward migration of the saline water impact front over the 30-year sustaining period are sustainable for the Oxnard Subbasin, while those that allow for net seawater intrusion and landward migration of the saline water impact front are not.

None of the model scenarios described in Section 2.4.5 successfully eliminated seawater intrusion in the LAS of the Oxnard Subbasin during the 50-year model period, or the 30-year sustaining period, while the majority of the model scenarios resulted in net freshwater loss from the UAS to the Pacific Ocean. Therefore, none of the direct model scenarios was used to determine the sustainable yield of the PVB. Instead, the relationship between seawater flux and groundwater production from the model scenarios for both the 50-year period and the 30-year period were plotted graphically and the linear relationship between the seawater flux and groundwater production was used to predict the quantity of groundwater production that would result in no net seawater intrusion over the periods in either the UAS or the LAS. This method is also discussed in Appendix I, Section 2.3.2.2, and the seawater flux and groundwater production plots are provided in Appendix I as Figures 4 and 5. In order to provide separate estimates for the two aquifer systems, independent relationships between groundwater production and seawater intrusion were developed for the UAS and the LAS. It was possible to develop relationships for each aquifer within the UAS and the LAS, but in general wells in the Oxnard Subbasin are screened in multiple aquifers in each aquifer system. Therefore, for management purposes, the sustainable yield estimates were developed for the aquifer systems rather than for independent aquifers.

Based on the scenarios presented in Section 2.4.5 and the uncertainty analysis discussed in Section 2.4.5.8, the PVB sustainable yield for the older alluvium and the LAS was estimated to be 11,600 AFY plus or minus 1,200 AFY. Using the ratio of Shallow Alluvial Aquifer pumping to LAS pumping, this produces an estimate of 4,400 AFY for the Shallow Alluvial Aquifer and 7,200 AFY for the LAS.

It is anticipated that the analysis for the 5-year update to the GSP will focus on differential extractions on the coast and inland, particularly in the LAS. Additional modeling is recommended for the 5-year update process to understand how changes in pumping patterns can increase the overall sustainable yield of the PVB. As this understanding improves, projects to support increases in the overall sustainable yield can be developed.

2.5 MANAGEMENT AREAS

In order to sustainably manage the groundwater resources of the PVB, the PVB has been divided into three management zones: the North Pleasant Valley Management Area (NPVMA), the Pleasant Valley Pumping Depression Management Area (PVPDMA), and the East Pleasant Valley Management Area (EPVMA; Figure 2-46, Pleasant Valley Basin Management Areas).

The NPVMA lies within the PVB northern boundary, the Bailey Fault, and the PVPDMA, which were defined by the lateral extent of the FCA in the PVB. The NPVMA, which includes the City of Camarillo, is east of the PVPDMA and north of the EPVMA (Figure 2-46).

The PVPDMA is west of the NPVMA and north of the EPVMA (Figure 2-46). The boundaries of the PVPDMA include the Bailey Fault, the Oxnard Subbasin, and a northwest-trending line starting at the intersection of Lewis Road and the Bailey Fault. This management area was established based on the historically low groundwater elevations recorded in both the UAS and the LAS in the area.

The EPVMA lies to the east of the Bailey Fault and is predominantly within the jurisdiction of CWD. The FCGMA jurisdictional boundary extends along the Bailey Fault and thus along the boundary with the EPVMA (Figure 2-46). This management area was established based on the Bailey Fault, which acts as a barrier to groundwater flow, and where the FCA is missing (Turner 1975; Section 2.2.1).

This GSP has been prepared for the entire PVB. The PVPDMA and NPVMA defined in this GSP will be managed by FCGMA. The EPVMA lies within the jurisdiction of the Camrosa Water District–Pleasant Valley GSA and the Pleasant Valley Basin Outlying Areas GSA (see Figure 1-2). The minimum thresholds and measurable objectives developed in Chapter 3, Sustainable Management Criteria, are based on the data available in the PVPDMA and the NPVMA. Comparable historical data on groundwater elevation, storage, production, and quality are not available for the EPVMA. Therefore, the minimum thresholds and measurable objectives for the PVPDMA and the NPVMA will be applied to age- and/or depth-equivalent hydrostratigraphic units in the EPVMA. As additional data are collected in the EPVMA, separate minimum thresholds and management objectives may be developed. If changes to the minimum thresholds and management objectives are warranted, justification will be provided in the 5-year GSP updates.

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Table 2-1
Pleasant Valley Basin Hydrostratigraphic and Stratigraphic Nomenclature

Geologic Epoch	DWR (2003)	This Report	Hanson et al. (2003); Bachman (2016)	Kew (1924); Bailey (1951)[a]	Jakes (1979)	Weber and Kiessling (1976)	Dibblee (1992a, 1992b)	DeVecchio et al. (2012b)
	Water-Bearing Formations	*Hydrostratigraphic Units*		*Lithologic Units and Formations*				
Holocene	Alluvium	Shallow Alluvial Aquifer and Semi-Perched Aquifer	Shallow Alluvium	**Recent Alluvium:** Active lagoonal, beach, river, and floodplain, and alluvial deposits				**Alluvium:** Active alluvium
Upper Pleistocene		Older Alluvium	Upper Aquifer System	**Terrace Deposits:** Deformed river deposits	Older Alluvium: Deformed beach, river, floodplain, and terrace deposits			**Older Alluvium:** Incised and gently folded fluvial deposits
	San Pedro Formation	Upper San Pedro Formation	Hueneme Aquifer	**Saugus Formation:** Terrestrial and marine sand and gravel		**Saugus Formation:** Terrestrial fluvial	**Saugus Formation:** Terrestrial	Saugus Formation
						San Pedro Formation: Marine clays and sand and terrestrial sediment		**Las Posas Sand:** Shallow marine sand thickening westward
Lower Pleistocene		Fox Canyon Aquifer	Fox Canyon				**Las Posas Sand:** Shallow marine sand	
		Grimes Canyon Aquifer	Grimes Canyon			**Santa Barbara Formation:** Shallow marine sand		
Pliocene	Non-Water-Bearing	Non-Water-Bearing	Non-Water-Bearing	Fernando Group	Pico Formation			Absent
Miocene				**Modelo Formation:** Marine mudstones			Monterey Formation	
				Conejo Volcanics: Terrestrial and marine extrusive and intrusive igneous rocks				
Oligocene/ Eocene				**Sespe Formation:** Sandstone and cobble conglomerate				

Note:

[a] As cited in DeVecchio et al. 2012a.

Table 2-2
Vertical Gradient

Location	SWN	Well	Screen Interval		Spring 2015 Elevation (ft msl)	Gradient (ft/ft)[a]	Fall 2015 Elevation (ft msl)	Gradient (ft/ft)[a]	Aquifer
			Top	*Bottom*					
Western PVB	02N21W34G	5	170	190	10.08	–0.365	–10.19	–0.369	Older Alluvium
		4	360	380	–59.25	–0.072	–80.28	–0.088	Older Alluvium
		3	800	860	–92.53	0.043	–120.62	0.022	Fox Canyon
		2	938	998	–86.65		–117.52		Fox Canyon

Notes: ft/ft = feet per feet; ft msl = feet above mean sea level; PVB = Pleasant Valley Basin; SWN = state well number.

[a] Negative gradients are directed downward.

Table 2-3
Basin Plan and FCGMA Water Quality Thresholds for Groundwater in the PVB (mg/L)

Threshold Source	TDS	Chloride	Nitrate	Sulfate	Boron
LARWQCB Basin Plan WQO	700	150	45	300	1
FCGMA 2007 BMO	—	<150	—	—	—

Sources: LARWQCB 2017; FCGMA 2007.

Notes: BMO = Basin Management Objective; FCGMA = Fox Canyon Groundwater Management Agency; LARWQCB = Los Angeles Regional Water Quality Control Board; mg/L = milligrams per liter; PVB = Pleasant Valley Basin; TDS = total dissolved solids; WQO = Water Quality Objective.

Table 2-4
Modeled Surface Water Percolation from Streams in the Pleasant Valley Basin (AF)

Water Year[a]	Arroyo Las Posas Percolation	Conejo Creek Percolation	Calleguas Creek Percolation
1986	2,434	9,001	3,903
1987	284	8,232	3,365
1988	2,126	8,742	3,659
1989	944	8,404	3,507
1990	797	8,169	3,347
1991	1,463	8,132	3,479
1992	4,308	9,358	4,283
1993	6,197	9,778	4,559
1994	3,349	8,336	3,582
1995	5,411	9,316	4,333
1996	3,373	8,289	3,645
1997	4,594	8,336	3,735
1998	9,946	9,670	4,250
1999	5,659	8,207	3,609
2000	5,208	8,228	3,619
2001	7,064	8,697	3,899
2002[b]	5,489	8,135	3,483

Table 2-4
Modeled Surface Water Percolation from Streams in the Pleasant Valley Basin (AF)

Water Year[a]	Arroyo Las Posas Percolation	Conejo Creek Percolation	Calleguas Creek Percolation
2003	6,993	8,319	3,744
2004	4,266	7,623	3,273
2005	10,417	9,555	3,852
2006	7,309	7,997	3,587
2007	5,082	7,597	3,241
2008	4,924	8,119	3,562
2009	3,877	7,932	3,459
2010	5,750	7,643	3,515
2011	6,125	7,651	3,607
2012	3,883	7,252	3,369
2013	1,734	6,719	3,124
2014	1,663	5,868	3,074
2015	1,264	6,341	3,251
Average	**4,398**	**8,188**	**3,630**

Source: Appendix D.
Note: AF = acre-feet.

[a] Results presented are in water years, and will not match values presented in Section 2.4 text and tables, which are presented in calendar years.

[b] Conejo Creek Diversion Project began operating in the year 2002.

