EXECUTIVE SUMMARY

The Fox Canyon Groundwater Management Agency (FCGMA, or the Agency), has developed this Groundwater Sustainability Plan (GSP) for the Las Posas Valley Basin (LPVB; DWR Basin 4-008) 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 LPVB. The other two GSAs are the Camrosa Water District GSA — Las Posas Valley GSA and the Las Posas Valley Outlying Areas GSA. This GSP is the sole GSP prepared for the LPVB, and covers the entire LPVB, including all areas of the LPVB outside of FCGMA's jurisdiction. The purpose of this GSP is to define the conditions under which the groundwater resources of the entire LPVB, which support agricultural, municipal and industrial, and environmental uses, will be managed sustainably in the future.

Although the California Department of Water Resources (DWR) has defined the LPVB as a single groundwater basin, the western and eastern parts of the basin are hydraulically separated from each other by the Somis Fault, a geologic feature that inhibits groundwater flow across it. As a result, groundwater conditions on the west side of the fault in the Fox Canyon Aquifer and Grimes Canyon Aquifer, two primary aquifers in the LPVB, differ from conditions on the east side of the fault. Furthermore, the Epworth Gravels Aquifer, located on the east side of the fault is hydrologically separated from the Fox Canyon Aquifer and Grimes Canyon Aquifer. Hydrologic differences in the controls on, and responses to, both recharge and groundwater production necessitate the definition of three separate management areas in the LPVB. These three management areas are the West Las Posas Management Area (WLPMA), the East Las Posas Management Area (ELPMA), and the Epworth Gravels Management Area. The hydrologic conditions, sustainable yield, and sustainability criteria are discussed and defined by management area throughout this GSP.

Historical groundwater production in the LPVB has resulted in chronic declines in groundwater levels and loss of groundwater in storage in parts of each of the three management areas. In the WLPMA, the average rate of groundwater production between 2015 and 2017 was approximately 14,000 acre-feet per year (AFY). In the ELPMA and the Epworth Gravels Management Area, the average rate of groundwater production between 2015 and 2017 was approximately 20,500 AFY and 1,500 AFY, respectively. Numerical groundwater simulations indicate that if these production rates were carried into the future, groundwater elevations in each of the management areas of the LPVB would not recover during multi-year cycles of drought and recovery.

In order to determine the sustainable yield of each management area, combinations of projects and management actions were explored to estimate the rate of groundwater production that would prevent chronic declines in groundwater elevation and ongoing loss of groundwater storage in the future. Additionally, in the WLPMA, the numerical groundwater model simulations were used to assess the influence of groundwater conditions on the adjacent Oxnard Subbasin. In the ELPMA, numerical groundwater simulations were also used to assess zones of the Fox Canyon Aquifer that are most prone to conversion from confined to unconfined conditions.[1] The rate of groundwater production that avoids chronic water level declines, loss of storage, potential land subsidence, and impacts to adjacent basins is referred to as the sustainable yield for each management area.

With the currently available projects and management actions, the sustainable yield of the WLPMA is approximately 12,500 AFY, with an uncertainty estimate of ±1,200 AFY (Table ES-1). In the ELPMA, the total sustainable yield (including the Epworth Gravels Management Area) is estimated to be between 17,80015,700 AFY ±1,2502,300 AFY AFY and 18,700 ±1,500 AFY, depending on which projects are ultimately implemented in the management area. In For the Epworth Gravels Management Area only, the sustainable yield is estimated to be approximately 1,300 AFY. Except for the Epworth Gravels Management Area, bothBoth the historical (1985–2015) and recent (2015–2017) groundwater production rates exceeded the upper end of the future sustainable yield estimates (Table ES-1).

Table ES-1
Sustainable Yield Estimates

Period	Management Area	Sustainable Yield (AFY)	Approximate Average Pumping During the Period (AFY)
Historical 1985 to 2015 (based on GSP Regulation Section 354.18[b][5])	WLPMA	10,000 to 11,000	15,400
	ELPMA	17,000 to 19,000	19,800
	Epworth Gravels	About 1,5001,300	1,5001,300
Average groundwater pumping during the 2015–2017 period using a simulated 1930 to 1969 climate period and the 2070 DWR climate change data (based on preventing significant and unreasonable affects for one or more of the six sustainability indicators)	WLPMA	11,300 to 13,700	14,000
	Total ELPMA	14,50015,500 to 20,20020,100	20,500
	Epworth Gravels	1,300 to 1,340	1,500

Notes: AFY = acre-feet per year; DWR = California Department of Water Resources; ELPMA = East Las Posas Management Area; GSP = Groundwater Sustainability Plan; WLPMA = West Las Posas Management Area.

Adoption of this GSP represents the first step in achieving groundwater sustainability within the LPVB, as required by SGMA. SGMA requires that groundwater condition in each of the management areas of the LPVB be managed sustainably within 20 years of adoption of the GSP. SGMA also requires that this GSP be evaluated at a minimum of every 5 years after adoption. As part of the 5-year evaluation process, the sustainable yield will be refined and adjusted. These

[1] A confined aquifer is saturated with water that is under pressure, so that when it is penetrated by a well, the water level in the well rises above the top of the aquifer. An unconfined aquifer is an aquifer whose upper water surface is at atmospheric pressure and below the top of the aquifer.

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.

The required 5-year evaluations will also examine both new water supply projects, and the potential impacts of extractions rates on groundwater elevations and sustainability in the LPVB. Additional modeling is recommended during the 5-year update process to understand how changes in pumping and additional new water supply projects can increase the overall sustainable yield of the different management areas of the LPVB. As this understanding improves, projects to support increases in the overall sustainable yield can be developed.

ES.1 INTRODUCTION

The LPVB 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 54°F to 84°F in summer and from 40°F to 74°F in winter. The Las Posas Valley ranges in elevation from approximately 100 feet above mean sea level in the southwest to more than 1,500 feet above mean sea level in the northeast. The primary surface water drainage in the Las Posas Valley is Arroyo Las Posas, which is named Arroyo Simi in the easternmost portion of the Las Posas Valley.[2] Land use overlying the LPVB is divided between agricultural and urban uses, with agricultural use covering approximately 51% of the land within the Las Posas Valley, and residential and urban use covering approximately 23% of the land. The remaining 26% is open space. DWR has designated the LPVB as a high-priority groundwater basin.

The majority of the LPVB is within the jurisdiction of the FCGMA, 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 groundwater users. Extractors within FCGMA jurisdiction are subject to the Agency's GSPs, ordinances, and policies created for the sustainable management of groundwater management actions.

FCGMA is one of three groundwater sustainability agencies (GSAs) that have jurisdiction over portions of the LPVB. FCGMA is the GSA for the area of the LPVB that falls within its jurisdiction. The Camrosa Water District GSA— Las Posas Valley GSA is the GSA for the portion of the Camrosa Water District Service area in the Las Posas Valley, and the Las Posas Outlying Areas GSA is the GSA for portions of the LPVB not within FCGMA or Camrosa Water District

2 For simplicity, the name *Arroyo Simi–Las Posas* is used in this GSP to denote the entire reach of the two arroyos in the ELPMA.

jurisdiction. This FCGMA GSP is the sole GSP prepared for the LPVB, and covers the entire LPVB, including all areas of the LPVB outside of FCGMA's jurisdiction.

Public participation and stakeholder feedback have played a critical role in the development of this GSP. 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 wereare 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 GSPs 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 held public meetings throughout the GSP development process, beginning in July 2015, and 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 wereare 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

Hydrogeologic Background

DWR defines three water-bearing formations in the LPVB: alluvium, the San Pedro Formation, and the Santa Barbara Formation. Geologic differences between the WLPMA and the ELPMA have resulted in different names being assigned to the hydrostratigraphic units associated with these three water-bearing formations in each management area. In the WLPMA, the alluvium is referred to as the shallow alluvial system to reflect the hydrologic connection between the WLPMA and the Upper Aquifer System of the Oxnard Subbasin to the west. Underlying the shallow alluvial system in the WLPMA, the San Pedro Formation has been divided into two hydrostratigraphic units: the upper San Pedro Formation and, underlying that, the Fox Canyon Aquifer. The Fox Canyon Aquifer is a principal aquifer in the WLPMA. The Grimes Canyon Aquifer in the upper Santa Barbara Formation, which underlies the Fox Canyon Aquifer, is the deepest aquifer in the WLPMA.

In the ELPMA, the alluvium is referred to as the Shallow Alluvial Aquifer, and is constrained to an area adjacent to Arroyo Simi–Las Posas. The San Pedro Formation is divided into three hydrostratigraphic units in the ELPMA: the Epworth Gravels Aquifer, the upper San Pedro Formation, and the Fox Canyon Aquifer. The extent of the Epworth Gravels Aquifer is approximately 1,600 acres (2.5 square miles) located 2 to 3 miles north-northwest of Moorpark in the ELPMA. Because the Epworth Gravels Aquifer is limited in extent and is hydrologically disconnected from the Fox Canyon Aquifer, the Epworth Gravels Aquifer has been designated as a separate management area in this GSP. The upper San Pedro Formation underlies the Shallow Alluvial Aquifer where it is present, and underlies the Epworth Gravels Aquifer, where it is present in the ELPMA. The upper San Pedro Formation is not a primary aquifer, but rather serves as a reservoir of stored water that through time has been slowly leaking into the Fox Canyon Aquifer below. The Fox Canyon Aquifer is a primary aquifer in the ELPMA. Underlying the Fox Canyon Aquifer is the Grimes Canyon Aquifer in the upper Santa Barbara Formation, which is the deepest aquifer in the ELPMA.

Extensive geologic folding and faulting in the LPVB have resulted in large differences in the thickness, elevation, and exposure of the subsurface aquifers. In general, the Fox Canyon Aquifer is confined, except where it crops out on the northern and southern margins of the basin, and in the vicinity of Moorpark, where a subsurface fold has thinned and lifted the Fox Canyon Aquifer. This fold is known as the Moorpark anticline. In these areas, declining groundwater elevations would result in larger portions of the Fox Canyon Aquifer becoming unconfined.

Historical Groundwater Conditions

Groundwater elevations and flow directions have varied historically in the different management areas of the LPVB. In the WLPMA, groundwater elevations in wells adjacent to the Oxnard Subbasin are influenced by surface water diversions of the Santa Clara River, which are directed to spreading basins in the Forebay area of the Oxnard Subbasin by the United Water Conservation District (UWCD). When UWCD has been able to divert river water to its recharge basins, groundwater elevations have risen in wells in the western parts of the WLPMA. The influence of UWCD recharge operations is not clear in historical water level records from wells farther east in the WLPMA. In this area, chronic declines in groundwater levels caused by groundwater production have been observed historically. These chronic declines were offset by in-lieu surface water deliveries between 1995 and 2008.

In the Epworth Gravels Management Area, chronic groundwater level declines were observed between 1930 and 1990. Water level declines in this management area caused property owners to drill deeper wells, which penetrated the Fox Canyon Aquifer. As groundwater production shifted from the Epworth Gravels Aquifer to the Fox Canyon Aquifer in this area, groundwater elevations began to recover in the Epworth Gravels Aquifer. With the onset of the drought that began in 2011, groundwater elevations in the Epworth Gravels Aquifer began to decline again.

In the ELPMA chronic groundwater level declines were observed prior to 1970. In 1970, upstream wastewater treatment plant and shallow dewatering well discharges began reaching the ELPMA and converted Arroyo Simi–Las Posas from an ephemeral stream to a perennial stream. The perennial flow in the Arroyo provided recharge to the underlying groundwater aquifers. This recharge caused water levels to recover in areas of the ELPMA adjacent to Arroyo Simi–Las Posas, while groundwater levels have continuously declined throughout the northern ELPMA, which does not receive recharge from Arroyo Simi–Las Posas. The volume of perennial surface water flows that reach the ELPMA has declined over the past decade, and water levels adjacent to Arroyo Simi–Las Posas have stabilized or declined in recent years in response to the combined effects of the diminished recharge and the drought that began in 2011.

As the ELPMA began to receive additional recharge from perennial flows in Arroyo Simi–Las Posas, groundwater concentrations of total dissolved solids (TDS) began to increase. Increased concentrations of TDS have been observed in both the Shallow Alluvial Aquifer and the Fox Canyon Aquifer.

Increased surface water flow and infiltration along Arroyo Simi–Las Posas also resulted in the establishment of riparian vegetation, along the banks of the arroyo. This riparian vegetation, which is dominated by non-native Arundo (*Arundo donax*), has been identified as a potential groundwater-dependent ecosystem. Within the boundaries of the ELPMA, ~~Arroyo Simi–Las Posas is generally a losing stream, meaning that the groundwater table is below the stream bed, and~~ water from Arroyo Simi–Las Posas percolates into the underlying sediments to recharge the groundwater. This ~~leads to the conclusion~~indicates that the riparian habitat along Arroyo Simi–Las Posas may rely on soil moisture from percolating surface water, rather than groundwater. As surface flows and recharge decrease in Arroyo Simi–Las Posas, groundwater elevations and soil moisture content in the vicinity of the potential groundwater-dependent ecosystem are anticipated to decline. These declines may impact the health of the riparian vegetation.

Water Budget

The water budget for the management areas of the LPVB provides an accounting and assessment of the annual volume of groundwater and surface water entering (i.e., inflow) and leaving (i.e., outflow) each management area. This enables an accounting of the cumulative change in groundwater in storage over time. Two numerical groundwater models were developed to calculate the water budget for the different management areas in the LPVB. Calleguas Municipal Water District (CMWD) developed the “Groundwater Flow Model of the East and South Las Posas Sub-Basins,” a MODFLOW numerical groundwater flow model, for the ELPMA and the Epworth Gravels Management Area. UWCD developed the “Ventura Regional Groundwater Flow Model,” a MODFLOW numerical groundwater flow model, for the WLPMA, the Oxnard Subbasin, the Mound Basin, and the Pleasant Valley Basin, which are in hydraulic communication with each other. A peer review study of each groundwater model was conducted for this GSP.

The historical groundwater budget for the WLPMA is based on the UWCD model, which had a historical base period from 1985 through 2015. During average conditions, which are defined as water years in which the precipitation was between 75% and 150% of the average annual precipitation, the net change in groundwater storage for the Shallow Aquifer System was an increase of 292 AFY. In the upper San Pedro Formation, Fox Canyon Aquifer, and Grimes Canyon Aquifer, the net change in groundwater storage was a decrease of approximately 263 AFY. Groundwater pumping during these years averaged 1,346 AFY in the Shallow Aquifer System, and 13,274 AFY in the upper San Pedro Formation, Fox Canyon Aquifer, and Grimes Canyon Aquifer, combined. Between 1995 and 2007, CMWD delivered in-lieu water to the WLPMA, which has kept groundwater levels and storage from declining further. As of 2015, CMWD had stored 25,192 AF of water in the WLPMA through in-lieu deliveries. Groundwater levels and storage would be lower if CMWD cumulative storage had not occurred.