Table 2-5
Stream Flows in Arroyo Las Posas and Conejo Creek, Conejo Creek Diversions, Deliveries by CWD, and Discharges from CSD into Conejo Creek (AF)

Calendar Year	Camarillo Sanitary District Discharges to Conejo Creek (AF)[a]	Arroyo Las Posas Subsurface Inflows from East LPVB (CMWD Model, 2018) (AF)	Arroyo Las Posas Flows Measured at Stream Gauge 806 until 1997 and 806A until 2005 (AF)[b]	Conejo Creek Flows Measured at Stream Gauge 800 until 2011 and 800A until 2012 (AF)	Conejo Creek Flows Delivered by CWD for PVB Agriculture (AF)[c]	Conejo Creek Flows Delivered by CWD for Agriculture In PVCWD (AF)[d]	Conejo Creek Flows Delivered by CWD for PVB M&I (AF)	Total Conejo Creek Flow Diversions (AF)
1985	2,375	148	1,174	14,265	2,450	0	0	2,450
1986	2,420	647	11,707	25,621	2,450	0	0	2,450
1987	2,464	695	3,487	16,851	2,450	0	0	2,450
1988	2,565	899	3,256	16,922	2,450	0	0	2,450
1989	2,364	768	840	14,785	2,450	0	0	2,450
1990	1,826	925	1,068	12,608	2,450	0	0	2,450
1991	1,456	1,090	9,715	20,227	2,450	0	0	2,450
1992	1,815	1,597	26,792	44,305	2,450	0	0	2,450
1993	1,512	1,877	27,749	52,306	2,450	0	0	2,450
1994	2,576	1,754	2,956	16,195	2,450	0	0	2,450
1995	3,338	1,991	26,984	45,909	2,450	0	0	2,450
1996	3,730	1,944	9,919	22,862	2,450	0	0	2,450
1997	3,327	1,920	10,742	22,905	2,450	0	0	2,450
1998	4,122	2,091	47,361	49,704	2,450	0	0	2,450
1999	2,307	1,849	923	16,479	2,450	0	0	2,450
2000	2,610	1,855	4,884	18,000	2,450	0	0	2,450
2001	2,722	2,050	18,819	28,092	2,450	0	0	2,450
2002	3,204	1,801	3,003	16,744	2,450	1,153	0	3,603
2003	3,237	2,108	12,973	21,592	1,249	2,644	256	4,149
2004	3,495	2,061	13,757	23,522	1,345	2,353	276	3,974
2005	3,674	2,207	54,549	46,396	1,639	2,447	336	4,422
2006	3,237	2,145	NA	23,175	1,457	2,834	298	4,589
2007	3,215	2,034	NA	17,048	3,288	2,658	674	6,620
2008	2,845	2,064	NA	25,254	2,895	2,136	358	5,389
2009	2,621	1,991	NA	19,099	3,225	1,759	673	5,657
2010	2,767	2,067	NA	20,293	2,554	2,147	594	5,295
2011	2,487	2,057	NA	17,518	2,359	2,827	533	5,719
2012	2,375	1,893	NA	7,612	2,603	1,897	653	5,153
2013	2,240	1,635	NA	NA	2,999	1,432	754	5,185

Table 2-5
Stream Flows in Arroyo Las Posas and Conejo Creek, Conejo Creek Diversions, Deliveries by CWD, and Discharges from CSD into Conejo Creek (AF)

Calendar Year	Camarillo Sanitary District Discharges to Conejo Creek (AF)[a]	Arroyo Las Posas Subsurface Inflows from East LPVB (CMWD Model, 2018) (AF)	Arroyo Las Posas Flows Measured at Stream Gauge 806 until 1997 and 806A until 2005 (AF)[b]	Conejo Creek Flows Measured at Stream Gauge 800 until 2011 and 800A until 2012 (AF)	Conejo Creek Flows Delivered by CWD for PVB Agriculture (AF)[c]	Conejo Creek Flows Delivered by CWD for Agriculture In PVCWD (AF)[d]	Conejo Creek Flows Delivered by CWD for PVB M&I (AF)	Total Conejo Creek Flow Diversions (AF)
2014	2,498	1,503	NA	NA	2,858	904	854	4,616
2015	2,274	1,370	NA	NA	2,555	1,036	794	4,385
Maximum	**4,122**	**2,207**	**54,549**	**52,306**	**3,288**	**2,834**	**854**	**6,620**
Minimum	**1,456**	**148**	**840**	**7,612**	**1,249**	**0**	**0**	**2,450**
Average	**2,700**	**1,646**	**13,936**	**24,153**	**2,423**	**911**	**227**	**3,562**

Notes: AF = acre-feet; CMWD = Calleguas Municipal Water District; CSD = Camarillo Sanitary District; CWD = Camrosa Water District; LPVB = Las Posas Valley Basin; M&I = municipal and industrial; NA = not available; PVB = Pleasant Valley Basin; PVCWD = Pleasant Valley County Water District.

[a] Data from City of Camarillo/Camarillo Sanitary District Annual Reports.

[b] 800A is downstream of Conejo Creek Diversion, whereas 800 was upstream.

[c] 2,450 AFY between 1985 and 2002 accounts for diversions of Conejo Creek water prior to development of CWD's Diversion Facility.

- Between 2003 and 2006, deliveries are less than previous assumptions as not all uses had connected to the CWD system.
- It is fair to assume the difference between those volumes and 2,450 were still applied to land.

[d] For water supplied by CWD to PVCWD, 56% is used in the Oxnard Subbasin and 44% in the PVB.

Table 2-6a
UWCD Water Budget for the Semi-Perched Aquifer

Calendar Year	Groundwater Recharge (AF)					Groundwater Discharge (AF)						Storage Change (AF)
	Recharge	*Calleguas Creek Percolation*	*Conejo Creek Percolation*	*Arroyo Las Posas Percolation*	*Total Inflow*	*Pumping*	*Tile Drains*	*Subsurface Outflow to UAS*	*Evapotranspiration*	*Subsurface Outflow to Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
1985	5,089	3,402	6,018	0	14,509	−244	−165	−11,251	0	−1,525	−13,184	−1,325
1986	6,539	3,856	6,815	475	17,684	−270	−233	−11,155	0	−1,720	−13,379	−4,305
1987	5,457	3,523	6,236	0	15,216	−362	−236	−13,833	0	−1,780	−16,212	996
1988	5,406	3,546	6,276	0	15,228	−349	−242	−13,262	0	−1,758	−15,612	383
1989	4,992	3,444	6,107	0	14,543	−384	−222	−14,768	0	−1,641	−17,015	2,472
1990	4,647	3,313	5,839	0	13,799	−457	−161	−16,146	0	−1,312	−18,077	4,278
1991	6,264	3,583	6,188	319	16,353	−433	−133	−14,830	0	−1,074	−16,470	117
1992	7,185	4,324	7,801	1,008	20,318	−336	−209	−12,936	0	−1,448	−14,929	−5,389
1993	6,855	4,524	8,224	1,191	20,794	−254	−329	−10,949	−80	−2,161	−13,774	−7,020
1994	4,908	3,508	6,221	372	15,009	−233	−317	−10,438	0	−2,249	−13,237	−1,772
1995	7,434	4,399	8,012	913	20,759	−163	−743	−8,640	−239	−3,070	−12,854	−7,904
1996	6,131	3,807	6,776	635	17,348	−161	−819	−9,386	−151	−3,281	−13,798	−3,551
1997	6,181	3,763	6,716	670	17,329	−188	−1,085	−10,937	−240	−3,628	−16,078	−1,251
1998	8,032	4,056	8,219	1,785	22,091	−104	−2,241	−8,680	−861	−4,336	−16,222	−5,868
1999	4,964	3,548	6,299	458	15,269	−139	−1,711	−10,502	−317	−4,254	−16,923	1,653
2000	5,218	3,617	6,450	586	15,871	−157	−1,549	−10,579	−314	−4,259	−16,858	988
2001	7,123	3,966	7,218	1,268	19,574	−135	−1,910	−10,319	−551	−4,414	−17,329	−2,245
2002	4,806	3,553	6,324	556	15,238	−173	−1,354	−11,427	−246	−4,219	−17,418	2,179

Table 2-6a
UWCD Water Budget for the Semi-Perched Aquifer

Calendar Year	Groundwater Recharge (AF)					Groundwater Discharge (AF)						Storage Change (AF)
	Recharge	*Calleguas Creek Percolation*	*Conejo Creek Percolation*	*Arroyo Las Posas Percolation*	*Total Inflow*	*Pumping*	*Tile Drains*	*Subsurface Outflow to UAS*	*Evapotranspiration*	*Subsurface Outflow to Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
2003	5,012	3,534	6,097	725	15,367	−148	−1,322	−9,501	−338	−4,207	−15,516	150
2004	6,165	3,575	6,444	952	17,136	−186	−1,168	−10,423	−254	−4,131	−16,161	−974
2005	6,812	3,610	7,914	1,742	20,078	−120	−2,280	−7,685	−1,081	−4,668	−15,834	−4,245
2006	5,176	3,545	6,231	1,020	15,973	−84	−2,092	−5,857	−658	−4,622	−13,314	−2,659
2007	4,145	3,260	5,758	17	13,181	−122	−1,913	−8,120	−295	−4,673	−15,123	1,942
2008	5,497	3,661	6,561	504	16,224	−140	−2,023	−8,641	−549	−4,791	−16,144	−80
2009	4,928	3,433	6,024	436	14,821	−136	−1,766	−8,604	−437	−4,711	−15,654	833
2010	6,608	3,420	5,607	943	16,579	−124	−1,832	−8,167	−646	−4,706	−15,475	−1,104
2011	4,755	3,668	6,436	603	15,462	−105	−2,052	−6,897	−875	−4,774	−14,703	−758
2012	4,096	3,362	5,343	252	13,053	−129	−1,610	−8,566	−367	−4,651	−15,323	2,270
2013	3,499	3,019	4,196	0	10,713	−204	−942	−11,587	−130	−4,237	−17,100	6,386
2014	4,681	3,251	4,087	13	12,032	−288	−483	−13,703	−37	−3,467	−17,977	5,945
2015	3,308	3,012	3,476	0	9,796	−297	−328	−12,581	−5	−2,760	−15,970	6,174
Maximum	**8,032**	**4,524**	**8,224**	**1,785**	**22,091**	**−84**	**−133**	**−5,857**	**0**	**−1,074**	**−12,854**	**6,386**
Minimum	**3,308**	**3,012**	**3,476**	**0**	**9,796**	**−457**	**−2,280**	**−16,146**	**−1,081**	**−4,791**	**−18,077**	**−7,904**
Average	**5,546**	**3,616**	**6,320**	**563**	**16,044**	**−214**	**−1,080**	**−10,657**	**−280**	**−3,372**	**−15,602**	**−441**

Notes: AF = acre-feet; UAS = Upper Aquifer System; UWCD = United Water Conservation District.

[a] A negative number indicates that water entered storage.

Table 2-6b
UWCD Water Budget for the Older Alluvium

Calendar Year	Groundwater Recharge (AF)								Groundwater Discharge (AF)						Storage Change (AF)
	Mountain-Front Recharge	*Recharge*	*Subsurface Inflow from the Semi-Perched Aquifer*	*Groundwater Flux from East LPVB by CMWD Model*	*Conejo Creek Percolation*	*Arroyo Las Posas Percolation*	*Subsurface Inflow from the Oxnard Subbasin*	*Total Inflow*	*Pumping*	*Subsurface Outflow to LAS*	*Evapo-transpiration*	*Subsurface Outflow to LPVB*	*Subsurface Outflow to Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
1985	763	558	11,251	148	2,388	222	1,551	16,882	−9,005	−8,623	−692	0	0	−18,320	1,438
1986	2,322	937	11,155	647	2,073	1,880	613	19,627	−8,001	−7,367	−957	−1	0	−16,326	−3,301
1987	1,088	630	13,833	695	2,299	1,067	15	19,628	−10,878	−8,030	−926	0	0	−19,834	205
1988	1,101	670	13,262	899	2,213	1,744	0	19,889	−10,052	−8,585	−966	−11	−142	−19,756	−133
1989	329	510	14,768	768	2,220	530	0	19,126	−11,750	−7,811	−972	−1	−588	−21,122	1,996
1990	261	399	16,146	925	2,254	780	0	20,766	−13,580	−8,947	−922	0	−1,153	−24,601	3,835
1991	2,152	786	14,830	1,090	2,026	1,770	0	22,654	−11,818	−9,510	−963	−1	−956	−23,248	593
1992	3,164	1,042	12,936	1,597	1,656	3,663	73	24,132	−7,967	−9,095	−1,008	−68	0	−18,138	−5,994
1993	2,786	986	10,949	1,877	1,530	4,592	2,107	24,827	−6,440	−7,861	−1,006	−198	0	−15,504	−9,323
1994	887	537	10,438	1,754	1,998	2,714	1,808	20,136	−7,778	−7,876	−1,006	−166	0	−16,826	−3,311

Table 2-6b
UWCD Water Budget for the Older Alluvium

Calendar Year	Groundwater Recharge (AF)								Groundwater Discharge (AF)						Storage Change (AF)
	Mountain-Front Recharge	*Recharge*	*Subsurface Inflow from the Semi-Perched Aquifer*	*Groundwater Flux from East LPVB by CMWD Model*	*Conejo Creek Percolation*	*Arroyo Las Posas Percolation*	*Subsurface Inflow from the Oxnard Subbasin*	*Total Inflow*	*Pumping*	*Subsurface Outflow to LAS*	*Evapo-transpiration*	*Subsurface Outflow to LPVB*	*Subsurface Outflow to Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
1995	3,633	1,199	8,640	1,991	1,368	4,767	1,346	22,946	−5,980	−7,726	−1,011	−237	0	−14,955	−7,991
1996	2,281	928	9,386	1,944	1,727	4,092	1,375	21,733	−7,275	−8,069	−1,008	−233	0	−16,584	−5,148
1997	1,968	819	10,937	1,920	1,708	4,007	407	21,765	−8,174	−9,126	−1,006	−308	0	−18,613	−3,153
1998	3,496	1,270	8,680	2,091	1,112	7,338	67	24,054	−5,465	−9,054	−1,025	−994	0	−16,538	−7,516
1999	711	534	10,502	1,849	1,849	4,821	106	20,372	−7,923	−9,029	−1,006	−800	0	−18,758	−1,614
2000	1,351	644	10,579	1,855	1,783	4,627	0	20,839	−7,367	−9,050	−1,008	−715	−1,084	−19,224	−1,615
2001	2,633	922	10,319	2,050	1,532	6,755	0	24,211	−7,138	−8,814	−1,006	−921	−1,233	−19,112	−5,099
2002	1,016	601	11,427	1,801	1,936	5,318	0	22,099	−8,865	−10,040	−1,006	−731	−1,150	−21,791	−307
2003	1,327	651	9,501	2,108	1,743	5,247	0	20,577	−6,480	−9,271	−1,005	−833	−1,803	−19,392	−1,185
2004	2,295	865	10,423	2,061	1,847	4,716	0	22,207	−7,296	−9,503	−1,000	−728	−2,485	−21,012	−1,195
2005	2,929	1,111	7,685	2,207	1,197	7,697	0	22,826	−4,715	−8,357	−1,006	−1,194	−1,757	−17,029	−5,797
2006	1,622	743	5,857	2,145	1,641	5,774	0	17,782	−4,332	−7,719	−1,006	−994	−1,283	−15,333	−2,449
2007	409	445	8,120	2,034	1,972	5,106	0	18,086	−6,281	−8,316	−1,004	−906	−2,419	−18,926	841
2008	1,755	826	8,641	2,064	1,710	4,502	0	19,497	−6,200	−9,210	−1,008	−843	−3,135	−20,396	898
2009	1,182	633	8,604	1,991	1,837	3,686	0	17,935	−5,575	−8,684	−998	−786	−3,515	−19,558	1,623
2010	2,842	1,014	8,167	2,067	1,593	5,177	0	20,860	−5,054	−8,995	−1,000	−1,082	−3,938	−20,069	−791
2011	1,314	739	6,897	2,057	1,610	4,886	0	17,503	−4,127	−8,427	−1,004	−1,196	−3,049	−17,803	299
2012	665	593	8,566	1,893	1,933	3,029	0	16,679	−5,588	−9,010	−994	−870	−3,162	−19,624	2,945
2013	71	331	11,587	1,635	2,050	1,238	0	16,912	−8,172	−9,349	−976	−493	−3,767	−22,757	5,845
2014	1,033	579	13,703	1,503	1,981	1,861	0	20,660	−9,429	−9,999	−971	−265	−4,552	−25,216	4,556
2015	175	337	12,581	1,370	1,989	1,003	0	17,454	−8,290	−8,896	−947	−240	−4,639	−23,012	5,558
Maximum	**3,633**	**1,270**	**16,146**	**2,207**	**2,388**	**7,697**	**2,107**	**24,827**	**−4,127**	**−7,367**	**−692**	**0**	**0**	**−14,955**	**5,845**
Minimum	**71**	**331**	**5,857**	**148**	**1,112**	**222**	**0**	**16,679**	**−13,580**	**−10,040**	**−1,025**	**−1,196**	**−4,639**	**−25,216**	**−9,323**
Average	**1,599**	**737**	**10,657**	**1,646**	**1,831**	**3,697**	**305**	**20,473**	**−7,645**	**−8,721**	**−981**	**−510**	**−1,478**	**−19,335**	**−1,138**

Notes: AF = acre-feet; CMWD = Calleguas Municipal Water District; LAS = Lower Aquifer System; LPVB = Las Posas Valley Basin; UWCD = United Water Conservation District.

[a] A negative number indicates that water entered storage

Table 2-6c
UWCD Water Budget for the Lower Aquifer System

Calendar Year	Groundwater Recharge (AF)					Groundwater Discharge (AF)				Storage Change (AF)
	Recharge	*Subsurface Inflow from the UAS*	*Subsurface Inflow from the LPVB*	*Subsurface Inflow from the Oxnard Subbasin*	*Total Inflow*	*Pumping*	*Subsurface Outflow to the LPVB*	*Subsurface Outflow to the Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
1985	196	8,623	1,425	100	10,345	−9,840	0	0	−9,840	−504
1986	378	7,367	686	0	8,430	−7,051	0	−285	−7,336	−1,094

Table 2-6c
UWCD Water Budget for the Lower Aquifer System

Calendar Year	Groundwater Recharge (AF)					Groundwater Discharge (AF)				Storage Change (AF)
	Recharge	*Subsurface Inflow from the UAS*	*Subsurface Inflow from the LPVB*	*Subsurface Inflow from the Oxnard Subbasin*	*Total Inflow*	*Pumping*	*Subsurface Outflow to the LPVB*	*Subsurface Outflow to the Oxnard Subbasin*	*Total Outflow*	*Change in Groundwater Storage*[a]
1987	221	8,030	1,343	0	9,594	−8,822	0	−1,146	−9,968	374
1988	235	8,585	678	0	9,499	−9,247	0	−710	−9,957	458
1989	141	7,811	961	0	8,913	−12,194	0	−43	−12,237	3,324
1990	146	8,947	1,259	0	10,352	−10,951	0	−1,027	−11,979	1,627
1991	313	9,510	830	491	11,144	−8,836	0	0	−8,836	−2,308
1992	409	9,095	0	1,073	10,577	−6,583	−407	0	−6,990	−3,587
1993	407	7,861	0	1,205	9,473	−6,590	−879	0	−7,469	−2,004
1994	203	7,876	0	263	8,342	−7,467	−466	0	−7,933	−410
1995	487	7,726	0	235	8,448	−4,631	−811	0	−5,442	−3,006
1996	363	8,069	0	117	8,549	−7,116	−420	0	−7,536	−1,013
1997	311	9,126	0	0	9,436	−8,019	−314	−167	−8,500	−937
1998	517	9,054	0	0	9,571	−5,430	−1,085	−109	−6,625	−2,946
1999	178	9,029	0	0	9,207	−9,001	−259	−116	−9,376	169
2000	239	9,050	0	0	9,289	−7,442	−39	−546	−8,027	−1,263
2001	348	8,814	0	0	9,161	−5,799	−219	−1,030	−7,048	−2,113
2002	215	10,040	303	0	10,558	−9,801	0	−913	−10,715	147
2003	236	9,271	0	0	9,507	−8,336	−125	−210	−8,671	−836
2004	317	9,503	54	0	9,874	−9,018	0	−353	−9,371	−502
2005	417	8,357	0	0	8,774	−5,337	−614	−819	−6,770	−2,004
2006	275	7,719	0	0	7,994	−4,949	−693	−1,430	−7,071	−923
2007	153	8,316	0	0	8,469	−7,539	−383	−1,266	−9,187	718
2008	324	9,210	0	0	9,535	−7,125	−621	−1,608	−9,355	−180
2009	244	8,684	0	0	8,929	−6,839	−853	−1,657	−9,350	421
2010	399	8,995	0	0	9,394	−5,881	−1,438	−1,162	−8,481	−913
2011	302	8,427	0	0	8,730	−5,525	−1,701	−1,618	−8,845	115
2012	247	9,010	0	0	9,257	−7,500	−1,429	−1,431	−10,360	1,103
2013	127	9,349	0	0	9,477	−10,086	−381	−1,499	−11,966	2,489
2014	236	9,999	73	0	10,308	−9,971	0	−1,346	−11,317	1,009
2015	131	8,896	0	0	9,027	−9,263	−269	−1,420	−10,952	1,925
Maximum	**1,657**	**10,040**	**1,425**	**1,205**	**11,144**	**−4,631**	**0**	**0**	**−5,442**	**3,324**
Minimum	**0**	**7,367**	**0**	**0**	**7,994**	**−12,194**	**−1,701**	**−1,657**	**−12,237**	**−3,587**
Average	**707**	**8,721**	**246**	**112**	**9,360**	**−7,813**	**−432**	**−707**	**−8,952**	**−408**

Notes: AF = acre-feet; LPVB = Las Posas Valley Basin; UAS = Upper Aquifer System; UWCD = United Water Conservation District.

[a] A negative number indicates that water entered storage.