During average conditions, the net change in groundwater storage for the Epworth Gravels Aquifer was an increase of 184 AFY. Groundwater pumping during these years averaged 1,203 AFY. The increase in storage during average years reflects the rising water levels in the aquifer that occurred after property owners drilled wells into the Fox Canyon Aquifer, and reduced production from the Epworth Gravels Aquifer.

During average conditions, the net change in groundwater storage for the ELPMA was an increase of 4,638 AFY. Groundwater pumping averaged 17,283 AFY during average conditions. The increase in storage primarily reflects the rising water levels in the management area that occurred since 1970, as perennial flow in Arroyo Simi–Las Posas began to recharge the management area. It also reflects CMWD in-lieu water deliveries, and Aquifer Storage and Recovery Project injections, which have kept groundwater levels and storage from declining. As of 2015, CMWD had stored 11,398 AF of water in the ELPMA through in-lieu deliveries and Aquifer Storage and Recovery Project injections. Groundwater levels and storage would be lower if CMWD cumulative storage had not occurred.

Projected Water Budget and Sustainable Yield

Several numerical groundwater model scenarios were developed for this GSP to assess the future sustainable yield of the management areas of the LPVB. Each future scenario covered a 50-year timeframe, from 2020 to 2069. The UWCD model was used to assess the future sustainable yield of the WLPMA, and the CMWD model was used to assess the future sustainable yield of the ELPMA and the Epworth Gravels Management Area.

Two scenarios in the WLPMA continued the 2015–2017 average groundwater extraction rate throughout the 50-year model period. The results of each of these scenarios indicated that continuing the 2015–2017 extraction rate would contribute to net seawater intrusion in the Oxnard Subbasin, which is hydrologically connected to the WLPMA. In three additional scenarios, the groundwater production rate was decreased gradually over the first 20 years in the WLPMA, Oxnard Subbasin, and Pleasant Valley Basin. These model scenarios indicated that reduced groundwater production can eliminate net seawater intrusion in the Oxnard Subbasin over periods of drought and recovery and may result in higher groundwater elevations in the WLPMA. Increasing groundwater elevations across the management area in the three scenarios indicate that the modeled groundwater production rates in the WLPMA during these scenarios were likely lower than the sustainable groundwater production rate. Based on the suite of model scenarios, the sustainable yield of the WLPMA was calculated to be approximately 12,500 AFY, with an uncertainty of ±-1,200 AFY.

In two numerical groundwater model scenarios for the ELPMA and the Epworth Gravels Management Area, the 2015–2017 average groundwater extraction rate was continued throughout the 50-year model period. The results of each of these scenarios indicated that there would be chronic declines in groundwater levels and associated loss of storage in the Epworth Gravels Management Area at the 2015–2017 average groundwater production rate. In the ELPMA, chronic declines in groundwater level and loss of storage were also predicted at the 2015–2017 average production rate. However, a smaller loss of storage was predicted for the scenario in which surface water flow was maintained in Arroyo Simi–Las Posas than for the scenario in which surface water flow was decreased.

Three additional scenarios were developed for the ELPMA and the Epworth Gravels Management Area. In one scenario, groundwater production was reduced and flow in Arroyo Simi–Las Posas was maintained. In the other two scenarios, groundwater production was reduced and flow in Arroyo Simi–Las Posas was also reduced. Based on the suite of model scenarios, the sustainable yield of the ELPMA was estimated to be 17,800 AFY ± 2,300 AFYbetween 15,700 ±1,250 AFY and 18,700 ±1,500 AFY, depending on which projects are ultimately implemented in the management area. In the Epworth Gravels Management Area, the sustainable yield is estimated to be approximately 1,300 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 water levels in the management areas of the LPVB. In the WLPMA, additional groundwater modeling will be needed to better constrain the sustainable yield over the next 5 years. In the ELPMA, additional modeling is recommended to understand how changes in pumping patterns and the addition of new water supply projects may influence the area of Fox Canyon Aquifer that would convert from confined to unconfined conditions and increase the overall sustainable yield of the management area. As this understanding improves, targeted projects and management actions can be developed to support increases in the overall sustainable yield in each management area.

ES.3 OVERVIEW OF SUSTAINABILITY CRITERIA

The primary sustainability goal in the LPVB is to maintain a sufficient volume of groundwater in storage in each management area so that there is no significant and unreasonable decline in groundwater elevation or storage over wet and dry climatic cycles. Further, groundwater levels in the WLPMA 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.[3]

Under SGMA, undesirable results occur when the effects caused by groundwater conditions occurring throughout the management area 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 LPVB when groundwater production exceeds the sustainable yield. The LPVB does not experience direct seawater intrusion, although groundwater elevations in the WLPMA can influence the ability of the Oxnard Subbasin to prevent seawater intrusion. Depletion of interconnected surface water is not occurring within the LPVB~~, where Arroyo Simi Las Posas is a losing stream, with groundwater elevations that have been below the bottom of the stream channel for decades~~. Minimum thresholds and measurable objectives, which are quantitative metrics of groundwater conditions in the LPVB, were established for the sustainability indicators determined to be a current and/or potential future undesirable result. Separate minimum thresholds and measurable objectives were developed for each management area in the LPVB. Groundwater elevations were used as a proxy for other sustainability indicators in establishing the minimum thresholds and measurable objectives.

3 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.

West Las Posas Management Area

The measurable objective groundwater levels for the WLPMA differ geographically, based on the extent of influence of surface water spreading on observed groundwater levels in the management area. In the western part of the WLPMA, where UWCD surface water spreading influences groundwater elevations, the measurable objective water level is the groundwater level to which the Fox Canyon Aquifer has recovered historically. In the eastern WLPMA, the measurable objective groundwater elevation is the elevation that represents half of the total recovery in the historical record. The measurable objective groundwater levels in the WLPMA are at least 20 feet higher than the minimum threshold groundwater levels, thereby allowing for operational flexibility in the management area. To allow for operational flexibility during drought periods, groundwater levels in the WLPMA are allowed to fall below the measurable objective as long as the periods during which groundwater elevations are below the measurable objective are offset by periods when the groundwater elevations are higher than the measurable objective.

The minimum threshold groundwater levels for the WLPMA also differ geographically, based on proximity to the Oxnard Subbasin. In the western part of the WLPMA, the minimum threshold is based on the lowest simulated groundwater elevation after 2040 for the model scenario in which the 2015–2017 average production rate was continued throughout the 50-year model simulation, and projects were implemented. For the eastern part of the WLPMA, the minimum threshold is based on the average low historical groundwater elevations in the early 1990s, before in-lieu surface water deliveries to the WLPMA began. These elevations were selected because the groundwater levels in the eastern part of the WLPMA recovered, with the aid of in-lieu surface water deliveries, from the historical low levels in the early 1990s. These minimum thresholds are anticipated to maintain or improve the beneficial uses of the WLPMA by preventing chronic lowering of groundwater levels. This allows for long-term use of groundwater supplies in the WLPMA without ongoing loss of storage.

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

- In any single monitoring event, groundwater levels in three of five identified representative monitoring wells, referred to as *key wells*, are below their respective minimum thresholds.
- 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.

East Las Posas Management Area

In the ELPMA, the measurable objective groundwater elevations were selected based on the historical groundwater level record and the groundwater model simulations that result in stable groundwater elevations after 2040. The measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040. The measurable objective groundwater elevation is lower than the 2015 groundwater elevation in each of the representative monitoring wells (key wells), in the ELPMA. These measurable objectives reflect the anticipated future declines in groundwater elevation that will result from a gradual reduction in groundwater production to the sustainable groundwater production rate over the next 20 years and the potential for further reductions in recharge to the ELPMA from Arroyo Simi–Las Posas.

The minimum threshold groundwater levels in the ELPMA, which vary geographically, are based on a review of the historical groundwater elevation data, incorporation of potential projects, and an analysis of the projected future declines in groundwater elevation and storage under multiple future groundwater production scenarios. For wells that are adjacent to Arroyo Simi–Las Posas and are, generally, south and west of the Moorpark Anticline, the minimum thresholds are based on the historical low groundwater elevation. For the remaining wells, the minimum threshold is based on the groundwater level that limits reduction in storage to less than 20% relative to the estimated 2015 groundwater storage volume in areas of the ELPMA where the Fox Canyon Aquifer may convert from being confined to unconfined. Conversion of the Fox Canyon Aquifer from confined to unconfined conditions is most likely to occur on the flanks of the Moorpark and Long Canyon anticlines, and on the northern and southern margins of the ELPMA where the Fox Canyon Aquifer crops out. Continued production at the 2015–2017 rates has the potential to cause these areas of the ELPMA to lose more than 30% of the available groundwater storage. Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply. The selected minimum thresholds are anticipated to maintain the future beneficial uses of the ELPMA by preventing chronic lowering of groundwater levels, ongoing loss of storage, and increased areas of unconfined conditions in the Fox Canyon Aquifer after 2040.

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

- In any single monitoring event, groundwater levels in 5 of 15 identified key wells are below their respective minimum thresholds.

- 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.

Epworth Gravels Management Area

In the Epworth Gravels Management Area, the measurable objective groundwater elevation was selected based on the historical groundwater level record and the groundwater model simulations that result in stable groundwater elevations after 2040. Groundwater elevations have been below the measurable objective groundwater elevation historically, but have been above the measurable objective since 2005.

The minimum threshold groundwater level in the Epworth Gravels Management Area was selected as the groundwater level that limits reduction in storage to less than 20% relative to the estimated 2015 groundwater storage volume. Limiting the long-term loss of storage to no more than 20% in in this management area was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply. The selected minimum threshold is anticipated to maintain the future beneficial uses of the Epworth Gravels Management Area by preventing chronic lowering of groundwater levels and ongoing loss of storage after 2040.

One well was selected as a key well in the Epworth Gravels Management Area. The definition of undesirable results for the Epworth Gravels Management Area is based on the time over which this well may exceed the minimum threshold. Under this definition, the Epworth Gravels Management Area would be determined to be experiencing an undesirable result if the groundwater level in the key well were below the minimum threshold for either three consecutive monitoring events or in three of five consecutive monitoring events. Monitoring events are scheduled to occur in the spring and fall of each year.

ES.4 OVERVIEW OF THE BASIN MONITORING NETWORK

The overall objective of the monitoring network in the LPVB 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 LPVB must be capable of the following:

- Monitoring changes in groundwater conditions (in six sustainability indicator categories)
- Monitoring progress toward minimum thresholds and measurable objectives
- Quantifying annual changes in groundwater 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 different management areas of the LPVB 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 LPVB.

In both the WLPMA and the ELPMA, monitoring can 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. Additionally, 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 the ELPMA, the monitoring network can also be improved by adding a monitoring well screened in the Grimes Canyon Aquifer, and a well screened in the Shallow Alluvial Aquifer. The monitoring well screened in the Shallow Alluvial Aquifer should be placed within the boundaries of the potential groundwater-dependent ecosystem to assist with understanding the potential connectivity between groundwater and the potential groundwater-dependent ecosystem.

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 management areas of the LPVB resulting from groundwater production in excess of the current sustainable yield. Three projects were included in this GSP. One project applies to the WLPMA and two projects apply to the ELPMA. No projects were proposed for the Epworth Gravels Management Area. The projects that are included in this GSP were suggested by stakeholders and reviewed by the FCGMA Board. The inclusion of these projects does not constitute a commitment by the FCGMA Board to construct or fund them, but rather signals that the projects were 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 LPVB. ~~.~~ Projects included in the GSP or any amendment thereof ~~which~~that increase the available supply of groundwater are necessary to meet the sustainability goal for the basin in a manner ~~which~~ that avoids adverse impacts to beneficial uses and users of groundwater within the basin.

Project No. 1 – Purchase of Imported Water from CMWD

The Purchase of Imported Water from CMWD for Basin Replenishment Project would supply imported water to the eastern part of the WLPMA in lieu of groundwater production. This project would reduce production from discrete wells in the WLPMA by 1,762 AFY. Numerical groundwater model scenarios suggest that this project will assist with water level recovery in the WLPMA. Furthermore, historical deliveries of imported water in lieu of groundwater production have resulted in groundwater elevation recoveries in the eastern WLPMA. Therefore, this project is anticipated to have a direct impact on groundwater elevations and could be used to help maintain elevations above the minimum thresholds.

Project No. 2 – Arroyo Simi–Las Posas Arundo Removal

The Arroyo Simi–Las Posas Arundo Removal Project consists of removing the invasive plant species Arundo from approximately 324 acres of land along the Arroyo Simi–Las Posas corridor. Arundo would be replaced with native riparian plant species, which are estimated to consume approximately 6 to 25 AFY per acre less water than Arundo. If all of the Arundo is removed, this project could result in up to an additional 2,680 AFY of recharge to the ELPMA. This project is anticipated to have a positive impact on groundwater recharge, as well as a positive impact on the health of riparian habitat along Arroyo Simi–Las Posas.

By increasing surface water flow in Arroyo Simi–Las Posas and decreasing evapotranspiration losses from invasive species that currently line the Arroyo Simi–Las Posas, the ELPMA is anticipated to receive more recharge along Arroyo Simi–Las Posas. Although this recharge alone is insufficient to maintain groundwater elevations at or above the measurable objectives throughout the ELPMA at the 2015–2017 average groundwater production rate, it will lessen groundwater pumping reductions necessary to maintain groundwater elevations close to the measurable objectives groundwater levels. This project is anticipated to have a positive impact on groundwater recharge, as well as a positive impact on the health of riparian habitat along Arroyo Simi–Las Posas.

Project No. 3 – Arroyo Simi–Las Posas Water Acquisition

The Arroyo Simi–Las Posas Water Acquisition Project would involve the purchase of recycled water and discharged groundwater from the City of Simi Valley. In return, Simi Valley would commit to continuing to discharge the purchased water from its shallow dewatering wells or the Simi Valley Water Quality Control Plant to Arroyo Simi–Las Posas for downstream recharge to the LPVB. Simi Valley has indicated that 3,000 AFY of recycled water would be available from the Simi Valley Water Quality Control Plant and 1,700 AFY would be available from the dewatering wells. However, due to the riparian use of the water along the Arroyo Simi–Las Posas, an estimated 1,000 to 2,500 AFY of the water may be lost due to plant uptake and evaporation, leaving 2,200 to 3,700 AFY available as surface flow and recharge to the ELPMA.

This project is anticipated to have a direct impact on groundwater elevations and could be used to help maintain elevations above the minimum thresholds throughout much, but not all, of the ELPMA. Although perennial surface water flow has provided recharge to the ELPMA, this flow is also thought to be the primary source of rising TDS concentrations observed in the groundwater adjacent to Arroyo Simi–Las Posas since the 1990s. Consequently, if this project is pursued further, the water quality of the surface water flows will have to be investigated further and addressed in the feasibility study.