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Table 2-7
Sales and Usage of Imported Water Supplied by CMWD (AF)

Calendar Year	Delivered and Used by the City of Camarillo for M&I	Delivered and Used by CWD for PVB M&I	Delivered and Used by CWD for PVB Agriculture	Delivered and Used by PVMWC for PVB M&I	Total Imported Water Delivered
1985	4,742	2,210	2,155	94	9,201
1986	4,110	2,218	2,163	23	8,514
1987	4,229	2,393	2,335	137	9,093
1988	4,035	2,678	2,613	151	9,477
1989	4,701	2,651	2,586	279	10,217
1990	4,431	3,024	2,950	253	10,657
1991	2,683	1,847	1,634	266	6,430
1992	3,291	1,768	1,419	120	6,599
1993	3,945	1,697	1,234	82	6,958
1994	4,215	1,769	1,163	126	7,274
1995	5,166	1,818	1,079	284	8,347
1996	3,750	1,852	989	303	6,894
1997	4,406	2,201	1,054	494	8,155
1998	4,273	1,792	766	153	6,984
1999	5,436	2,301	874	201	8,812
2000	5,686	2,405	806	187	9,083
2001	5,487	2,256	661	359	8,764
2002	6,169	2,657	674	205	9,704
2003	4,679	2,698	585	194	8,155
2004	5,651	3,044	553	632	9,880
2005	5,468	3,238	482	384	9,573
2006	5,685	3,364	396	279	9,724
2007	6,366	4,823	425	632	12,246
2008	6,328	3,909	235	280	10,751
2009	5,592	3,092	149	313	9,146
2010	4,541	2,700	99	231	7,570
2011	5,057	2,779	96	357	8,288
2012	5,463	2,992	90	249	8,793
2013	5,223	3,046	78	255	8,601
2014	5,091	2,946	63	428	8,527
2015	4,551	2,388	41	233	7,213
Maximum	**6,366**	**4,823**	**2,950**	**632**	**12,246**
Minimum	**2,683**	**1,697**	**41**	**23**	**6,430**
Average	**4,853**	**2,599**	**982**	**264**	**8,698**

Notes: AF = acre-feet; CWD = Camrosa Water District; M&I = municipal and industrial; PVB = Pleasant Valley Basin; PVMWC = Pleasant Valley Mutual Water Company.

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Table 2-8
Other Pleasant Valley Basin Imported Water

Calendar Year	City of Camarillo (AF)	PVCWD (AF)	CWD Water in PVB (AF)						UWCD Water (AF)[a]		Total Other Imported Water
	Camarillo Sanitary District Recycled water Used for Agriculture[b]	*Pumped Groundwater from Oxnard Subbasin Used for Agriculture*[c]	*Pumped Groundwater from Santa Rosa Valley Used for M&I*	*Pumped Groundwater from Santa Rosa Valley Used for Agriculture*	*Groundwater Pumped in Tierra Rejada Basin Used for M&I*	*Groundwater Pumped in Tierra Rejada Basin Used for Agriculture*	*Recycled Water Used for M&I*	*Recycled Water Used for Agriculture*	*Diversions of Santa Clara River Water Used for Agriculture (PVP)*	*Recharged Spreading Water Pumped and Used for Agriculture (Saticoy Wells)*	
1985	1,635	170	513	501	0	0	0	450	3,845	0	7,114
1986	1,613	282	709	692	0	0	0	450	4,334	0	8,080
1987	1,703	231	686	669	0	0	0	450	2,006	0	5,745
1988	1,859	−387	485	473	0	0	0	450	3,046	0	5,926
1989	2,162	−121	382	373	0	0	0	450	2,509	0	5,755
1990	2,644	−273	303	296	0	0	0	450	140	0	3,561
1991	2,487	−708	321	284	0	0	0	450	737	0	3,570
1992	2,229	604	420	337	0	0	0	450	4,101	0	8,140
1993	2,543	197	708	515	0	0	0	450	6,729	0	11,142
1994	1,523	369	749	492	0	0	0	450	5,428	0	9,011
1995	1,400	308	676	401	0	0	0	640	6,166	0	9,591
1996	1,053	1,007	187	100	108	58	0	593	4,117	0	7,221
1997	1,915	425	529	253	124	60	0	497	5,005	0	8,808
1998	1,400	−107	727	311	98	42	0	671	7,068	0	10,210
1999	1,624	119	570	217	115	44	0	501	5,657	0	8,846
2000	1,400	376	750	251	146	49	0	777	5,140	0	8,889
2001	1,299	484	820	240	119	35	0	807	6,879	0	10,684
2002	1,031	145	986	250	113	29	0	617	2,664	0	5,834
2003	941	298	914	198	127	27	0	623	2,777	0	5,904
2004	784	767	954	173	162	30	0	459	2,308	0	5,637
2005	762	1,051	1,100	164	189	28	0	516	5,741	0	9,550
2006	874	−2	1,233	145	288	34	127	506	5,498	0	8,703
2007	930	41	1,692	149	305	27	154	344	4,360	238	8,240
2008	1,434	213	1,374	83	254	15	142	600	4,987	639	9,741
2009	1,624	218	1,013	49	210	10	124	841	6,419	778	11,287
2010	1,479	−77	733	27	218	8	138	835	5,084	166	8,611
2011	1,770	−164	788	27	248	9	167	806	5,576	213	9,439
2012	1,792	5	1,067	32	223	7	223	802	4,480	246	8,876
2013	1,882	−101	1,380	35	189	5	284	893	1,421	57	6,045
2014	1,691	287	1,030	22	171	4	278	1,008	88	0	4,578
2015	1,703	876	862	15	76	1	232	1,031	0	0	4,797
Maximum	**2,644**	**1,051**	**1,692**	**692**	**305**	**60**	**284**	**1,031**	**7,068**	**778**	**11,287**
Minimum	**762**	**−708**	**187**	**15**	**0**	**0**	**0**	**344**	**0**	**0**	**3,561**
Average	**1,587**	**211**	**795**	**251**	**112**	**17**	**60**	**609**	**4,010**	**75**	**7,727**

Notes: AF = acre-feet; CWD = Camrosa Water District; M&I = municipal and industrial; NA = Not Available; PVB = Pleasant Valley Basin; PVCWD = Pleasant Valley County Water District; PVP = Pleasant Valley Pipeline; UWCD = United Water Conservation District.

[a] For water supplied by the PVP to PVCWD, 44% is used in the Pleasant Valley Basin and 56% in the Oxnard Subbasin.
[b] Data from City of Camarillo/Camarillo Sanitary District Annual Reports.
[c] Negative value indicates groundwater pumped in the PVB and used in the Oxnard Subbasin.

Table 2-9
Recharge from Tables 2-6a through 2-6c by Type (AF)

Calendar Year	Precipitation	Pumped Groundwater	Applied Water (M&I and Domestic)	PVB System	Total Recharge
1985	1,560	2,773	732	779	5,843
1986	4,196	2,081	678	897	7,853
1987	2,028	3,123	739	418	6,308
1988	1,959	2,883	834	635	6,312
1989	629	3,508	965	541	5,643
1990	520	3,725	886	61	5,192
1991	3,419	3,172	582	191	7,363
1992	5,135	1,994	604	904	8,636
1993	4,607	1,572	641	1,427	8,247
1994	1,757	2,093	632	1,165	5,648
1995	5,668	1,566	592	1,294	9,121
1996	3,763	2,204	535	921	7,422
1997	3,255	2,280	690	1,085	7,311
1998	6,339	1,401	587	1,491	9,819
1999	1,318	2,452	708	1,199	5,676
2000	2,289	1,982	742	1,087	6,100
2001	4,395	1,770	700	1,528	8,392
2002	1,663	2,593	790	576	5,623
2003	2,528	1,723	683	966	5,900
2004	3,431	2,005	779	1,131	7,347
2005	4,924	966	720	1,730	8,340
2006	2,717	938	728	1,812	6,194
2007	783	1,707	827	1,426	4,744
2008	2,611	1,619	794	1,624	6,647
2009	1,904	1,457	733	1,712	5,806
2010	4,589	1,244	632	1,557	8,021
2011	2,254	1,132	657	1,754	5,797
2012	1,176	1,801	670	1,290	4,936
2013	145	2,524	693	594	3,956
2014	1,791	2,809	652	244	5,496
2015	423	2,555	565	233	3,776
Maximum	**6,339**	**3,725**	**965**	**1,812**	**9,819**
Minimum	**145**	**938**	**535**	**61**	**3,776**
Average	**2,702**	**2,118**	**702**	**1,041**	**6,564**

Notes: AF = acre-feet; M&I = municipal and industrial; PVB = Pleasant Valley Basin.

Table 2-10
Groundwater Extraction

Calendar Year	Agricultural Pumpage (AF)				M&I Pumpage (AF)				Domestic Pumpage (AF)				Totals (AF)			
	Pumping UAS	*Pumping LAS*	*Pumping Semi-Perched*	*Total Agricultural Pumping*	*Pumping UAS*	*Pumping LAS*	*Pumping Semi-Perched*	*Total M&I Pumping*	*Pumping UAS*	*Pumping LAS*	*Pumping Semi-Perched*	*Total Domestic Pumping*	*Total Pumping UAS*	*Total Pumping LAS*	*Total Pumping Semi-Perched*	*Total Pumping*
1985	8,939	9,049	242	18,229	0	364	0	364	66	428	2	495	9,005	9,840	244	19,089
1986	7,944	5,364	269	13,577	0	1,304	0	1,304	56	383	2	442	8,001	7,051	270	15,322
1987	10,794	7,432	359	18,586	0	1,059	0	1,059	83	330	3	416	10,878	8,822	362	20,062
1988	9,905	7,516	344	17,765	0	1,489	0	1,489	147	242	5	394	10,052	9,247	349	19,648
1989	11,630	9,546	380	21,556	0	2,382	0	2,382	120	267	4	390	11,750	12,194	384	24,328
1990	13,471	9,130	454	23,054	0	1,578	0	1,578	109	243	4	356	13,580	10,951	457	24,989
1991	11,692	7,265	428	19,385	0	1,445	0	1,445	126	126	5	256	11,818	8,836	433	21,087
1992	7,844	4,888	331	13,063	0	1,590	0	1,590	123	104	5	232	7,967	6,583	336	14,885
1993	6,308	4,176	249	10,733	0	2,236	0	2,236	132	177	5	315	6,440	6,590	254	13,284
1994	7,684	6,078	231	13,992	0	1,321	0	1,321	95	68	3	165	7,778	7,467	233	15,478
1995	5,893	3,546	161	9,599	0	1,021	0	1,021	88	64	2	154	5,980	4,631	163	10,774
1996	7,112	5,837	157	13,106	0	1,268	0	1,268	163	10	4	177	7,275	7,116	161	14,552
1997	8,018	6,212	184	14,414	0	1,699	0	1,699	156	107	4	266	8,174	8,019	188	16,380
1998	5,337	3,329	102	8,768	0	1,903	0	1,903	128	197	2	328	5,465	5,430	104	11,000
1999	7,734	6,807	135	14,677	0	2,020	0	2,020	189	174	3	366	7,923	9,001	139	17,063
2000	7,096	5,471	151	12,719	0	1,832	0	1,832	271	139	6	416	7,367	7,442	157	14,967
2001	6,683	3,998	127	10,808	0	1,686	0	1,686	455	115	9	579	7,138	5,799	135	13,073
2002	8,353	7,914	163	16,429	0	1,758	0	1,758	512	130	10	652	8,865	9,801	173	18,839
2003	6,084	6,088	139	12,311	0	2,166	0	2,166	396	82	9	487	6,480	8,336	148	14,963
2004	7,133	7,017	182	14,332	0	1,948	0	1,948	163	52	4	220	7,296	9,018	186	16,499
2005	4,541	3,086	115	7,743	0	2,209	0	2,209	174	41	4	220	4,715	5,337	120	10,172
2006	4,119	3,017	80	7,216	0	1,932	0	1,932	213	0	4	218	4,332	4,949	84	9,365
2007	5,983	6,003	116	12,102	0	1,535	0	1,535	299	1	6	305	6,281	7,539	122	13,942
2008	5,872	5,602	133	11,607	0	1,523	0	1,523	328	1	7	336	6,200	7,125	140	13,465
2009	5,248	5,112	128	10,489	0	1,727	0	1,727	327	1	8	335	5,575	6,839	136	12,551
2010	4,488	3,987	110	8,584	0	1,894	0	1,894	566	0	14	580	5,054	5,881	124	11,059
2011	3,912	3,616	100	7,627	0	1,908	0	1,908	215	1	5	221	4,127	5,525	105	9,757
2012	5,286	5,767	122	11,176	0	1,732	0	1,732	302	1	7	309	5,588	7,500	129	13,217
2013	7,810	8,712	195	16,717	0	1,373	0	1,373	362	1	9	371	8,172	10,086	204	18,462
2014	9,309	8,639	285	18,233	0	1,332	0	1,332	120	0	4	124	9,429	9,971	288	19,689
2015	8,089	7,905	289	16,284	0	1,357	0	1,357	201	1	7	209	8,290	9,263	297	17,849
Maximum	**13,471**	**9,546**	**454**	**23,054**	**0**	**2,382**	**0**	**2,382**	**566**	**428**	**14**	**652**	**13,580**	**12,194**	**457**	**24,989**

Table 2-10
Groundwater Extraction

Calendar Year	Agricultural Pumpage (AF)				M&I Pumpage (AF)				Domestic Pumpage (AF)				Totals (AF)			
	Pumping UAS	*Pumping LAS*	*Pumping Semi-Perched*	*Total Agricultural Pumping*	*Pumping UAS*	*Pumping LAS*	*Pumping Semi-Perched*	*Total M&I Pumping*	*Pumping UAS*	*Pumping LAS*	*Pumping Semi-Perched*	*Total Domestic Pumping*	*Total Pumping UAS*	*Total Pumping LAS*	*Total Pumping Semi-Perched*	*Total Pumping*
Minimum	**3,912**	**3,017**	**80**	**7,216**	**0**	**364**	**0**	**364**	**56**	**0**	**2**	**124**	**4,127**	**4,631**	**84**	**9,365**
Average	**7,429**	**6,068**	**208**	**13,706**	**0**	**1,632**	**0**	**1,632**	**216**	**112**	**5**	**333**	**7,645**	**7,813**	**214**	**15,671**

Notes: AF = acre-feet; LAS = Lower Aquifer System; M&I = municipal and industrial; UAS = Upper Aquifer System.
Pumping amounts are from the UWCD model and usage type is from the FCGMA well database.

Table 2-11
UWCD Model Scenario Results (AFY)

Model Scenario	UAS Groundwater Extractions	LAS Groundwater Extractions	Total Groundwater Extractions	Project Water	Total Scenario
Future Baseline	6,000	9,000	14,000	0	14,000
Future Baseline With Projects	4,000	8,000	12,000	2,000	14,000
Reduction With Projects	3,000	7,000	10,000	2,000	12,000
Reduction Without Projects Scenario 1	3,000	5,000	8,000	0	8,000
Reduction Without Projects Scenario 2	3,000	7,000	10,000	0	10,000
Reduction Without Projects Scenario 3	5,000	9,000	14,000	0	14,000

Notes: AFY = acre-feet per year; LAS = Lower Aquifer System; UAS = Upper Aquifer System; UWCD = United Water Conservation District.

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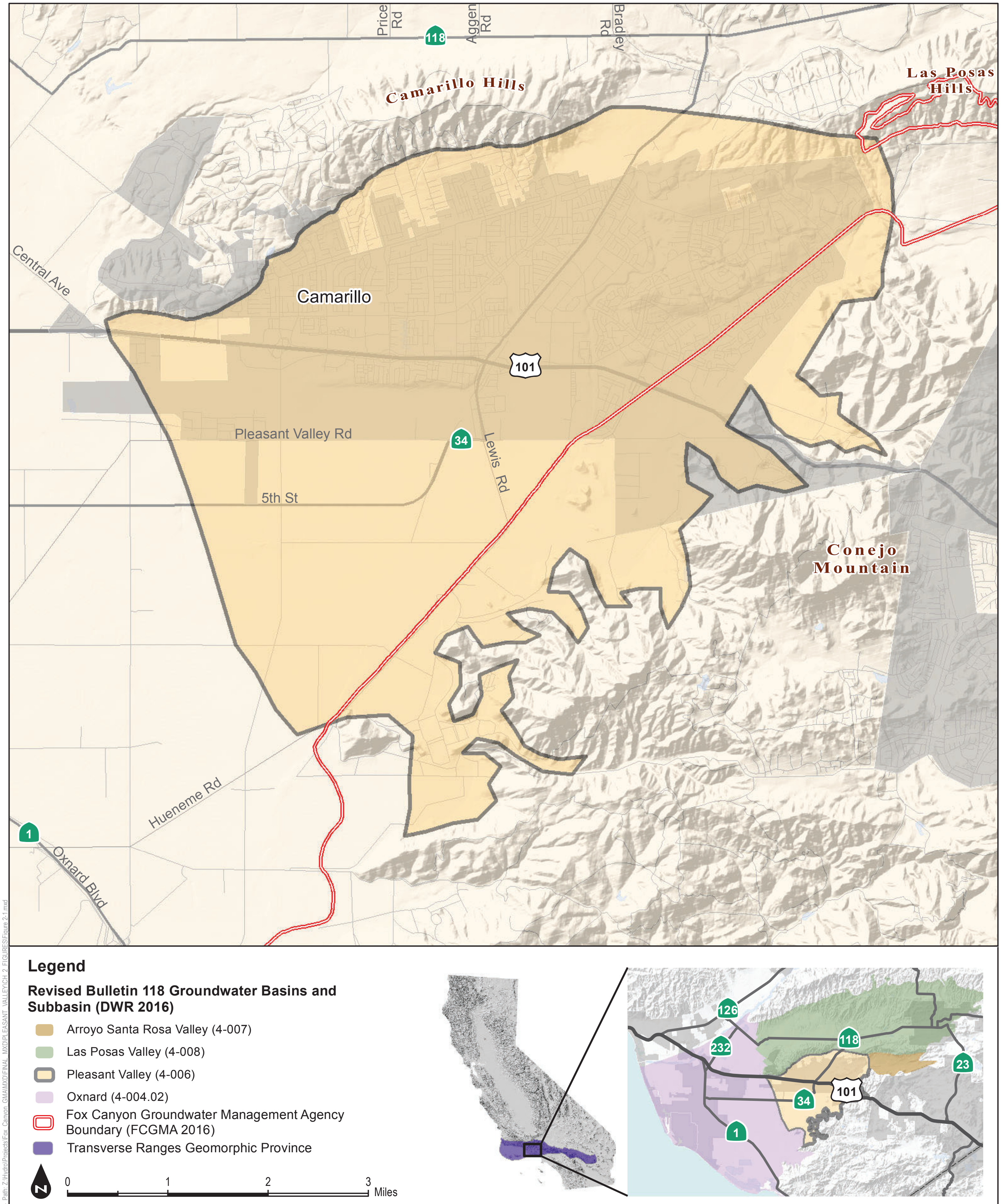