Management Action No. 1 – Reduction in Groundwater Production

The primary management action proposed under this GSP is Reduction in Groundwater Production from the LPVB. FCGMA has had the authority to monitor and regulate groundwater production in the LPVB since 1983. The FCGMA Board has established extraction allocations for each extraction facility and has used its authority to reduce groundwater production from the LPVB in the past, and will continue to ~~exert its authority over~~ control groundwater production as a GSA for the LPVB.

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In the WLPMA, the estimated long-term rate of groundwater production that will prevent chronic declines in groundwater levels, loss of storage, and subsidence due to groundwater withdrawal and will also allow the prevention of seawater intrusion in the Oxnard Subbasin is approximately 12,500 AFY, with an estimated uncertainty of approximately ±1,200 AFY. The difference between the estimated sustainable yield and the average 2015–2017 production rate is 1,500 AFY. In the ELPMA, the sustainable yield is estimated to be between 17,800 AFY ± 2,300 AFY~~15,700 ±1,250 AFY and 18,700 ±1,500 AFY, depending on which projects are ultimately implemented in the management area~~. The average 2015–2017 groundwater production rate was approximately 20,500 AFY. In the Epworth Gravels Management Area, the sustainable yield is estimated to be approximately 1,300 AFY. The average 2015–2017 groundwater production rate was approximately 1,500 AFY.

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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 Las Posas Valley Basin (LPVB), 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 LPVB, including those portions of the LPVB that lie outside FCGMA's jurisdictional boundary, primarily consisting of fringe areas of the LPVB. The County of Ventura (County) and the Camrosa Water District (CWD) have each elected to act as the GSA for portions of the LPVB not within FCGMA's jurisdiction. The County and CWD will rely on this GSP and coordinate with FCGMA as necessary to ensure that the LPVB 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 over a 50-year 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 LPVB 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 LPVB, groundwater production from the western part of the West Las Posas Management Area (WLPMA) influences groundwater elevations in the Oxnard Subbasin to the west. This influence has the potential to exacerbate

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).

seawater intrusion in the Oxnard Subbasin. Portions of the LPVB are experiencing, or under threat of experiencing degraded water quality. Land subsidence has occurred historically in the LPVB and has the potential to occur in the future if groundwater conditions are not managed sustainably. Depletions of interconnected surface water have occurred between the 1970s (the start of Simi Valley discharges) and January 1, 2015, although groundwater elevations in the vicinity of potential Groundwater-Dependent Ecosystems recovered as surface water flows from Simi Valley wastewater treatment plant and dewatering discharges increased along Arroyo Las Posas.

The purpose of this GSP is to define the conditions under which the groundwater resources of the entire LPVB, which support agricultural, municipal and industrial (M&I), and environmental uses, will be managed sustainably in the future. The ~~publication~~ adoption of this GSP represents the first step in achieving groundwater sustainability within the LPVB 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 LPVB improves, this GSP will be updated to reflect the new understanding of the LPVB. 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 LPVB.

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 (1) the County of Ventura (County), (2) the United Water Conservation District (UWCD), (3) the ~~seven~~ mutual water companies and water districts within FCGMA (Alta Mutual Water Company, Pleasant Valley County Water District, 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 FCGMA (Ventura, Oxnard, Camarillo, Port Hueneme, and Moorpark), and (5) the farmers. 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 to act 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 2019a).

Extractors within FCGMA jurisdiction are subject to the Agency's GSPs, ordinances, and policies created for the sustainable management of groundwater. 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 does not construct, operate, or maintain capital facilities but does have the authority to adopt ordinances requiring registration of groundwater wells, requiring reporting of groundwater use, regulating groundwater extractions, and requiring fees. FCGMA contracts with the County of Ventura to provide staff to support FCGMA (FCGMA 2019b).

1.2.4 Plan Manager

Executive Officer of FCGMA, Jeff Pratt, PE

Phone: 805.654.2073

Email: Jeff.Pratt@ventura.org

Mailing Address:

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

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 FCA and includes portions of the Oxnard Subbasin and the LPVB, the PVB, and the Arroyo Santa Rosa Valley Basin. FCGMA may adopt ordinances for the purpose of regulating, conserving, managing, and controlling the use and extraction of groundwater within its territory (Fox Canyon Groundwater Management Agency Act [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 GSA 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.

1.2.6 Groundwater Sustainability Plan Implementation and Cost Estimate

This GSP will be implemented by FCGMA. 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 LPVB 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 LPVB 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 current reporting year, will be included in the annual report. As described in Section 1.2.6.2, Data Collection, Validation, and Analysis, relevant data collected by entities within the PVB are regularly provided 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 LPVB 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 LPVB, 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 the following:

- 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 LPVB. Besides VCWPD, other entities that monitor groundwater level and groundwater quality in the LPVB include UWCD, CMWD, and mutual water companies. Relevant data collected by these entities is regularly provided to the 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 LPVB are generated by VCWPD and CMWD. 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, VCWPD will continue to host the data for the LPVB 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 into 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 into 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 LPVB 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 and potential projects developed during the next 5 years, 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 LPVB 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 West Las Posas Management Area (WLPMA), the Oxnard Subbasin, and the PVB. 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 $1.5 million for 2020. Costs were increased annually, using a 2.8% inflation rate, from 2020 to 2040 (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 LPVB, as well as for the PVB and the Oxnard Subbasin. FCGMA is the GSA for these three basins 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 the costs in the budget account for 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. FCGMA anticipates using this existing revenue structure, along with eventual implementation of a replenishment fee, to fund the GSP implementation and direct costs.

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 ~~implement~~ 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 LPVB (DWR Groundwater Basin 4-008) is bounded to the north by South Mountain and Oak Ridge; to the northeast and east by the foothills of Big Mountain; to the south by the Springville ~~f~~Fault (western segment of the Simi—Santa Rosa ~~f~~Fault) ~~the Camarillo Hills, the Somis Gap,~~ and the Las Posas Hills; and to the west by the Oxnard Subbasin of the Santa Clara River Valley Basin (Figure 1-1, Vicinity Map for the Las Posas Valley Basin, and Figure 1-2, Administrative Boundaries for the Las Posas Valley Basin). The LPVB ranges in elevation from approximately 100 feet above mean sea level (msl) in the southwest to more than 1,500 feet msl in the northeast.

Although DWR does not recognize any subbasins within the LPVB, FCGMA has recognized the three groundwater subbasins identified by the U.S. Geological Survey (Hanson et al. 2003). These three subbasins, which are referred to as basins rather than subbasins, are based on the location of geologic structures that were thought to affect flow in the FCA and the Grimes Canyon Aquifer (Las Posas Users Group 2012). The local basins/subbasins are named the West, East, and South

Las Posas Basins (Figure 1-2). Local investigators now divide the LPVB into two management areas, rather than three basins/subbasins (CMWD 2017). The area of the WLPMA is the same area as the West Las Posas Basin. The East Las Posas Management Area (ELPMA) comprises the entire eastern portion of the LPVB, including both the East Las Posas Basin and the South Las Posas Basin (Figure 1-2). FCGMA recognized and established these two management areas in 2011 with the adoption of Ordinance No. 8.6 (FCGMA 2019c). In addition, local investigators have identified the Epworth Gravels Aquifer in the northeastern area of the LPVB as a water-bearing geologic unit that is hydrologically isolated from the other aquifers in the basin, based on differences of more than 100 feet in measured groundwater elevations (see Figure 1-2 and Section 2.2, Hydrogeologic Conceptual Model).

The ELPMA, the WLPMA, and the Epworth Gravels are identified as Management Areas for the LPVB in this GSP (see Section 2.5, Management Areas).

In this document, to distinguish between features on the land surface and in the subsurface, the term Las Posas Valley (LPV) will be used to refer to the geographic area overlying the LPVB.

1.3.1.1 Basin Priority

The California Statewide Groundwater Elevation Monitoring Program (CASGEM) has categorized the LPVB as a high-priority basin.

1.3.1.2 Basin Boundaries and Expansion Area

The boundary between the LPVB and the Oxnard Subbasin is a jurisdictional boundary, which generally follows the mapped surface expression of the Wright Road Fault. 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 to the south, 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 PVB (CMWD 2017).

Multiple boundaries have been used to define or manage the LPVB (Figure 1-2), including the following:

1. The boundary of the LPVB defined by DWR in its 2018 Basin Boundary Modification
2. The jurisdictional boundary of FCGMA
3. The boundary of the LPVB historically used by FCGMA (as indicated in the 2007 Update to the Groundwater Management Plan [FCGMA et al. 2007] and annual reports)

4. The boundaries of the LPVB historically used by VCWPD (as indicated in the 2015 Annual Report of Groundwater Conditions [VCWPD 2016b])

The jurisdictional boundary of FCGMA was established based on a vertical projection of the FCA as defined by the FCGMA Act in 1982. As a result, the DWR Bulletin 118 boundary for the LPVB deviates substantially from the FCGMA boundary in three locations (DWR 2019). In 2019, DWR finalized its latest Basin Boundary Modification process, in which the boundaries of the LPVB remained the same as those defined in the 2016 Basin Boundary Modification (DWR 2019).

First, the DWR Bulletin 118 boundary extends beyond the FCGMA jurisdictional boundary to the east because the FCA thins and disappears east of Moorpark. In this area, the County of Ventura has filed to become the GSA for the Las Posas Valley Outlying Areas (see Appendix A, GSA Formation Documentation, to this GSP; Figure 1-2). The jurisdictional area of the Las Posas Valley Outlying Areas GSA also includes small sections of the LPVB on the northern and southern boundaries, where there was a mismatch between the FCGMA boundary and the boundary currently used by DWR (Figure 1-2).

Second, the FCA is also absent in the Las Posas Hills along the southern boundary between the LPVB and the Arroyo Santa Rosa Valley Basin. This area is within the jurisdiction of CWD. CWD has filed to be the Camrosa Water District GSA–– Las Posas Valley Basin GSA for this area (see Appendix A; Figure 1-2).

Third, because outcrops of the Santa Barbara and San Pedro Formations ("aquifer outcrops") occur along the southern face of South Mountain and Oak Ridge, the FCGMA jurisdictional boundary extends beyond the Bulletin 118 boundary to the northeast (Figure 1-2). These aquifer outcrops are managed as areas that directly recharge the Lower Aquifer System (Las Posas Users Group 2012; FCGMA 1987).

To manage these aquifer outcrops and their watersheds, FCGMA passed Ordinance 4 in July 1987 (and subsequently Ordinances No. 4.1 in June 1995, 4.2 in October 1995, 4.3 in March 2001, 8 in June 2002, and 8.8 in January 2015, each of which superseded the previous code versions). The Ordinance Code established the "Expansion Area" (Figure 1-2), which is defined as follows (FCGMA Ordinance Code, last amended January 9, 2015):

> **"Expansion Area"** means that portion of land beyond the outer limits of the Agency Boundary in the West, East, and South Las Posas Basins that lies between the Agency Boundary and the crest of the hill or 1.5 miles beyond the Agency Boundary as defined by Map Number Two, entitled Fox Canyon Outcrop, Las Posas Basin, 1995.

Groundwater extraction and land use within the Expansion Area is regulated in order to protect groundwater resources.

Although not identical, the boundaries of the LPVB used in 2007 by FCGMA and currently by DWR are similar (Figure 1-2), and generally follow the extent of the alluvium that constitutes the floor of the LPV. The main discrepancy between the 2007 and current DWR boundaries for the LPVB is that the 2007 boundary excludes the area of the Camarillo and Las Posas Hills, while both areas fall within the current DWR boundary (Figure 1-2). Another discrepancy is that the DWR boundary includes more area along the northern border of the western LPVB. Table 1-3 provides a summary of the areal extent of GSAs within the LPVB and the percentage of each GSA that is overlapped by the LPVB. The Las Posas Valley Basin Outlying Areas GSA represents the portion of the LPVB within the boundaries of the LPVB historically used by VCWPD, and the Camrosa Las Posas Basin GSA represents the portion of the LPVB within the jurisdiction of CWD. Although both CWD and the VCWPD manage larger areas, they have delineated their GSAs according to DWR basin boundaries, and thus contained by the LPVB.

Land Ownership and Jurisdiction

Land within the LPVB is under a variety of municipal and County jurisdictions. The City of Moorpark is nearly entirely encompassed by the eastern part of the LPVB and makes up 15.5% of the land area. The City of Camarillo lies primarily outside the LPVB; however, the city's northwestern edge is crossed by the LPVB boundary. Land under County jurisdiction outside the incorporated cities composes the majority (79.6%) of the LPVB's land area. There is no state or federal land ownership within the LPVB. Land owned by the City of Moorpark, the Pleasant Valley Recreation and Park District, and the County of Ventura is used for open space or recreational (parks, golf courses) purposes. 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 body in LPV is Arroyo Las Posas, which is named Arroyo Simi in the easternmost portion of the LPV, and becomes Calleguas Creek after entering the PVB (Figure 1-3, Active Gauge Locations; VCWPD 2016). Arroyo Las Posas enters the valley in the east and generally extends along the southern border of the valley floor until exiting the valley through the Somis Gap and flowing into Pleasant Valley (Figure 1-3). Various facilities have been installed in some reaches of Arroyo Las Posas, including riprap bank protection and drop structures, to reduce erosion and control streamflow.

The northern portion of LPV is characterized by more rugged terrain than the south, and is drained by several features referred to as canyons, washes, barrancas, and drains. Flow in these drainages is ephemeral (Hanson et al. 2003). These features trend generally north–south and eventually discharge to Arroyo Las Posas. The western portion of the LPV drains south and west to Beardsley Wash and ultimately to the Revolon Slough in the Oxnard Plain region (VCWPD 2016).

In 2011, CMWD retained Larry Walker & Associates Inc. to monitor and characterize surface water flow in Arroyo Simi–Las Posas within the bounds of LPV. When measured in late summer of 2011, the upper, middle, and lower sections of the stream channel could be characterized as losing, gaining, and losing reaches, respectively (CMWD 2012). This approximate pattern held true during the long-term monitoring conducted from July 3 through December 14, 2012 (CMWD 2013). The flow in Arroyo Las Posas was affected by significant diurnal fluctuations, likely due to the presence of giant reed ("Arundo"; *Arundo donax*) along much of the riparian corridor. These patterns of diurnal flow change manifested at different magnitudes at different in-stream locations (CMWD 2012).