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DUDEK

SOURCE: CGS 2002; DWR 2016; Cal-Atlas 2016; FCGMA 2016

FIGURE 2-1

Pleasant Valley Basin Vicinity Map

Groundwater Sustainability Plan for the Pleasant Valley Basin

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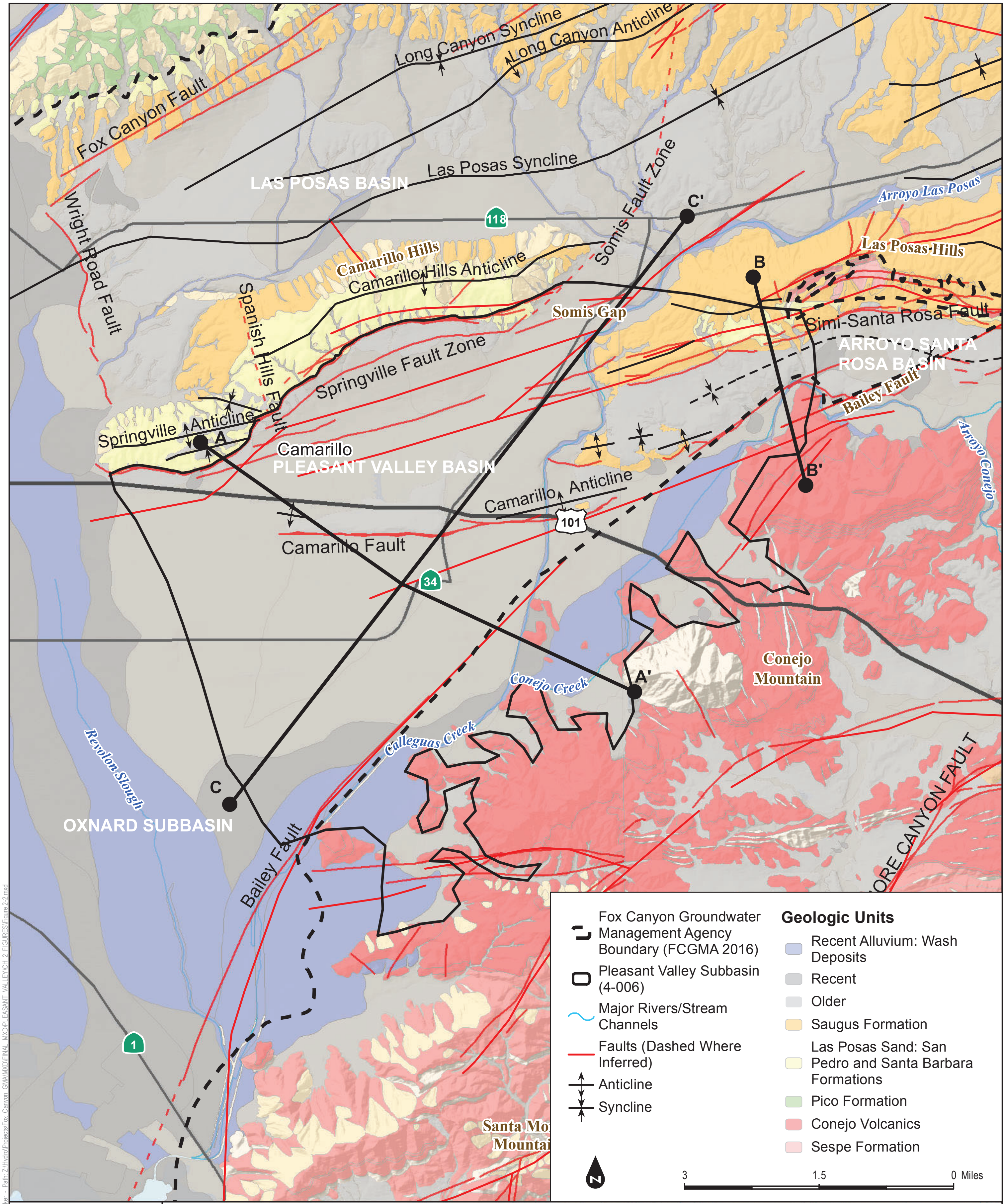

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SOURCE: DWR; FCGMA; surficial geology after California Geological Survey; folds after Dibblee 1992a and 1992b, DeVecchio 2012a, Turner 1975; faults after DeVecchio et al. 2012a

FIGURE 2-2

Geology of the Pleasant Valley Basin

Groundwater Sustainability Plan for the Pleasant Valley Basin

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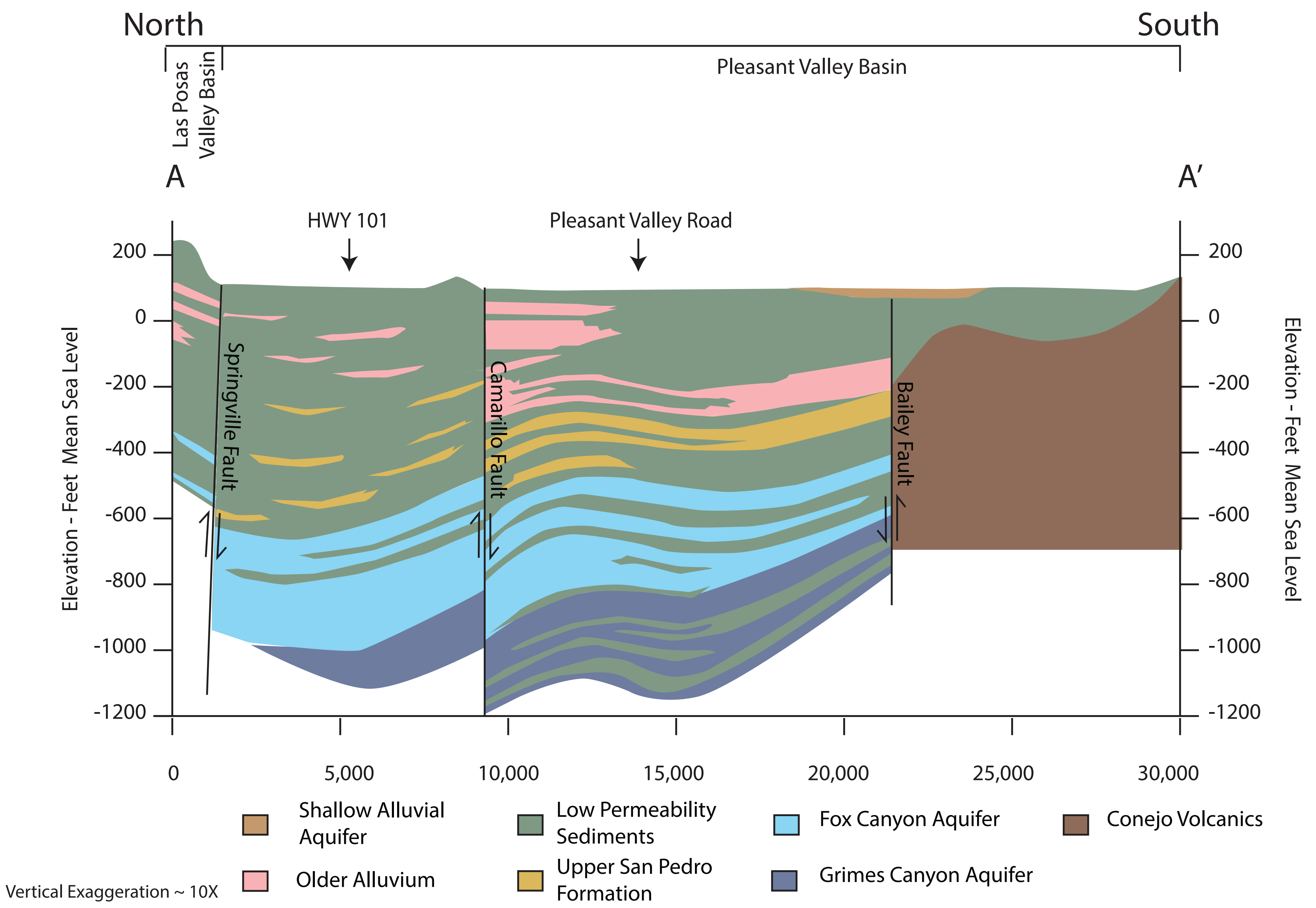

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SOURCE: Turner 1975; Southern Section of Cross section B-B’.

FIGURE 2-3
Cross Section A-A’

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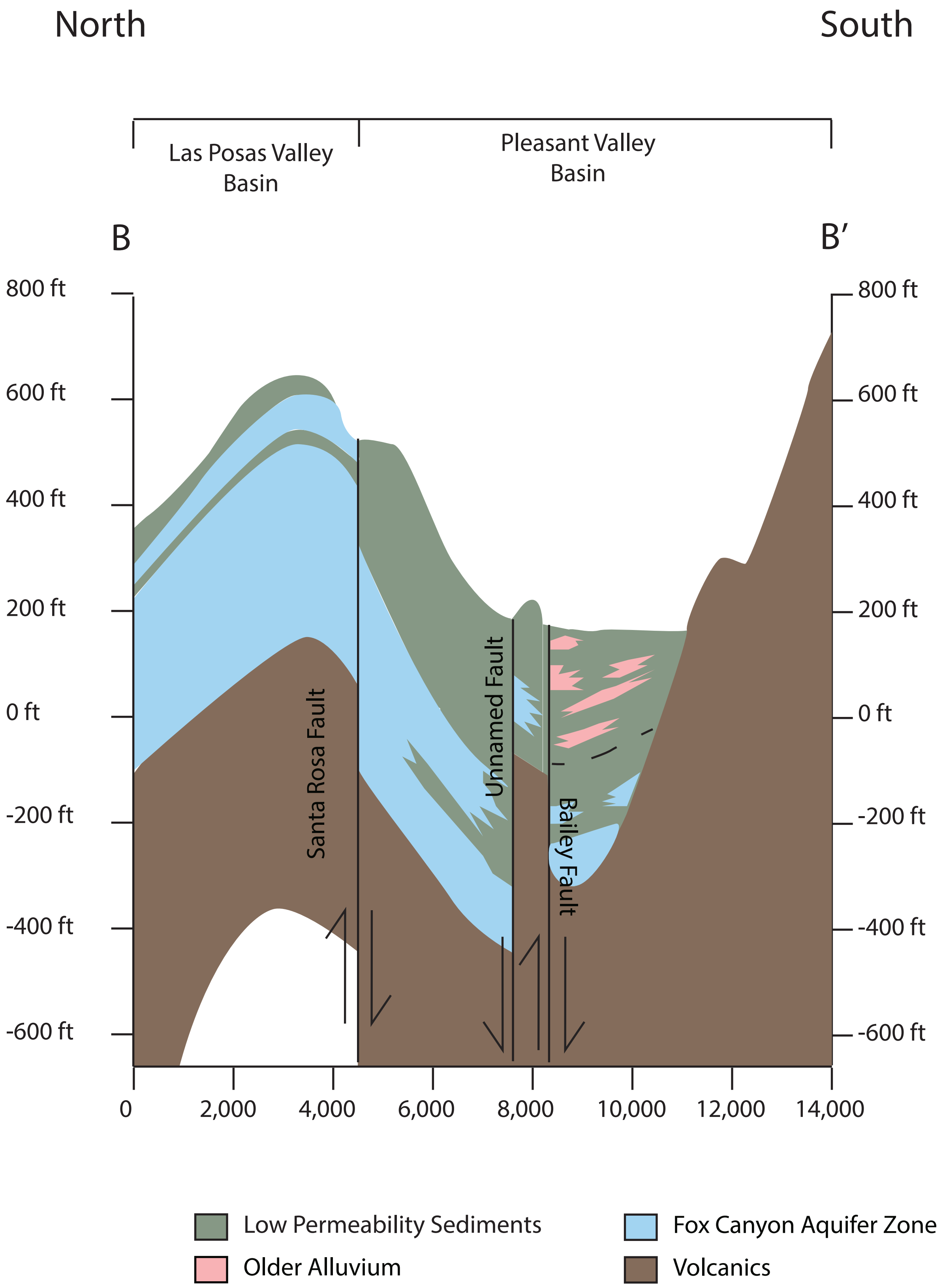

Vertical Exaggeration ~ 10X

SOURCE: Turner 1975; Southern Section of Cross section D-D’

FIGURE 2-4

Cross Section B-B’

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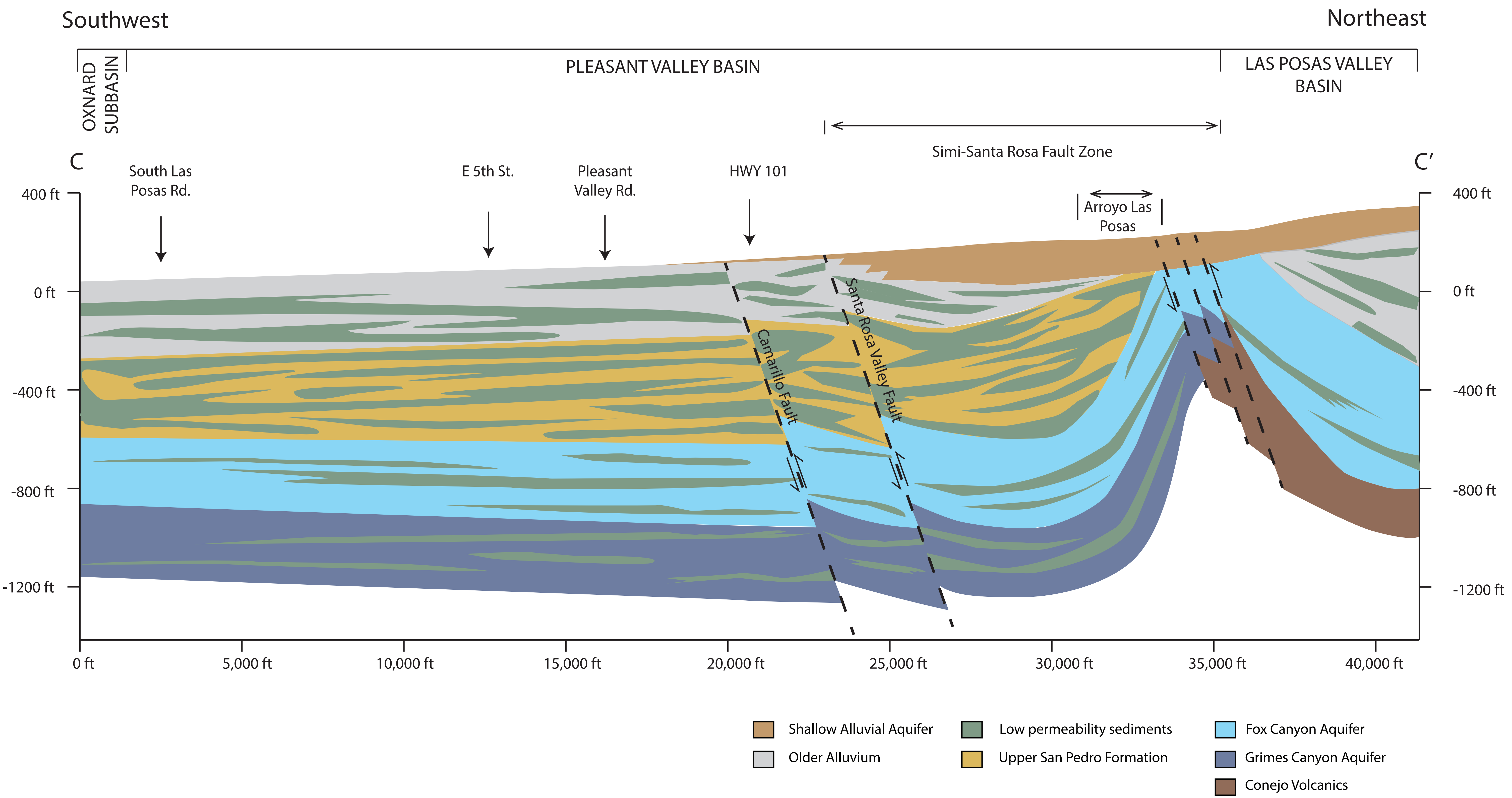

Vertical exaggeration ~7.5X
Faults are interpreted from USGS surface locations. Offsets are for illustration only and have not been measured.

SOURCE: Calleguas 2012; Calleguas 2016a

FIGURE 2-5
Cross Section C-C'

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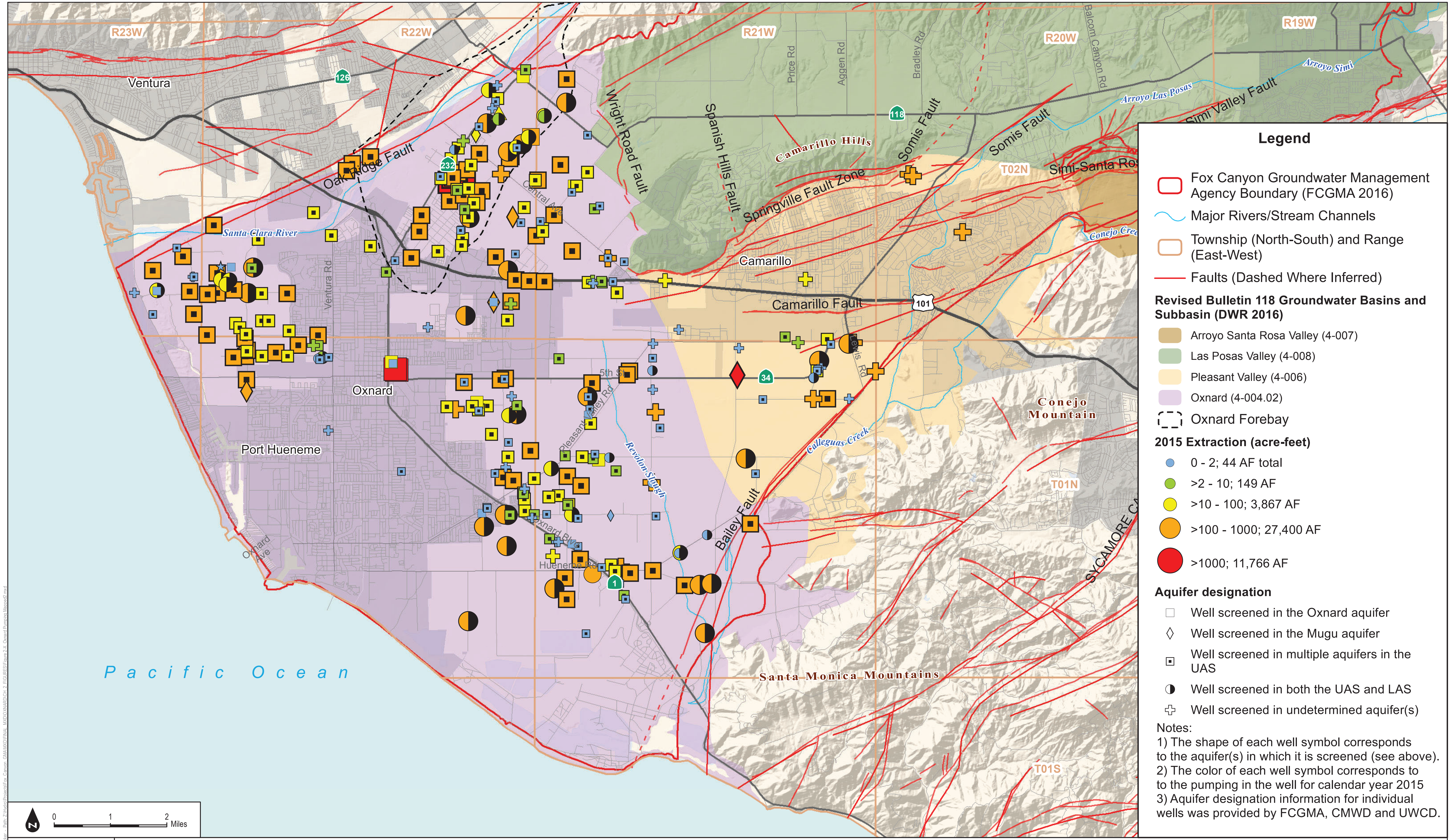

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SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

FIGURE 2-6

Upper Aquifer System 2015 Extraction (acre-feet) in Oxnard and Pleasant Valley

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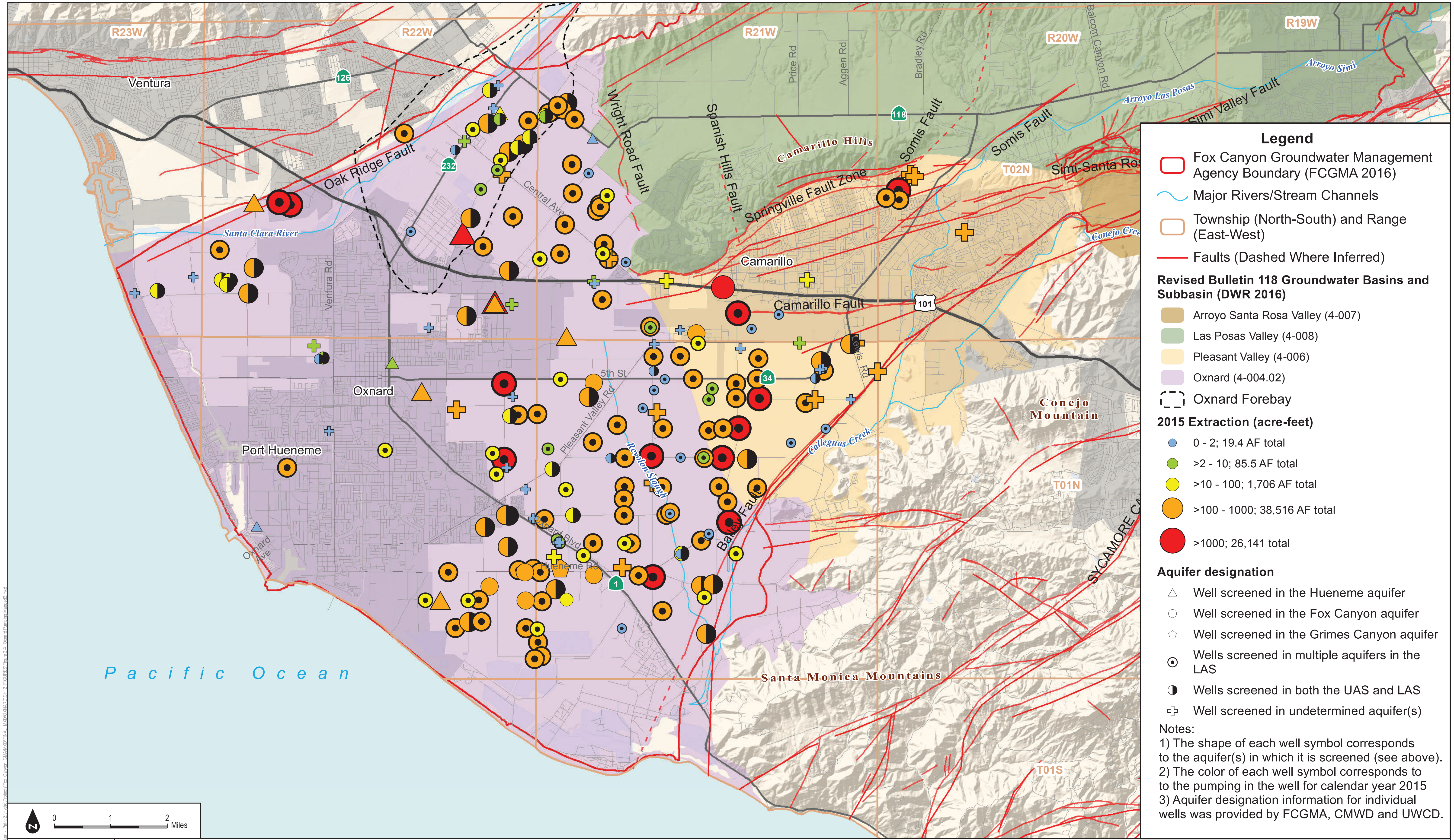