Characterization of Flow in Arroyo Simi–Las Posas

Sources of dry-weather flow in Arroyo Las Posas currently include wastewater treatment effluent from the City of Simi Valley, shallow dewatering of groundwater in Simi Valley, and wastewater treatment effluent from the City of Moorpark. The Simi Valley Water Quality Control Plant discharged 8,506 acre-feet (AF) to Arroyo Simi in 2015 (DBS&A 2017), and dewatering operations discharges an estimated 1,618 acre-feet per year (AFY) to Arroyo Simi (DBS&A 2017). The Moorpark Wastewater Treatment Plant discharges effluent to percolation ponds located near the course of the arroyo, and since 1985, discharge volumes have ranged from 1,559 to 2,534 AFY. Annual discharges to the percolation ponds peaked in the late 1990s and early 2000s and generally declined between 2005 and 2015. In addition, the Moorpark plant discharged directly to the arroyo in 2001 (1,647 AF) and 2002 (1,613 AF) (DBS&A 2017).

Records of average daily flow (ADF) from three VCWPD gauges are available for Arroyo Las Posas within LPV. One of these stations (Station 841A) is active, and two (Stations 841 and 801) are inactive. Additionally, an active VCWPD gauge (Station 803) is located approximately 3 miles upstream of where Arroyo Simi enters the LPV (Figure 1-3; Table 1-5). It should be noted that these gauges can be used to characterize flow only in the eastern portion of LPV. In recent years, dry-weather surface flow in Arroyo Las Posas has typically disappeared upstream of the boundary between the ELPMA and the PVB (Bondy, pers. comm. 2016).

Station 841A is located approximately 100 meters (328 feet) upstream of Station 841, and the combined data from these two stations represent one active streamflow record beginning in 1990 (although no data were collected at either gauge in water year 1996).

To characterize ADF, ADF records for each gauge on Arroyo Simi–Las Posas were grouped by month. Each month in the record of each gauge was assigned a minimum, average, and maximum value (see Table 1-6 and Figure 1-4, Monthly Minimum, Average, and Maximum Average Daily Flows in Arroyo Simi–Las Posas).

By visual inspection, the record of monthly minimum ADF (a proxy for baseflow) at Station 803 can be divided into four periods: 1933–1974 (baseflow near zero), 1975–1994 (rising baseflow), 1995–2005 (relatively stable baseflow, which largely ranged from 4 to 8 cubic feet per second, with occasional high outliers), and 2005–present (declining baseflow). For comparison, the ranges of the monthly ADF and the maximum monthly ADF are also shown.

Higher flows than Station 803 are measured at Stations 801 and 841, while flow measured at Station 803 is generally more consistent than at the other two locations. In the 2012 Larry Walker & Associates study, a small gain in flow was recorded between Stations 801 and 841 (located near Stations G3 and G6 in the Larry Walker & Associates study, respectively), which is also reflected in the stream gauge records in the period between 1975 and 1995.

Collectively, the streamflow records reflect the changing status of this portion of the Calleguas Creek watershed. Flow in Arroyo Simi–Las Posas was ephemeral prior to the 1970s. Increasing releases from wastewater treatment plants in Simi Valley and Moorpark, as well as shallow groundwater dewatering in Simi Valley, contributed to rising baseflow in the 1970s, 1980s, and 1990s, and maintained relatively stable baseflows through the mid-2000s. In the past decade, baseflows have declined in the vicinity of Simi Valley (Station 803), and average flows have declined slightly in the LPV (Stations 841 and 841A). These declining flows have been a source of concern for local practitioners, as perennial flow in the Arroyo Simi–Las Posas constitutes an important source of recharge to the shallow aquifers in the ELPMA of the LPV and, to a lesser extent, northern Pleasant Valley (Las Posas Users Group 2012).

1.3.2.2 Current, Historical, and Projected Climate

Current Climate

The climate of LPV is typical of coastal Southern California, with average daily temperatures ranging generally from 54°F to 84°F in summer and from 40°F to 74°F in winter, as measured at the weather stations in Camarillo and Moorpark operated by the California Irrigation Management Information System (CIMIS) and National Oceanic and Atmospheric Administration (NOAA) (CIMIS 2018; NOAA NCEI 2016). 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 in the LPV watershed (8 active and 10 inactive; Figure 1-3, Figure 1-5 (Las Posas Valley Precipitation), and Table 1-7).

Annual precipitation is typically greater in areas with higher relief, such as near South Mountain and Oak Ridge.

Annual precipitation varies somewhat from gauge to gauge (Figure 1-5). Higher-elevation gauges typically record higher annual precipitation. Stations 238 (South Mountain–Shell Oil) and 250 (Moorpark–Happy Camp Canyon) are the highest-elevation gauges in LPV, at 2,240 and 1,410 feet msl, respectively. These two gauges consistently record the highest rainfall in LPV (Table 1-5).

The Agency contracted and received evapotranspiration data from two private weather stations located in LPV during the period 1992 to 2013. The data received from those stations were used by the Agency until 2013 to determine the annual irrigation efficiency allocation. CIMIS station 217, which began recording in July 2014, is located in Moorpark southeast of the LPVB boundary (Figure 1-3). Monthly average evapotranspiration ranges from 2.52 inches in January to 6.76 inches in July, with the average total annual evapotranspiration of 57.58 inches.

There are no governmental monitored and maintained weather stations in LPV that measure pan evaporation rates. Outside the LPV there are two County of Ventura Watershed Protection District weather stations that measure pan evaporation rates: one to the east (Station 227 – Bard Lake) and one to the west (Station 239, El Rio–UWCD Spreading Grounds) of the LPV. At Station 227, the pan evaporation record begins in 1966 and ends in 2010. Averaged by month over the full record, pan evaporation ranges from 3.2 inches in February to 7.9 inches in July, with an average total annual pan evaporation of 65.0 inches. At Station 239, the pan evaporation record begins in 1972 and ends in 2013. Monthly average pan evaporation ranges from 3.7 inches in January to 7.2 inches in July, with the average total annual pan evaporation of 63.0 inches.

Historical Climate Trends

In order to characterize rainfall variability in LPV over the past century, two stations whose combined records cover the entire period were selected: Stations 002 and 190 (Figure 1-3). Station 190 (Somis–Bard, shown on Figure 1-5 in magenta) is located approximately 1 mile north-northwest of Station 002 (Somis–Aggen Ranch, shown on Figure 1-5 in red). However, to ensure that rainfall recorded at these two stations varied in the same manner as at the other stations, correlations between station data were examined.

To quantify variance between stations during wet and dry years, the correlation coefficient (R) was calculated between each pairwise combination temporally overlapping station records. The correlation coefficients between all pairs of station records (excepting pairs that included Station 126) exceeded 0.94. This high degree of correlation provides sufficient confidence to justify the use of the records of Stations 002 and 190 to characterize the precipitation trends in LPV over the 113-year period from 1903 to 2015.

Correlation coefficients between Station 126 and other station records ranged from 0.848 (with Station 002) to 0.563 (with Station 238). This may be due in part to anomalously low values recorded at Station 126 in 1966 and 2008.

The long-term trends record was based on the record from Station 002. For years in which data was not available at Station 002 (1973–present), the annual precipitation value recorded at Station 190 was used to predict a value for the location of Station 002, based on a linear regression of the annual precipitation values in the 17 years of overlap (1956–1972) in the records for Stations 002 and 190 (see formula below).

$$\textit{Station 002 (inches)} = 1.0704 * \textit{Station 190 (inches)} + 0.0691 \qquad (R^2 = 0.9254)$$

This long-term record was used to calculate the mean annual precipitation in LPV near Somis (15.7 inches) and to develop an annual value for the cumulative departure from mean precipitation (Figure 1-6, Long-Term Precipitation Trends in Las Posas Valley), which was used to assess periods of water shortage and surplus. Historical drought periods (defined as a falling limb on the cumulative departure from the mean curve) were identified by visual inspection. Based on the historical record, a drought in LPV can be defined as a period of years in which the valley experiences no more than one consecutive year of above-average precipitation and at least 20 inches of cumulative precipitation deficit (Table 1-8).

The century-long precipitation record demonstrates that drought cycles have frequently impacted LPV. The average drought duration in the past century was 8.5 years, and the duration of periods of average or above-average rainfall was rarely more than 10 years. In this historical context, the approximately 20-year period from 1991 to 2011 constitutes an unusually long wet period (Figure 1-6). 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, or 1.8°F to 5.4°F)
- Increased evaporation rate
- Decrease in annual precipitation (2% to 5%)
- Increase in extreme precipitation events

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

1.3.2.3 Historical, Current, and Projected Land Use

Historical land uses within the LPV were determined based on review of data from the Southern California Association of Governments (SCAG), which has mapped more than 105 land use categories to a minimum 2-acre resolution for the years 1990, 1993, 2001, and 2005 (SCAG 2005). Current land uses within the LPV 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; City of Moorpark 2009). Existing land use patterns and trends are expected to continue, and are described based on information contained in General Plan documents.

The majority of LPV consists of unincorporated areas of Ventura County; however, it also encompasses nearly all of the City of Moorpark and crosses the northwestern edge of the City of Camarillo. Land use in LPV is dominated by agriculture (51% of LPV), consisting mostly of citrus, berries, and avocado crops, although row crops and nursery stock are also increasingly grown in the LPVB. Urban and residential land uses in the LPVB consist of the City of Moorpark, as well as several unincorporated communities concentrated in the central and southwestern portion of the LPVB. These include Somis, the Spanish Hills development, and the Las Posas Estates. Recreational land uses in and around these areas include golf courses and equestrian uses, as well as smaller community parks in the City of Moorpark. The northeastern portion of LPV bisects the Happy Valley Canyon Regional Park. Upland areas along the northern and southern margins of the LPV, particularly as elevations increase toward the east, are occupied by open space and/or rural residential land uses. Table 1-9 shows the County General Plan land uses within LPV, tabulated by area in acres and percentage of total area.

Land uses in Moorpark (generalized as "urban" in the Ventura County General Plan land use map) consist predominantly of planned residential communities, retail shopping centers adjacent to main thoroughfares, and office/light-industrial parks (City of Moorpark 2008). Much of the area within the jurisdictional boundaries of Moorpark, particularly to the northwest part of the city, remains undeveloped. It is expected that some conversion of agricultural space to urban or residential uses will continue within the ~~City~~ city boundaries and sphere of influence, as there are at least 11 active development agreements within the city (City of Moorpark 2008). 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; City of Moorpark 2009). Generally, the boundaries of urban development have stayed similar in the past 20 years, though subdivisions in the southeastern portion of Moorpark were developed in the mid to late 1990s, and additional residences were incrementally developed within and adjacent to the City of Moorpark and unincorporated communities.

The primary east–west thoroughfare in LPV consists of State Route (SR) 118 (East Los Angeles Avenue), which connects Moorpark with Oxnard and Simi Valley, and the north–south SR-23, which connects the area to Fillmore and Thousand Oaks. SR-34 connects Somis to Highway 101 in Camarillo from SR-118. The Ventura County General Plan Environmental Impact Report identifies the widening of roads (for example, in Somis) as a 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). Demographics and population growth within LPV 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 LPV, most of which are derived from decennial census counts, which last 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 LPVB boundary to determine the population within the basin for 2010. Census tracts that intersected the boundaries of the LPVB were area-weighted to determine the population that falls within the basin.
- **City and County General Plans**: The City of Moorpark and the County of Ventura gather data on development, growth, and land use patterns, and make population estimates in conjunction with census data. The City of Moorpark and County of Ventura 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 countywide level, population growth is skewed toward incorporated cities (such as Moorpark). 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 the population in the cities increased at a much higher rate, closer to 10.4%, over the same period.

Table 1-10 shows the past, current, and projected population for Ventura County, the City of Moorpark, and the LPV. The current population of LPV is estimated to have been 38,101 in 2010, based on census data. The current population of the City of Moorpark is 35,033, as of 2015, with an average household size of 3.29 (City of Moorpark 2016). The population of unincorporated areas within LPV is therefore a small portion of the total population in LPV (roughly 10%), concentrated in Camarillo Heights, Las Posas Estates, and Somis. Residents have a median age of 36.5 years; 25.3% of the population is under 18, and 8.4% of the population is over 65. Approximately 70% of the population is white or non-Hispanic, and 30% of the population is Hispanic or Latino (City of Moorpark 2016).

1.4 EXISTING MONITORING AND MANAGEMENT PLANS

Over the past few decades, multiple agencies have implemented programs to monitor and manage water within the LPVB. Local and state agencies have worked together and with basin stakeholders to develop management strategies and monitoring programs. Tables 1-11 and 1-12 summarize the monitoring and management programs, projects, and strategies that are currently in effect.

1.4.1 Monitoring and Management Programs

Table 1-11 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 1-12 provides a summary of management programs, projects, and strategies. It is similarly subdivided into projects and programs that address primarily surface water 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.

Table 1-12 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, the Las Posas Basin Aquifer Storage and Recovery (ASR) Project allows CMWD to store imported surface water in the aquifers of the ELPMA, thereby recharging groundwater and providing a backup source of water in periods during which of imported water is unavailable. When extracted, the water can be used by retailers within the CMWD service area.

Due to the overlapping jurisdictions of the agencies that manage groundwater resources, there are many programs that occur within the LPVB or multiple basins. Therefore, Tables 1-11 and 1-12 both include a column 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 1-11 and 1-12. Some of these have been developed, in part, to increase the operational flexibility within LPVB 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, either physically or through water sources, the opportunity for operational flexibility exists and has been used by FCGMA and local water agencies.

Despite the coordination of projects and programs within the LPVB, there remain limits to operational flexibility. Diverting flows from the Santa Clara River for recharging of groundwater, and extracting from wells in the vicinity of the project, the Freeman Diversion Project creates artificial gradients that impact the flow of groundwater to and from the West Las Posas Valley Basin. The CMWD ASR program provides a backup water source for CMWD customers but also impacts available storage, gradients, and water levels in the East Las Posas Valley Basin (see Section 1.6, Land Use Elements or Topic Categories of Applicable General Plans, and Table 1-12). The City of Moorpark and unincorporated areas in the WLPMA and ELPMA rely in part on imported water from the State Water Project (SWP) and/or Colorado River imported by CMWD and provided to users through the Ventura County Waterworks District (VCWD) No. 1, VCWD No. 19, Crestview Mutual Water Company, Solano Verde Mutual Water Company, Zone Mutual Water Company, Berylwood Mutual Water Company, Camrosa Water District, and California–American Water Company. In addition, shallow groundwater dewatering discharge and treated wastewater produced by the Simi Valley Water Quality Control Plant and Moorpark Wastewater Treatment Plant contribute to continuous flow and recharge via the Arroyo Simi–Las Posas creek system and percolation ponds. Plans to increase the direct use of these discharges will impact the amount of recharge available in the future.

1.5 EXISTING CONJUNCTIVE-USE PROGRAMS

Due to the history of interagency collaboration on groundwater management within FCGMA jurisdiction and the LPVB, some conjunctive-use programs are currently operational. These are identified and described in Table 1-12, as introduced in Section 1.4, Existing Monitoring and Management Plans. Some of the most important of these conjunctive-use programs are described in this section.

CMWD ASR Project. The CMWD ASR Project is located in the ELPMA. The project, which became operational in 1994, has a total storage capacity of about 50,000 AF in the FCA (CMWD 2016). Water may be injected and withdrawn from 18 ASR wells and can be delivered to Camarillo, Moorpark, Somis, Oxnard, and limited unincorporated areas through the CMWD delivery system to a portion of the CMWD service area. Year 2015 plans included a pump station to be completed by 2019 that would allow for delivery to all of the CMWD service area.

CMWD Imported Water Deliveries. SWP deliveries are supplied by CMWD to various retail water agencies within the LPVB. All of these retail water agencies use potable water to fill M&I demand (see Table 2-5, Las Posas Valley Basin Water Purveyors, in Chapter 2 of this GSP). The CMWD has also provided water to agricultural users in the LPVB in lieu of groundwater pumping. Note that CMWD is a member agency of the Metropolitan Water District of Southern California (MWD), which supplies water from a number of sources, including the Colorado River.

UWCD Imported Water. 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 and recharged at percolation ponds that provide water to the LPVB.

FCGMA 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 for groundwater credits equal to the amount of surface water delivered that would otherwise be unavailable (i.e., water from outside the County) or water that would be wasted to the ocean.

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 may affect water use and sustainability within FCGMA’s 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, as well as how the GSP may affect the water supply assumptions made in these plans (DWR 2016b, Sections 354.8[f] and 354.8[g]). California Water Code requires that the GSP include processes to review land use plans and coordinate with planning agencies related to groundwater issues (California Water Code, Section 10727.2). Plan types relevant to FCGMA jurisdiction and the individual basins within it include ~~County~~ county and city~~City~~

generalGeneral plansPlans and associated area-specific and community plans, urban water management plans (UWMPs), and agricultural water management plans.

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).

The Urban Water Management Planning Act of 1983 requires urban water suppliers to report on water sources, deliveries, demand, and efficiency, as well as to perform 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 both to 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 2016b). The applicable codes have been modified multiple times to include various provisions for water-related reporting. As noted in the City of Camarillo's 2015 UWMP (City of Camarillo 2016):

> The purpose of the UWMP is for water suppliers to evaluate their long-term resource planning and establish management measures to ensure adequate water supplies are available to meet existing and future demands. The UWMP provides a framework to help water suppliers maintain efficient use of urban water supplies, continue to promote conservation programs and policies, ensure that sufficient water supplies are available for future beneficial use, and provide a mechanism for response during water drought conditions.

The preparation of an agricultural water management plan is required by public or private water suppliers providing water to 10,000 or more irrigated acres (excluding recycled water) (California Water Code, Section 10802). Such plans are required to be updated every 5 years and adopted by the relevant governing boards. Agricultural water management plans must include a description of the service area; information about the source, quantity, and quality of water supplied; drainage of the service area; and the reliability of the source water.

For more than three decades, FCGMA has participated in the management of water within its jurisdiction. Such management includes oversight of many aspects of water production and use as well as coordination with all 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 water planning within LPVB, a discussion of the consideration given to the land use plans, and an assessment of how the GSP may affect those plans.

1.6.1 General Plans

General plans are considered applicable to the GSP if at least a portion of their water demands are served by groundwater pumped from the LPVB.

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. 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 requirements 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 653525, requires that the GSA provide the current version of the GSP to planning agencies preparing to update or adopt the General Plan.

FCGMA will comply with the preceding code requirements by requesting the attendance of a County Planning Department representative at key GSA meetings in order to make the County Planning Department aware of water-related issues that may impact the General Plan Update, including the County Planning Department on all stakeholder notifications for GSP development, and coordinating directly with County Planning Department staff on subjects that impact land or water use within FCGMA jurisdiction and that may be proposed as part of the GSP in order to achieve groundwater sustainability.

How the Plan May Affect Sustainable Water Management

Because General Plans and their associated elements define long-term policy related to community growth, development, and land use, General Plans are critical to the implementation of sustainable water management. The County General Plan is in the process of undergoing a comprehensive update that provides the opportunity for consistency in regard to the relevant areas of the County General Plan and the GSP. Areas where coordination may be necessary or beneficial 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 redesignation 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, ground 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, 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, Sustainable Management Criteria), and projects and management actions by which these goals will be obtained (Chapter 5, Projects and Management Actions).

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 the General Plan or demonstration of "overriding considerations." The General Plan may include the GSP as an additional plan with which consistency of discretionary development will be required. 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.

1.6.2 Urban Water Management Plans

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 (FCGMA et al. 2007; Figure 1-8, Ventura County Water Purveyors). It 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 for mainly M&I uses, with only about 5% going to agricultural uses (CMWD 2016, p. 13). Most of the water supplied by CMWD is SWP water that is purchased from MWD. Storage facilities available to CMWD include a surface water reservoir in Thousand Oaks and underground storage via the Las Posas ASR project (see Table 1-12).

CMWD does not operate any wastewater treatment facilities but has historically supported the use of recycled water through the ownership and operation of recycled water pipelines and pumping facilities. In addition, CMWD has invested in the Salinity Management Pipeline that conveys salty water away from surface waters in the southern Ventura County region to other beneficial uses or to the Pacific

Ocean (Table 1-12). CMWD also supports water use efficiency programs. Such programs include rebate/incentive programs, school education programs, social media, and public workshops.

The UWMP, adopted June 15, 2016, has a planning horizon of 25 years. The production of the UWMP was coordinated with, and obtained information from, numerous water suppliers and management agencies, including the Camrosa Water District, City of Camarillo, City of Oxnard, City of Port Hueneme, City of Moorpark, VCWD No. 1, VCWD No. 19, 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.

Coordination with SGMA and Other Agencies

CMWD is a stakeholder in FCGMA and in the production of the GSP. 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 its role in preparing the GSP (CMWD 2016, Section 6-2).

In January of 2016, the CMWD Board of Directors adopted a strategic plan, one provision 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 2016, p. 7-13).

How the Plan May Change Water Demands within the Basin

Due to the extensive collaboration between FCGMA, as the historical management agency and GSA, and CMWD, as a major wholesale water supplier within the FCGMA basins, the CMWD 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 basin 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, and participation in capital projects that provide for conjunctive use on a regional scale.

How the Plan May Affect Sustainable Groundwater Management within the Basin

For the reasons noted previously, the CMWD UWMP largely fosters the goals of sustainable management within the LPVB. Both CMWD and MWD, which provides SWP water to CMWD, are pursuing remedies to improve the reliability of water supplies within their respective service areas. UWMP strategies to remediate reliability issues of water supplies includes pursuing demand management programs and local water supply projects, such as increased use of recycled and desalinated water. 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 2016, p. 7-2). CMWD's goal of relying less on SWP supplies has the potential to add additional strain on the existing water supplies, including groundwater.

In regard to water quality degradation, the CMWD UWMP 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 method to transfer poor-quality water away from surface waters within the southwestern Ventura County area to other beneficial uses or the Pacific Ocean (Table 1-12).

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 of as much as 50% below historic 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.

Ventura County Waterworks District No. 1 UWMP

Description/Summary of Agency and Plan

VCWD No. 1 is a retail water supply agency formed in 1921. The service area encompasses the City of Moorpark and unincorporated areas to the north and west. VCWD No. 1 serves potable water from CMWD, groundwater from VCWD wells, and recycled water from the VCWD-owned Moorpark Wastewater Treatment Plan. Approximately three-quarters of the water supplied by VCWD No. 1 is for domestic, commercial, and industrial uses, and about one-quarter is for agriculture. Groundwater extraction is from five wells located in the ELPMA. In 2015, nearly 80% of water supplied by VCWD No. 1 was imported from CMWD, with most of the remainder from groundwater.

The UWMP, adopted June 14, 2016, has a planning horizon of 25 years. The production of the UWMP was coordinated with, and obtained information from, numerous water suppliers and management agencies, including the Ventura County Planning Department, City of Moorpark Planning Department, FCGMA, MWD, and the public. VCWD No. 1 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.

Coordination with SGMA and Other Agencies

The Ventura County Board of Supervisors is the governing body of VCWD No. 1 and appoints one of its members to serve on the FCGMA Board (FCGMA Act, Section 121-401). Therefore, there is structural coordination between FCGMA and VCWD No. 1. 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 its role in preparing the GSP (VCWD 2016, Section 6.2.2.1).

How the Plan May Change Water Demands within the Basin

VCWD No. 1 has complied with Senate Bill X7-7 goals for conservation and cooperates with CMWD in the implementation of a comprehensive demand management program. The program reduces water demand by implementing water conservation pricing, public education, rigorous metering, rebates for water-saving devices, and other measures.

How the Plan May Affect Sustainable Groundwater Management within the Basin

The plan does not project increased future groundwater demands; however, the plan also anticipates the construction of the VCWD Moorpark Desalter project. This project is expected to provide up to 5,000 AFY of potable water from 10 to 18 extraction wells that are to be constructed to extract brackish water from the Shallow Alluvial Aquifer in the ELPMA. Extraction of additional 5,000 AFY of groundwater from the ELPMA has not been modeled as a future project for the ELPMA (Chapter 5). Extraction of this volume of water will need to be incorporated into the existing groundwater model of the LPVB in order to understand how it will impact the sustainable yield, measurable objectives, and minimum thresholds set forth in this GSP.

How the GSP May Impact the Assumptions of the UWMP

The sustainable yield, measurable objectives, and minimum thresholds developed as part of this GSP may impact the ability of VCWD to construct and operate the proposed Moorpark Desalter project. The project will have to be evaluated using the numerical groundwater model for the LPVB in order to understand how the project may impact, or be impacted by the sustainable management criteria set forth in this GSP.

1.7 WELL PERMITTING POLICIES AND PROCEDURES

The two agencies requiring well permits within the LPVB are FCGMA and the Ventura County Public Works Agency. The FCGMA well permit requirements will pertain to the entirety of the LPVB under this GSP.

1.7.1 FCGMA

FCGMA has implemented multiple ordinances and policies since 1988 related to well permitting. A complete list of historical policies and ordinances is kept and updated on the FCGMA website (FCGMA 2016). 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 limits extraction from existing wells (FCGMA 2014).

Currently, the FCGMA Ordinance Code requires that permits be obtained from FCGMA for new wells prior to construction. For wells installed within the FCGMA area, the applicant must subsequently obtain a permit from the Ventura County Public Works Agency. The FCGMA Ordinance Code requires the installation and maintenance of flow meters, providing proof of flowmeter accuracy, and reporting of all extractions semi-annually (Table 1-12). 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

Ordinance No. 4468, Chapter 8, Water, Article 1 – Groundwater Conservation, Sections 4811–4828, relate to groundwater wells in Ventura County. This ordinance regulates 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" (Chapter 8, 4813, C8). Ventura County does not issue a permit for a well within the FCGMA boundary until a well permit is issued by FCGMA. Ventura County well construction or destruction activity standards are required to comply with the DWR Well Standards Bulletin Nos. 74-81, 74-90, and 74-9. 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 or modification or repair of existing 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 LPVB.

1.8 NOTIFICATION AND COMMUNICATION

1.8.1 Notification and Communication Summary

Notification and communication regarding the development of the LPVB 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 DWR to develop a GSP for the LPVB. 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 includes 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 the LPV is primarily agriculture and the area includes all of the City of Moorpark and the northwestern edge of the City of Camarillo.

Beneficial users in the LPV have an active stakeholder group called the Las Posas Users Group (LPUG) that was formed before SGMA and continues to meet regularly to discuss and provide feedback to FCGMA regarding localized management. In April 2016, the role of LPUG as an advisory group toward the development of a new extraction allocation system for the LPVB was formalized through an FCGMA Charter. LPUG has participated in public meetings and provided occasional presentations to the FCGMA Board. LPUG developed a proposed extraction allocation system that was presented to the FCGMA Board~~, but LPUG subsequently withdrew its support for the proposed system it had developed~~.

The beneficial users of groundwater and property interests potentially affected by the use of groundwater in LPVB are described in this section.

Municipal Well Operators, Public and Private Water Purveyors. There are over 20 public and private water purveyors in the LPV, as shown on Figure 1-8. A detailed description of each purveyor is included in the VCWPD Inventory of Public and Private Water Purveyors (VCWPD 2006). ~~All of the purveyors in the LPV, including all municipal well operators, are in whole or part supplied water by CMWD, except for one that is supplied by UWCD.~~ CMWD is one of seven water districts that together appoint a member to the FCGMA Board. Staff from both UWCD and CMWD have provided groundwater monitoring data, have participated in public meetings, and regularly collaborate with FCGMA staff. The ~~city~~ City of Moorpark also has direct representation on the FCGMA Board by the representative appointed to serve on behalf of the five incorporated cities within FCGMA jurisdiction. Several of the 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. Agricultural users are represented within the LPV 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 that receive electronic newsletters regarding the status and development of the LPVB GSP.

Domestic Users. The majority of domestic groundwater users in the LPV are supplied water from 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 that receive electronic newsletters regarding the status and development of the LPVB GSP. In addition, well operators are mailed hardcopy newsletters with their semi-annual groundwater extraction statements.

Local Land Use Planning Agencies. FCGMA staff has reached out to all local land use planning agencies with jurisdiction over the LPVB, including the County of Ventura, the City of Moorpark, 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 cities of Moorpark and Camarillo. As discussed in Section 1.6, 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 the General Plan Update are consistent.

Environmental Users. Environmental uses of groundwater are not well characterized in LPVB. Arroyo Simi–Las Posas was identified as a potential Groundwater-Dependent Ecosystem in the LPVB~~, but in general.~~ Within the LPVB, Arroyo Simi–Las Posas is a ~~losing stream~~complex system of losing and gaining reaches. The interaction between surface water and groundwater in these reaches is primarily influenced by the presence of perennial flow from shallow dewatering wells and wastewater treatment plants outside the boundaries of the LPVB. The potential Groundwater--Dependent Ecosystem developed along the arroyo after these discharges began. Prior to that, there was little to no vegetation lining the banks of the ~~A~~arroyo. Therefore, based on the history of streamflow and vegetation growth along Arroyo Las Posas, it is likely that the primary environmental users of water in the LPVB are using percolating surface water rather than groundwater. 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 who receive electronic newsletters regarding the status and development of the LPVB GSP.