Notes:
1) The shape of each well symbol corresponds to the aquifer(s) in which it is screened (see above).
2) The color of each well symbol corresponds to to the pumping in the well for calendar year 2015
3) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

SOURCE: DWR, FCGMA, VCWPD, CMWD, UWCD

DUDEK

FIGURE 2-7

Lower Aquifer System 2015 Extraction (acre-feet) in Oxnard and Pleasant Valley

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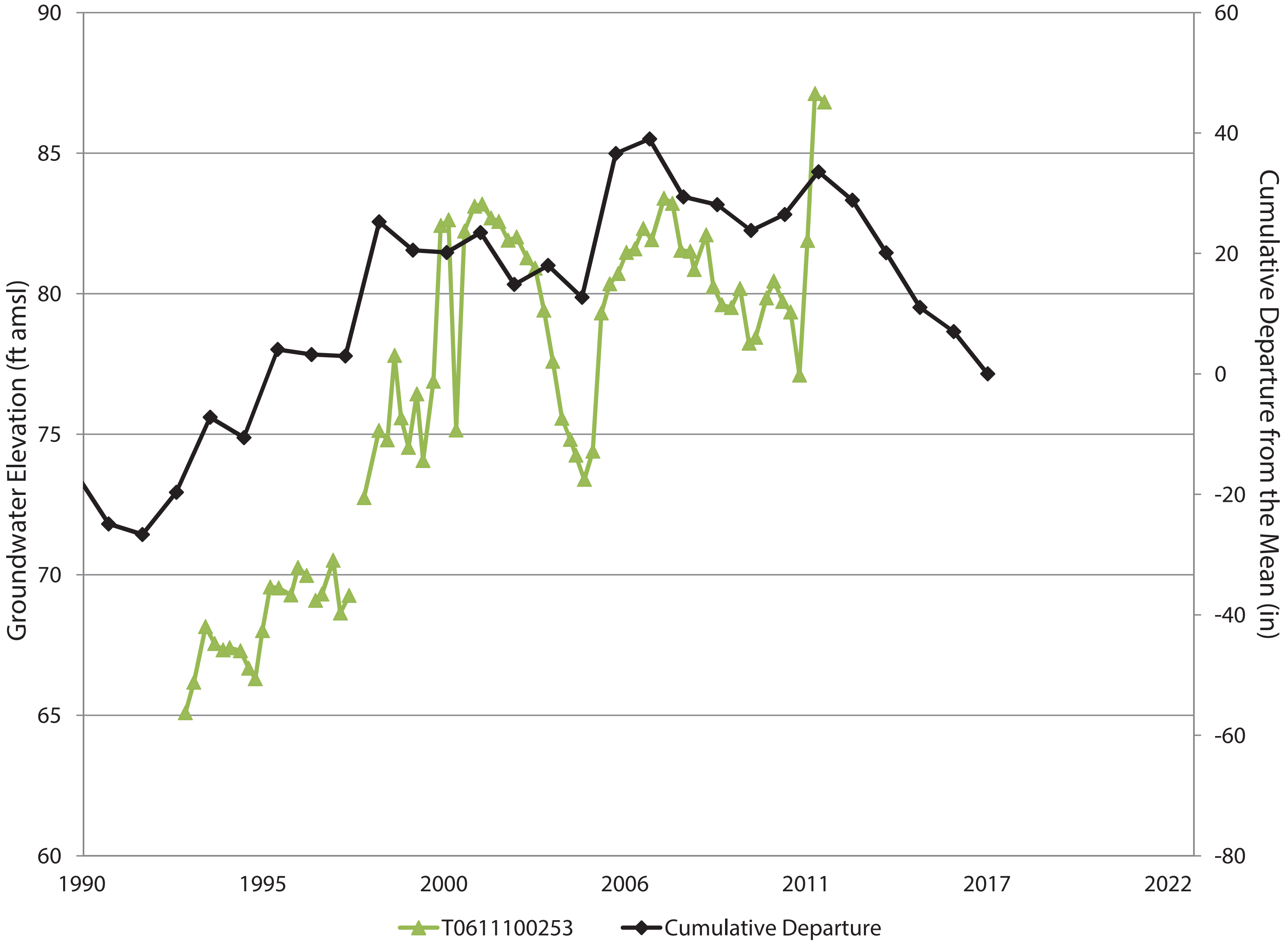

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FIGURE 2-8

Groundwater Elevation Hydrographs in the Shallow Aquifer

Groundwater Sustainability Plan for the Pleasant Valley Basin

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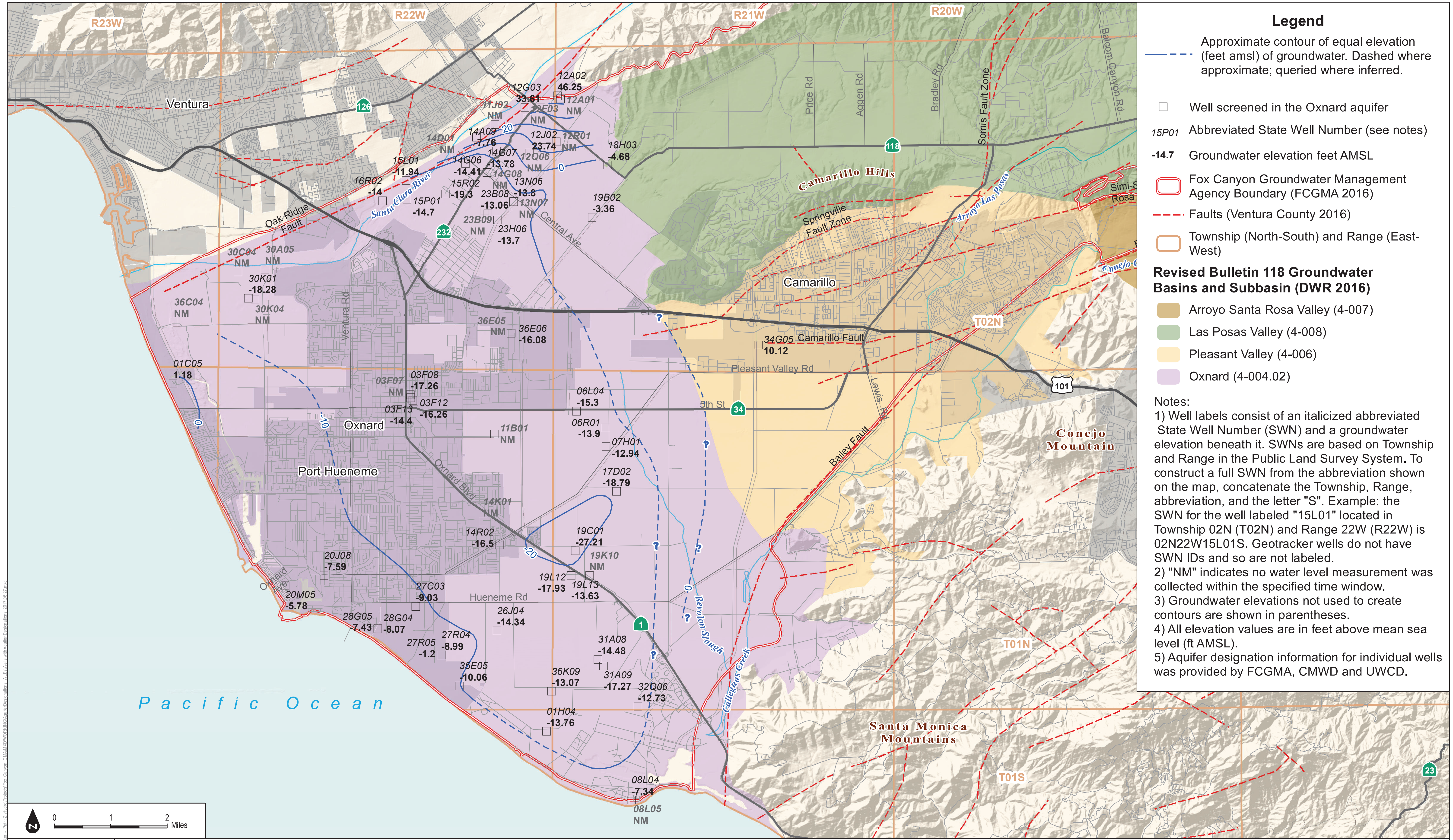

Legend

Approximate contour of equal elevation (feet amsl) of groundwater. Dashed where approximate; queried where inferred.

☐ Well screened in the Oxnard aquifer

15P01 Abbreviated State Well Number (see notes)

-14.7 Groundwater elevation feet AMSL

Fox Canyon Groundwater Management Agency Boundary (FCGMA 2016)

Faults (Ventura County 2016)

Township (North-South) and Range (East-West)

Revised Bulletin 118 Groundwater Basins and Subbasin (DWR 2016)

Arroyo Santa Rosa Valley (4-007)

Las Posas Valley (4-008)

Pleasant Valley (4-006)

Oxnard (4-004.02)

Notes:
1) Well labels consist of an italicized abbreviated State Well Number (SWN) and a groundwater elevation beneath it. SWNs are based on Township and Range in the Public Land Survey System. To construct a full SWN from the abbreviation shown on the map, concatenate the Township, Range, abbreviation, and the letter "S". Example: the SWN for the well labeled "15L01" located in Township 02N (T02N) and Range 22W (R22W) is 02N22W15L01S. Geotracker wells do not have SWN IDs and so are not labeled.
2) "NM" indicates no water level measurement was collected within the specified time window.
3) Groundwater elevations not used to create contours are shown in parentheses.
4) All elevation values are in feet above mean sea level (ft AMSL).
5) Aquifer designation information for individual wells was provided by FCGMA, CMWD and UWCD.

SOURCE: DWR; Ventura County; UWCD; CMWD

FIGURE 2-9

Groundwater Elevation Contours in the Oxnard Aquifer (Older Alluvium), March 2-29, 2015

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