California Native American Tribes. According to the California Indian Tribal Homelands and Trust Land Map (DWR 2011), available from the DWR website, the entire LPVB is within the Chumash Tribal/Cultural area. There are not currently any federally recognized Indian Tribes, Indian land currently or historically held in trust by the U.S. government, or smaller Reservation or Rancheria areas in the LPVB. 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 Community shown on the DWR mapping tool (DWR 2017) within the LPVB is within the City of Moorpark 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. LPUG has also been meeting regularly and discussing GSP development. FCGMA staff regularly participate in LPUG meetings; however, the LPUG meetings are not considered FCGMA meetings and are therefore not included in Table 1-13, which provides a list of FCGMA public meetings in which the participants discussed or took action on the LPVB GSP. Note that the list will be updated as additional meetings occur.

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 1, 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 have beenwere incorporated into this the Draft GSP. After theThe Draft GSP wasis approved by the FCGMA Board and released for, a 60-day public comment period will be openedon July 29, 2019, during which time FCGMA will 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 LPVB 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) was developed for all of the GSPs that FCGMA is developing. In accordance with Section 354.10.(d) of the GSP Emergency Regulations (DWR 2016b), the plan discusses FCGMA's decision-making process; identifies opportunities for public engagement and discusses how public input and responses will be used; describes how FCGMA encourages the active involvement of diverse social, cultural, and economic elements of the population in the LPVB; 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 27, 2017; February 1, 2019; and March 15, 2019), a survey for input on sustainability indicators, and a public call for project ideas for incorporation in 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
Arroyo Las Posas Arundo Removal (ELPMA)	$1,000,000	2,000	$500
Arroyo Las Posas Water Acquisition (ELPMA)	$2,345,590	4,691	$500
Purchase of Imported Water from CMWD (WLPMA)	$2,141,378	1,762	$1,215
Total	$5,486,968	8,453	—

Notes: CMWD = Calleguas Municipal Water District; ELPMA = East Las Posas Management Area; WLPMA = West Las Posas Management Area.

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 LPVB as well as the Oxnard Subbasin and PVB, for which FCGMA is the GSA.

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

Table 1-3
Groundwater Sustainability Agencies in the Las Posas Valley Basin

GSA Name	Total Area of GSA (acres)	% of GSA Area within the LPVB	Acres within the LPVB	% of LPVB
Fox Canyon Groundwater Management Area	117,280	34.0%	39,870	89.4%
Las Posas Valley Basin Outlying Areas	4,246	100%	4,246	9.5%
Camrosa Las Posas Basin	469	100%	469	1.1%
		Total	44,585	100%

Notes: GSA = Groundwater Sustainability Agency; LPVB = Las Posas Valley Basin.

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

Ownership	Jurisdiction	Description	Acres within the LPVB	% of Total
		Private[a]		
Private	County of Ventura	Privately owned land under County jurisdiction, largely agriculture and open space	35,508	79.6%
Private	City of Moorpark	Privately owned land under municipal jurisdiction, largely consisting of urban development	6,931	15.5%
Private	City of Camarillo	Privately owned land under municipal jurisdiction, largely consisting of urban development	1,211	2.7%
		Subtotal (private land)[a]	*43,650*	*97.8%*
		Public		
Municipal	City of Moorpark	Parks	147	0.3%
Special District	Pleasant Valley Recreation and Park District	Parks	7	0.02%
County	County of Ventura	Park and golf course	818	1.8%
		Subtotal (public land)[a]	*972*	*2.1%*
		Total	44,622	100%

Notes: LPVB = Las Posas Valley Basin.

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

Table 1-5
Station Name and Record Length for Stream Gauges on Arroyo Simi–Las Posas

Record Name	Start Date	End Date
Station 801	10/1/1933	9/30/1978
Station 803	10/1/1933	9/30/2014
Station 841	10/1/1990	9/30/2004
Station 841A	10/1/2004	9/30/2013

Table 1-6
Characterization of Average Daily Flows on Arroyo Simi–Las Posas

Statistic	Period	Station 801 (cfs)	Station 803 (cfs)	Stations 841 and 841A (cfs)
Monthly minimum (baseflow)	1933–1974	0–0.06	0–1.0	—
	1975–1994	0	0–11.0	7.7–20
	1995–2004	—	4.0–19.0	7.0–29
	2005–2014	—	2.2–15.0	6.4–58
Monthly average	1933–1974	0–134	0–129.9	—
	1975–1994	0–213	0–204.6	9.3–307
	1995–2004	—	4.5–301	9.8–596
	2005–2014	—	3.3–257	10.1–428
Monthly maximum	1933–1974	0–1,853	0–1,680	—
	1975–1994	0–3,350	0–3,543	12.0–3,500
	1995–2004	—	5–1,710	12.0–3,290
	2005–2014	—	3.6–1,740	12.0–4,860

Note: cfs = cubic feet per second.

Table 1-7
Las Posas Valley Precipitation Station Information

Station Number	Station Name	Record Start	Record End	Active?	Latitude	Longitude	Elevation (ft msl)	Station Type	Mean Annual Rainfall (in.)
002	Somis–Aggen Ranch	1903	1972	No	34.26889	−119.00111	375	Standard Precipitation	14.7
009	Moorpark–Kerr Brothers	1902	1992	No	34.31333	−118.89000	800	Standard Precipitation	16.7
126	Moorpark–Ventura County Water Works Dist. No. 1	1943	1967	No	34.29333	−118.87667	720	Standard Precipitation	12.4
126A	Moorpark–Ventura County Yard	2008	N/A	Yes	34.29551	−118.87797	725	Recording Precipitation Gauge	9.0
141	Moorpark–Soil Conservation Service	1948	1965	No	34.27833	−118.87667	520	Standard Precipitation	12.9
141A	Moorpark–County Fire Station	1965	2008	No	34.28722	−118.88111	525	Standard Precipitation	15.5
189	Somis–Deboni	1955	N/A	Yes	34.28525	−119.07325	520	Recording Precipitation Gauge	15.5
190	Somis–Bard	1955	N/A	Yes	34.28241	−119.00818	460	Recording Precipitation Gauge	15.2
191	Moorpark–Downing Ranch	1955	2008	No	34.32611	−118.89500	1,040	Recording Precipitation Gauge	17.6
206	Somis–Balcom Canyon	1960	1971	No	34.31361	−118.97167	800	Standard Precipitation	15.6
206A	Somis–Fuller	1971	1977	No	34.31750	−118.98139	870	Standard Precipitation	13.7
206B	Somis–Fuller	1977	N/A	Yes	34.31093	−118.97998	733	Recording Precipitation Gauge	17.6

Table 1-7
Las Posas Valley Precipitation Station Information

Station Number	Station Name	Record Start	Record End	Active?	Latitude	Longitude	Elevation (ft msl)	Station Type	Mean Annual Rainfall (in.)
238	South Mountain–Shell Oil	1970	N/A	Yes	34.33176	−119.00900	2,240	Recording Precipitation Gauge	20.2
250	Moorpark–Happy Camp Canyon	1976	N/A	Yes	34.34649	−118.85052	1,410	Recording Precipitation Gauge	19.0
262	Moorpark College	1985	1990	No	34.30194	−118.83417	750	Recording Precipitation Gauge	10.9
262A	Moorpark College (Type B)	1999	2008	No	34.30181	−118.83431	750	Non-Standard Recorder	15.0
507	South Mountain East (Type B)	2002	N/A	Yes	34.30154	−119.04504	1,020	Non-Standard Recorder	12.8
508	Moorpark–Home Acres ALERT (Type B)	2004	N/A	Yes	34.27129	−118.92485	400	Non-Standard Recorder	13.0

Notes: ft msl = feet above mean sea level; in. = inches. N/A = not applicable, because gauge is active.

Table 1-8
Drought Periods in Las Posas Valley

Drought Period	Duration (years)	Cumulative Deficit (inches)
1918–1936	18	−50.5
1944–1951	7	−42.1
1958–1966	8	−26.7
1969–1977	8	−20.1
1986–1991	5	−22.3
2011–2016	5	−33.0

Table 1-9
Past and Present Land Use in Las Posas Valley, 1990–2015

Land Use Category	1990		1993		2001		2005		2015	
	Acres	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*	*Acres*	*%*
Agriculture										
Orchards and Vineyards	17,086	38%	17,618	39%	17,666	40%	17,084	38%	—	—
Cropland and Improved Pasture Land	4,439	10%	3,563	8%	2,658	6%	2,960	7%	—	—
Nurseries	874	2%	979	2%	1,095	2%	1,647	4%	—	—
Horse Ranches	418	1%	459	1%	697	2%	871	2%	—	—
Other Agriculture	103	0%	117	0%	171	0%	161	0%	—	—
Poultry Operations	47	0%	47	0%	47	0%	0	0%	—	—
Total	22,966	51%	22,783	51%	22,335	50%	22,723	51%	22,677	51%
Vacant/Open Space										
~~Vacant~~Open Space	15,445	35%	14,888	33%	14,753	33%	13,374	30%	—	—
Water	62	0%	62	0%	6	0%	9	0%	—	—
Total	15,507	35%	14,950	34%	14,759	33%	13,383	30%	11,747	26%
Urban/Built-Up										
Residential	4,230	9%	4,417	10%	5,039	11%	5,376	12%	—	—
Mixed Commercial and Industrial	800	2%	1,295	3%	1,031	2%	1,600	4%	—	—
Commercial and Services	406	1%	439	1%	528	1%	572	1%	—	—
Industrial	327	1%	348	1%	374	1%	391	1%	—	—
Transportation, Communication, and Utilities	387	1%	390	1%	557	1%	578	1%	—	—
Total	6,150	14%	6,890	15%	7,528	17%	8,517	19%	10,205	23%

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 1-10
Past, Current, and Projected Population for
Ventura County, City of Moorpark, and Las Posas Valley

Population	1990	2000	2010	2012	2015	2040
Ventura County	—	756,902	825,378	—	853,188	965,210
City of Moorpark	26,054	—	—	34,800	35,033	43,000
LPV	—	—	38,101	—	—	—

Sources: SCAG 2016 (for Ventura County 2000, 2010, 2015, 2040; City of Moorpark 2012, 2040); City of Moorpark 2009 (City of Moorpark 1990); City of Moorpark 2016 (for City of Moorpark 2015); U.S. Census 2010 (for LPV 2010).
Notes: — = not available or unknown; LPV = Las Posas Valley.

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Table 1-11
Las Posas Valley Basin Existing Water Resources Monitoring Programs

Program	Program Agency	Program Description	Parameter	Multi-Basin Program	Source	Link
Surface Water Monitoring Programs						
Ventura County Precipitation Monitoring	VCWPD	Collection of real-time and historic data from a network of precipitation gauges throughout Ventura County. Data are available on the web along with some statistical reports. Gauge data are available in various time increments, depending on gauge type.	Precipitation	LPVB, PVB, ASRVB, Oxnard Subbasin	VCWPD. 2016. Ventura County Watershed Protection District, Hydrology Section Website. Accessed 9/15/2016.	http://vcwatershed.net/hydrodata/gmap.php?param=rain
Ventura County Streamflow Monitoring Program	VCWPD in cooperation with USGS	Approximately 64 stream locations are monitored county-wide (approximately seven active and inactive gauges in the Las Posas Management Areas). Available data includes average daily flow, event hydrographs, and peak flows.	Streamflow	LPVB, PVB, ASRVB, Oxnard Subbasin	VCWPD. 2016. Ventura County Watershed Protection District, Hydrology Section Website. Accessed 9/15/2016.	http://vcwatershed.net/hydrodata/gmap.php?param=rain
Groundwater Monitoring Programs						
Basin Management Objectives Monitoring	FCGMA	FCGMA has established a set of water quality Basin Management Objectives that pertain to the overall health of the LPVB. Each year, FCGMA publishes a report tracking the progress toward meeting the objectives.	Groundwater Conditions	LPVB, PVB, ASRVB, Oxnard Subbasin	FCGMA, UWCD, and CMWD. 2007. 2007 Update to the Fox Canyon Groundwater Management Agency Groundwater Management Plan. May 15, 2007 (p. iii).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
California 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	LPVB, PVB, ASRVB, Oxnard Subbasin	DWR. 2016. "California Statewide Groundwater Elevation Monitoring (CASGEM) Program." Accessed 9/15/2016.	http://www.water.ca.gov/groundwater/casgem/
Ground Water Ambient Monitoring & Assessment Program (GAMA)	SWRCB	SWRCB Program implemented in 2000 (modified by AB 599 in 2001) to monitor and assess groundwater basins throughout the state.	Groundwater Quality	LPVB, PVB, ASRVB, Oxnard Subbasin	SWRCB. 2016. GAMA – Groundwater Ambient Monitoring and Assessment Program Website. Accessed 9/22/2016.	http://www.swrcb.ca.gov/gama/
Ventura County Groundwater Elevation Monitoring Program	VCWPD	Quarterly measurement of approximately 200 groundwater well elevations throughout Ventura County by District staff (approximately 29 wells monitored within the LPVB).	Groundwater Elevation	LPVB, PVB, ASRVB, 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
Ventura County Groundwater Quality Monitoring Program	VCWPD	Approximately 150 wells sampled throughout the County (17 in the LPVB) and analyzed for general minerals and other constituents.	Groundwater Quality	LPVB, PVB, ASRVB, 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
FCGMA Groundwater Extraction Reporting Program (1985)	FCGMA	Since 1985, FCGMA has collected extraction records from well operators on a semi-annual basis. Requirements include periodic verification of flowmeter accuracy.	Groundwater Extraction	LPVB, PVB, ASRVB, Oxnard Subbasin	FCGMA, UWCD, and CMWD. 2007. 2007 Update to the Fox Canyon Groundwater Management Agency Groundwater Management Plan. May 2007 (pg. 17).	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
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	LPVB, PVB, ASRVB, Oxnard Subbasin	Ventura Countywide Stormwater Quality Management Program. 2016. Ventura Countywide Stormwater Quality Management Program Website. Accessed September 15, 2016.	http://www.vcstormwater.org/
UWCD Groundwater Monitoring Program	UWCD	UWCD monitors water levels and water quality in the LPVB and other groundwater basins.	No	LPVB, Oxnard Subbasin, PVB	UWCD. 2014. Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-02.	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf
Calleguas Municipal Water District Groundwater Monitoring Program	CMWD	CMWD monitors groundwater levels, quality, and surface water quality in the LPVB and reports on the operation of its ASR Project.	Groundwater Levels and Quality; Surface Water Quality	LPVB	CMWD. Las Posas Basin ASR Annual Reports.	https://www.lpug.org/new-pagep

Notes: AB = Assembly Bill; ASR = Aquifer Storage and Recovery; ASRVB = Arroyo Santa Rosa Valley Basin; CMWD = Calleguas Municipal Water District; DWR = California Department of Water Resources; FCGMA = Fox Canyon Groundwater Management Agency; LPVB = Las Posas Valley Basin; PVB = Pleasant Valley Basin; SWRCB = State Water Resources Control Board; UWCD = United Water Conservation District; USGS = U.S. Geological Survey; VCWPD = Ventura County Watershed Protection District.

Table 1-12
Las Posas Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameter	Conjunctive Use Program?	Multi-Basin Program	Source	Link
Surface Water Management Programs							
Conejo Creek Diversion (2000)	CWD, PVCWD, City of Thousand Oaks	Non-potable water from the Thousand Oaks Hill Canyon WWTP upstream of the Conejo Creek Diversion is used for agricultural irrigation and landscaping in the southern part of the ELPMA, ASRVB, and PVB.	Surface Water	Yes	LPVB, ASRVB, PVB	CWD. 2018. *2015 Urban Water Management Plan*. Final Camarillo, California: CWD. November 15, 2018 (p. 3-4).	https://www.camrosa.com/wp-content/uploads/2018/12/UWMPamended2018FINAL.pdf
Salt TMDL	LARWQCB	Salt TMDL developed for the Calleguas Creek Watershed.	Surface Water Quality	No	LPVB, PVB, ASRVB, Simi Valley	LPUG. 2012. Final Draft V.1 Las Posas Basin-Specific Groundwater Management Plan. August 17, 2012 (p. 12).	http://www.calleguas.com/images/docs-water-resources-and-quality/drafts-for-discussion/LP_BSGMP_Final_Draft_V1_081712_Text_Tables.pdf http://www.swrcb.ca.gov/rwqcb4/
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	Oxnard Subbasin and PVB Impacts to WLPMA	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
State Water Project Importation	CMWD, Ventura County, UWCD	SWP water is supplied by the CMWD to retail water suppliers. UWCD occasionally purchases SWP water. In 2017, 10,000 acre-feet was purchased and used to recharge groundwater in the Oxnard Forebay.	Supplemental Water	No	LPVB, PVB, Oxnard Subbasin	UWCD. 2014, Groundwater and Surface Water Conditions Report – 2013. UWCD Open-File Report 2014-12 (p. 36). FCGMA, UWCD, and CMWD. 2007. 2007 Update to the Fox Canyon Groundwater Management Agency Management Plan. May 2007 (p. 50). CMWD. 2016. *2015 Urban Water Management Plan*. Final. Prepared by Black and Veatch. June 2016.	http://www.unitedwater.org/images/stories/reports/GW-Conditions-Reports/2013%20GW%20and%20SW%20Conditions%20Report%20(UWCD%202014)%20FINAL.pdf http://www.calleguas.com/images/docs-documents-reports/cmwdfinal2015uwmp.pdf
Groundwater Management Programs							
Importation of Metropolitan Water District of Southern California Water	CMWD	Import and deliver water from wholesaler MWD. Water purchased by water retailers such as the VCWD No. 1 and No. 19 to supplement water supply instead of pumping groundwater.	Supplemental Water	Yes	LPVB, PVB, Oxnard Subbasin	CMWD. 2016. *2015 Urban Water Management Plan* – Final. pp. 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
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 ASRVB.	Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	CMWD. 2016. *2015 Urban Water Management Plan* – Final, p. 6-1.	http://www.calleguas.com/images/docs-documents-reports/cmwdfinal2015uwmp.pdf
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	LPVB, PVB, ASRVB, Oxnard Subbasin	FCGMA.. 2015. *Calendar Year 2014 Annual Report* (p. 11).	http://www.fcgma.org/public-documents/reports
Las Posas Basin Aquifer Storage and Recovery Project (1994)	CMWD	CMWD operates an 18-well ASR project located within the ELPMA that allows CMWD to recharge the basin via injection of imported water and receive storage credits. The program provides a source of local stored water during shutdowns of imported water supplies. Stored water can be delivered to cities and water retailers within CMWD's service area.	Supplemental Water	Yes	LPVB	CMWD. 2016. *2015 Urban Water Management Plan* – Final, p. 6-1.	http://www.calleguas.com/images/docs-documents-reports/cmwdfinal2015uwmp.pdf

Table 1-12
Las Posas Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameter	Conjunctive Use Program?	Multi-Basin Program	Source	Link
FCGMA M&I Allocation Program	FCGMA	The current M&I allocation program, also known as a Temporary Extraction Allocation, was implemented with the passage of Ordinance E in 2014. It was implemented for M&I users, replacing Historical Allocation and Baseline Allocation.	Groundwater	Yes	LPVB, PVB, ASRVB, Oxnard Subbasin	FCGMA. 2015. *Calendar Year 2014 Annual Report* (p. 10).	http://www.fcgma.org/public-documents/reports
FCGMA Groundwater Injection Credit Program	FCGMA	This is a program by which credits are issued to operators that inject "newly available" water, water from outside the County, or recycled water	Groundwater	Yes	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA. 2015. *Calendar Year 2014 Annual Report* (p. 23).	http://www.fcgma.org/public-documents/reports
FCGMA Groundwater Storage (including 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" water, imported water from outside the County, recycled water, or diverted surface water that would otherwise be wasted to the ocean. Delivered water used in lieu of pumping.	Groundwater	Yes	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA. 2015. *Calendar Year 2014 Annual Report* (p. 23).	http://www.fcgma.org/public-documents/reports
FCGMA Credit Transfer Program	FCGMA	Agency allows for credit transfers in accordance with the Ordinance Code and/or pertinent resolutions.	Groundwater	Yes	LPVB, PVB, Oxnard Subbasin	FCGMA. 2015. *Calendar Year 2014 Annual Report* (pg. 24).	http://www.fcgma.org/public-documents/reports
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	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA. Draft Brackish Groundwater Project Pumping Policy.	http://www.fcgma.org/images/Erin/Draft%20Brackish %20Groundwater%20Project%20Pumping%20Policy %20revised%2020160720.pdf
Extraction Fee Program	FCGMA	Groundwater extractors are assessed fees per acre-foot of extraction. Fees have been used by FCGMA to finance its management activities since its enabling legislation in 1983.	Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	Assembly Bill no. 2995, Article 9.	http://www.fcgma.org/fcgma.old/publicdocuments/ ordinances/ordinanceAB-2995.pdf
Groundwater Extraction Limitation Program	FCGMA	FCGMA has implemented a program of reduced allocations.	Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA, UWCD, and 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
Extraction Surcharge Program	FCGMA	Surcharges are imposed on well operators for groundwater extractions in excess of annual allocation amounts.	Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA, UWCD and 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
Camrosa Wastewater Treatment Plant (1997)	CWD	Wastewater collected is treated to tertiary level and distributed for agriculture and landscape use. Treated water is released to Calleguas Creek when there is no irrigation demand.	Recycled Water	Yes	ELPMA, WLPMA, Oxnard Subbasin, PVB	CWD. 2016. Water Reclamation. Accessed September 29, 2016.	http://www.camrosa.com/about_fac_wrf.html
Moorpark Wastewater Treatment Plant	VCWD No. 1	Wastewater recycling.	Recycled Water	Yes	ELPMA	County of Ventura Public Works Agency. n.d. "Ventura County Waterworks District No. 1 (Moorpark) – Description."	http://pwaportal.ventura.org/WSD/Home/docs/ DescriptionWWD1.pdf
Prohibition of export of groundwater	FCGMA	FCGMA Ordinance requires Board of Directors approval for the export of groundwater from within the FCGMA boundary for use outside of the boundary. (Note that Resolution 1997-2 exempted some exporters that pre-dated FCGMA.)	Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA Ordinance Code, Chapter 5, 5.2.2.1.	http://www.fcgma.org/images/ordinances_legislation/ Ord_Code_FINAL_-_amended_01-09-2015.pdf
Other Programs							

Table 1-12
Las Posas Valley Basin Existing Water Resources Management Projects, Programs, and Strategies

Program	Program Agency	Program Description	Parameter	Conjunctive Use Program?	Multi-Basin Program	Source	Link
Agricultural Water Management Plan	VCWD No. 1	The AWMP contains detailed drought management plan and information regarding the quantity and category of water use in accordance with Executive Order B-29-15.	Ground and Surface Water Quality and Quantity	No	Las Posas Valley	VCWD No. 1. 2015. *2015 Agricultural Water Management Plan*. Prepared by County of Ventura Public Works Agency Water and Sanitation Department.	http://www.water.ca.gov/wateruseefficiency/sb7/docs/2016/Ventura%20Co%20Waterworks%20Dist%20No.%201%202015%20AWMP.pdf
Las Posas Basin Expansion Area Protection (1997)	FCGMA	FCGMA established an ordinance that provides for protection of exposed aquifer recharge areas in the ELPMA and WLPMA. As part of this ordinance, agriculture and development may be restricted.	Groundwater/ Land Use	No	LPVB	FCGMA, UWCD, and CMWD. 2007. *2007 Update to the Fox Canyon Groundwater Management Agency Management Plan*. May 2007 (p. 48). Chapter 4 of Ordinance 8 of FCGMA Ordinance Code.	http://www.fcgma.org/component/content/article/20-public-documents/plans/95-groundwater-management-plan
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	LPVB, ASRVB, PVB, Oxnard Subbasin	Ventura County Watersheds Coalition. 2016. Watersheds Coalition of Ventura County. Accessed September 15, 2016.	http://www.ventura.org/wcvc/IRWMP/2014IRWMP.htm
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.	Surface Water, Groundwater	No	LPVB, ASRVB, PVB, Oxnard Subbasin	—	—
FCGMA Irrigation Allowance Index Program/Annual Efficiency Allocation	FCGMA	Requirement for agricultural well operators to irrigate efficiency as compared to FCGMA calculated water demand for specific crop types with consideration of weather conditions. Operators apply for allocation.	Groundwater, Surface Water	No	LPVB, ASRVB, PVB, Oxnard Subbasin	FCGMA. 2015. *Calendar Year 2014 Annual Report* (p. 10).	http://www.fcgma.org/public-documents/reports

Notes: ASR = aquifer storage and recovery; ASRVB = Arroyo Santa Rosa Valley Basin; AWMP = Agricultural Water Management Plan; CMWD = Calleguas Municipal Water District; CWD = Camrosa Water District; ELPMA = East Las Posas Management Area; FCGMA = Fox Canyon Groundwater Management Agency; LARWQCB = Los Angeles Regional Water Quality Control Board; LPUG = Las Posas Users Group; LPVB = Las Posas Valley Basin; M&I = Municipal and Industrial; MWD = Metropolitan Water District of Southern California; PTP = Pumping Trough Pipeline; PVB = Pleasant Valley Basin; PVCWD = Pleasant Valley County Water District; PVP = Pleasant Valley Pipeline; SGMA = Sustainable Groundwater Management Act; SWP = State Water Project; TMDL = total maximum daily load; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area; WWTP = Wastewater Treatment Plant.

Table 1-13
FCGMA Public Meetings on Las Posas 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 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
FCGMA Special Board Meeting	March 9, 2018

Table 1-13
FCGMA Public Meetings on Las Posas Valley Basin GSP

Meeting	Date
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 1, 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. 2	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 Special Board Meeting LPVB	June 23, 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
Las Posas Valley Town Hall Meeting	April 11, 2017
Special TAG Meeting	March 24, 2017
Special TAG Meeting – Groundwater Models	March 24, 2017

Table 1-13
FCGMA Public Meetings on Las Posas Valley Basin GSP

Meeting	Date
FCGMA Regular Board Meeting	March 22, 2017
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 Stakeholder 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
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 1-13
FCGMA Public Meetings on Las Posas 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; LPVB = Las Posas Valley Basin; TAG = Technical Advisory Group.

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Figure 1-1 Vicinity Map for the Las Posas Valley Basin

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Figure 1-2 Administrative Boundaries for the Las Posas Valley Basin

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Figure 1-3 Active Gauge Locations

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Figure 1-4 Monthly Minimum, Average, and Maximum Average Daily Flows in Arroyo Simi-Las Posas

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Figure 1-5 Las Posas Valley Annual Precipitation

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Figure 1-6 Long-Term Precipitation Trends in Las Posas Valley

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Figure 1-7 Land and Water Use

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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 Las Posas Valley Basin (LPVB) is located near the western edge of the Transverse Ranges Geomorphic Province, which extends from the San Bernardino Mountains in the east to San Miguel, Santa Rosa, and Santa Cruz Islands in the west (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 (Hadley and Kanamori 1977; Bohannon and Howell 1982; Eberhart-Phillips et al. 1990; Nicholson et al. 1994; DeVecchio et al. 2012a). Compression across this restraining bend is responsible for rapid, ongoing uplift of the mountain ranges (Yeats 1988; Feigl et al. 1993; Marshall et al. 2008) and extensive folding and faulting of the Pleistocene and older geologic formations in the province (Rockwell et al. 1988; Huftile and Yeats 1995).

The LPVB, which underlies the east-to-northeast-trending Las Posas Valley in southern Ventura County, is bounded by the Camarillo and Las Posas Hills to the south, South Mountain and Oak Ridge to the north, the Santa Susana Mountains to the east, and the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin to the west (SWRCB 1956; DWR 2003). The Oak Ridge/South Mountain uplift is an anticlinal structure associated with deformation in the hanging wall of the southward-dipping Oak Ridge Fault (Yeats 1988; DeVecchio et al. 2012a). To the south, the Las Posas Hills are part of the Camarillo fold belt, which consists of several active anticlinal folds (DeVecchio et al. 2012a). Between these two uplifts, the LPVB is bisected by the Las Posas syncline, an east-to-northeast-trending fold that plunges to the west.

The primary water-bearing formations from top to bottom in the LPVB are alluvium, the San Pedro Formation, and the Santa Barbara Formation. The Santa Barbara Formation is a lower Pleistocene marine sand, and the San Pedro Formation is a lower to middle Pleistocene shallow marine deposit that grades upward from a white gray sand and gravel basal layer into an overlying series of interbedded silts, clays, and gravels (SWRCB 1956; Weber and Kiessling 1976; Turner 1975; Jakes 1979). The lower San Pedro Formation hosts the Fox Canyon Aquifer (FCA), the primary aquifer from which the majority of the water in the LPVB is produced. An additional localized aquifer, the Epworth Gravels Aquifer, is located in the Saugus Formation. The Epworth Gravels Aquifer covers an area of approximately 1,600 acres (2.5 square miles) located 2 to 3 miles north-northwest of Moorpark. This aquifer is not believed to be in hydraulic communication with the underlying FCA (Turner 1975).

The majority of the LPVB lies within the jurisdiction of the Fox Canyon Groundwater Management Agency (FCGMA), with two notable exceptions (Figure 2-1, Map of the Las Posas Valley Basin). These exceptions are the easternmost area of the LPVB, in the foothills of the Santa Susana Mountains, and the southern part of the LPVB, in the Las Posas Hills. The reason for this discrepancy is that the FCGMA boundary was established based on a vertical projection of the FCA as defined by the Fox Canyon Groundwater Management Agency Act in 1982, whereas the LPVB boundary is based on the surface extent of the alluvium in the Las Posas Valley and the location of geologic structures that impede flow between the LPVB and neighboring groundwater basins (DWR 2003). The geologic and hydrologic descriptions of the LPVB in this Groundwater Sustainability Plan (GSP) are based on the boundaries of the LPVB, including the areas to the east and south that are outside the FCGMA jurisdictional boundaries.

2.2 HYDROGEOLOGIC CONCEPTUAL MODEL

The California Department of Water Resources (DWR) defines three water-bearing formations in the LPVB: alluvium, the San Pedro Formation, and the Santa Barbara Formation (DWR 2003). These formations are similar to, but not the same as, the five principal hydrostratigraphic units defined by local investigators in the LPVB (Table 2-1; CMWD 2016a). The five principal hydrostratigraphic units are the Shallow Alluvial Aquifer, the Upper San Pedro Formation (USP), the Epworth Gravels Aquifer, the FCA, and the Grimes Canyon Aquifer (GCA; CMWD 2016a). The Shallow Alluvial Aquifer hydrostratigraphic unit corresponds to the alluvium as described by DWR (2003). In this GSP, the term *Shallow Alluvial Aquifer* applies to the alluvium adjacent to Arroyo Simi–Las Posas, while in the western part of the LPVB, the undifferentiated alluvium is referred to as the *shallow aquifer system*. The USP, the Epworth Gravels Aquifer, and the FCA correspond to the San Pedro Formation as described by DWR. The GCA corresponds to the Santa Barbara Formation as described by DWR (2003). Together, the Epworth Gravels, USP, FCA, and GCA are referred to as the Lower Aquifer System (LAS) in the LPVB, although the USP is not considered an aquifer throughout much of the LPVB.

Although DWR does not recognize any subbasins within the LPVB, local investigators have historically divided the LPVB into three groundwater subbasins based on the location of geologic structures that were thought to affect flow in the LAS (Figure 2-1). These subbasins are referred to as *basins* by both FCGMA and the Ventura County Watershed Protection District (VCWPD); therefore, we will refer to them as such in this document. These local basins are named the West, East, and South Las Posas Basins (WLP, ELP, and SLP, respectively). The Somis Fault, which trends north-northeast across the LPVB in the vicinity of Somis, defines the boundary between the WLP and ELP. Groundwater elevation differences in excess of 200 feet across the Somis Fault are evidence that it acts as a barrier to groundwater flow in the principal water-bearing units of the LAS (CMWD 2016a). The northeastern-trending axis of the Moorpark anticline has historically been used as the boundary between the ELP and the SLP. Groundwater quality data collected during recent investigations, however, suggest that the Moorpark anticline does not act as a barrier to groundwater movement between the ELP and the SLP (CMWD 2016b, 2016a).

Because the Moorpark anticline does not appear to restrict groundwater flow, local investigators now divide the LPVB into two management areas rather than three basins (CMWD 2016a). The area of the West Las Posas Management Area (WLPMA) is the same area as the WLP: west of the Somis Fault to the western boundary of the LPVB with the Oxnard Subbasin. The East Las Posas Management Area (ELPMA) comprises the entire eastern portion of the LPVB east of the Somis Fault and includes both the ELP and the SLP (Figure 2-1).

In addition to the WLPMA and ELPMA, a third management area has been proposed in a localized area of the ELPMA for the Epworth Gravels Aquifer (Figure 2-1; CMWD 2016a). The Epworth Gravels Aquifer occurs in an area limited to approximately 1,600 acres (2.5 square miles) located 2 to 3 miles north-northwest of Moorpark (Turner 1975; CMWD 2016a). A separate management area was proposed for this aquifer because it is a locally significant source of water but is not believed to be in hydraulic communication with the other aquifers of the LAS (Turner 1975).

Both the lithologic units and geologic structures present in the LPVB affect the hydrology of the basin. These features are discussed in more detail in the following sections.

2.2.1 Geology

Geologic Units and Variation

The nomenclature of the lower Pleistocene and younger stratigraphic units exposed in outcrop and drilled in the subsurface within the LPVB has evolved through time since the first regional scale mapping was conducted by Kew in 1924 (Table 2-1; Kew 1924; Weber and Kiessling 1976; Jakes 1979; DeVecchio et al. 2012b). Kew (1924) identified the lower Pleistocene stratigraphic unit, which marks the base of the freshwater aquifer in the LPVB, 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 (Weber and Kiessling 1976; DWR 2003; CMWD 2016a). To remain consistent with DWR nomenclature, 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 USP has been referred to in the literature as both the *Las Posas Sand* (Pressler 1929, as cited in DeVecchio et al. 2012a; Dibblee 1992a, 1992b; DeVecchio et al. 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. Weber and Kiessling

(1976) and DeVecchio et al. (2012b) identify the Saugus Formation as unconformably overlying the San Pedro Formation, whereas DWR (2003) and CMWD (2016a) include the Saugus Formation as part of the upper San Pedro Formation.

Older alluvial deposits unconformably overlie the San Pedro Formation (Weber and Kiessling 1976; Jakes 1979; Dibblee 1992a, 1992b; DeVecchio et al. 2012b). These older alluvial deposits correspond to the terrace deposits of 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 east Las Posas Valley, 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 LPVB are generally considered semi-permeable or non-water-bearing (Turner 1975; DeVecchio et al. 2012b; CMWD 2016a). 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 (Weber and Kiessling 1976; Dibblee 1992a, 1992b; Jakes 1979; DeVecchio et al. 2012b; CMWD 2016a). These formations are exposed in outcrop to the north, east, and south of the LPVB boundary and have been encountered in deep wells drilled throughout the LPVB (Figure 2-2, Geology of the Las Posas Valley Basin; Weber and Kiessling 1976; Jakes 1979; DeVecchio et al. 2012b). Because these formations typically contain poor-quality water, they are not considered an important source of groundwater in the LPVB (Turner 1975).

Quaternary Sedimentary Formations

The Quaternary sedimentary formations are listed in Table 2-1 and are described below. The lithologic nomenclature used in this GSP is per Weber and Kiessling (1976).

<u>Santa Barbara Formation (Lower Pleistocene; Marine)</u>

The Santa Barbara Formation is typically composed of laminated, poorly indurated blue-gray marine mud- and siltstone with sand and gravel (Turner and Mukae 1975). The clay-rich sediments act as an aquitard between the Santa Barbara Formation and the overlying USP (Weber and Kiessling 1976). The localized basal conglomerate within the upper member of the Santa Barbara Formation hosts the GCA (Weber and Kiessling 1976). The lower member of the Santa Barbara Formation, which underlies the GCA, is fine-grained sandstone, siltstone, and mudstone (Weber and Kiessling 1976).

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

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

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). Overlying the clay marker bed are lenticular layers of sand, gravel, and silt (CMWD 2016a). Below this marker bed, the basal unit of the San Pedro Formation comprises a 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 LPVB (Turner 1975; CMWD 2016a).

Saugus Formation (Middle to Upper Pleistocene; Terrestrial)

In the LPVB, the Saugus Formation 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). The upper part of the Saugus Formation hosts the Epworth Gravels (Table 2-1).

Older Alluvium (Upper Pleistocene; Terrestrial)

Unconformably overlying the Saugus Formation is the older alluvium, which is composed of gravel, sand, silt, and clay. The older alluvium was deposited in river, floodplain, beach, and terrace environments. These deposits lack marine fossils and have evidence of soil "B" horizon development (Jakes 1979). The older alluvium has been incised and slightly folded (DeVecchio et al. 2012b).

Recent Alluvium (Holocene; Terrestrial)

Recent alluvium comprises surficial deposits of loose sand, silt, clay, gravel, and boulders (Weber and Kiessling 1976; Jakes 1979). The recent alluvium includes colluvium and slopewash, stream channel, valley fill and floodplain, and alluvial fan deposits. These deposits are distinguished from the older

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

alluvium by the lack of soil horizon development and lack of deformation. The recent alluvium is an aquifer beneath the floodplain of Arroyo Simi–Las Posas. The alluvium is also present in the WLPMA in Beardsley Wash and Ferro Ditch, although it is not an aquifer in these locations (Figure 2-2).

Geologic Structure

Boundary Faults

Wright Road Fault

The Wright Road Fault is an active oblique right reverse fault. The western boundary of the LPVB, separating the Oxnard Subbasin to the west from the LPVB to the east, generally parallels the Wright Road Fault (Figure 2-2; DeVecchio et al. 2007). The fault trace is characterized by a 20-meter-high topographic scarp with up-to-the-east displacement along the north-northwest-trending fault (DeVecchio et al. 2007). There is no evidence that the Wright Road Fault impacts groundwater flow between the LPVB and the Oxnard Subbasin.

Springville Fault Zone

The Springville 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 WLPMA to the north and the Pleasant Valley Basin (PVB) to the south (Figure 2-2; DeVecchio et al. 2012a). The southern Springville Domain extends from the Wright Road Fault on the west to the inferred Spanish Hills Fault (Figure 2-2; DeVecchio et al. 2012a). The northern Springville Domain extends from the Spanish Hills Fault to the Somis Fault. 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 Saugus Formation on the north side of the fault and older alluvium on the southern side of the fault (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. In both domains, the Springville Fault restricts groundwater flow between the WLPMA and the PVB to the south.

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 has resulted in 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. The Simi–Santa Rosa Fault Zone restricts groundwater flow between the ELPMA and the PVB to the south.

Internal Faults

Somis Fault (Central Las Posas Fault)

The Somis Fault is a high-angle oblique right-reverse fault that strikes north-northeast across the LPVB in the vicinity of the Somis gap between the Las Posas Hills to the east and the Camarillo Hills to the west (Figure 2-2; DeVecchio et al. 2012a; CMWD 2016a). The surface trace of the fault is concealed by Arroyo Las Posas alluvium, which has resulted in several interpretations of the fault trace, sense of motion, and nomenclature, depending on the investigator (Bailey 1951, as cited in DeVecchio et al. 2012a; Weber and Kiessling 1976; Jakes 1979; USGS 2003; DeVecchio et al. 2012a). The Somis Fault discussed in this GSP is that of DeVecchio et al. (2012a), which is the same as the Central Las Posas Fault in U.S. Geological Survey (USGS 2003), but differs from the Somis Fault of Weber and Kiessling (1976) and USGS (2003) (Figure 2-2).

The presence of the Somis Fault in the subsurface is apparent from differences in groundwater elevations measured in the LAS east and west of the fault (CMWD 2016a). Since the early 1980s, groundwater elevations to the west of the fault have consistently been several hundred feet lower than those to the east of the fault (CMWD 2016b). The Somis Fault impedes groundwater movement in the LAS; therefore, the trace of the Somis Fault is generally coincidental with the boundary between the WLPMA and the ELPMA.

Additional Internal Faults

In addition to the Somis Fault, several other faults have been identified within the LPVB (Figure 2-2). These faults include the La Loma and Fox Canyon Faults on the northern edge of the WLPMA; the Berylwood Fault on the northern edge of the WLPMA and the ELPMA; the Conejo NE2 Fault in the west-central ELPMA; the Fairview Fault in the northeastern ELPMA (USGS 2003); and the Little Simi Valley Fault on the southern boundary of the ELPMA. These faults were all modeled as flow barriers with varying degrees of resistance to flow across them (USGS 2003). However, additional data are needed to further refine the influence of these faults on groundwater flow within the LPVB.

Folds

The LPVB is located within the Camarillo fold belt, an area characterized by south-verging anticlinal folds (DeVecchio et al. 2012a). Within the LPVB, there are two primary east-to-northeast-trending anticlines and three primary east-to-northeast-trending synclines (Turner 1975). These are, from north to south, the Long Canyon syncline, Long Canyon anticline, Las Posas syncline, Moorpark anticline, and Moorpark syncline (Figure 2-2). In general, the Long Canyon anticline is associated with lower transmissivity in the USP, and the Las Posas syncline is associated with higher transmissivity in the USP (CMWD 2016a). Along the axis of the Las Posas syncline in the center of the LPVB, the USP thickens, and the depth to the FCA at the base of the USP can approach 2,000 feet bgs (Turner 1975; CMWD 2016a).

The Moorpark anticline causes thinning and disruption of the San Pedro Formation and the underlying Santa Barbara Formation. The USP thins along the axis of the anticline, and the Santa Barbara Formation pinches out along the axis of the anticline (CMWD 2016a). The Santa Barbara Formation is present to the north of the Moorpark anticline and thin to absent to the south (CMWD 2016a). The thinning and disruption to the LAS units were previously thought to affect groundwater flow across the anticline during periods of low water levels (Las Posas Users Group 2012; CMWD 2016a). Recent water quality data, however, suggest that the Moorpark anticline is not a barrier to groundwater flow (CMWD 2016a, 2016b).

2.2.2 Boundaries

The southern boundary of the LPVB is defined by the Springville and Simi–Santa Rosa Fault Zones. These faults are associated with uplift of the Camarillo and Las Posas Hills (SWRCB 1956; DWR 2003).

The western boundary of the LPVB is associated with the topographic change in slope along the trace of the Wright Road Fault and separates the LPVB from the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin to the west. The Wright Road Fault is not known to impede groundwater movement between the LPVB and the Oxnard Subbasin. Because the LPVB and Oxnard Subbasin are in hydraulic communication, a jurisdictional boundary, which generally follows the trace of the Wright Road Fault, serves as the boundary between the LPVB and Oxnard Subbasin. The recent jurisdictional boundary change allows the water produced from wells along the western boundary to be associated with the same basin from which it is pumped and used.

The northern and eastern boundaries of the LPVB are delineated by the contact between the alluvial deposits and surface exposures of bedrock. The northern boundary follows the contact between the alluvium and the base of the Oak Ridge/South Mountain uplift, coinciding with outcrops of the upper San Pedro Formation in the WLPMA. To the east, the water-bearing strata of the LPVB pinch out against the uplift of the Santa Susana Mountains (SWRCB 1956; DWR 2003).

2.2.3 Basin Bottom

The bottom of the LPVB is defined by the contact between the upper member of the Santa Barbara and the underlying Pliocene and older formations, where the upper member of the Santa Barbara Formation is present (Figure 2-2 and Figure 2-3, Conceptual Cross Section A–A′). Where the upper member of the Santa Barbara Formation is absent, the bottom of the LPVB is defined by the contact between the USP and the underlying Pliocene and older formations. This contact coincides with the base of the freshwater aquifer (Turner 1975). In the western part of the LPVB, and in the eastern part of the LPVB north of the Moorpark anticline, the base of the freshwater aquifer occurs at the base of the upper member of the Santa Barbara Formation (Figure 2-4, Conceptual Cross Section B–B′). South of the Moorpark anticline, however, the base of the freshwater aquifer coincides with the base of the USP.

In general, the depth to the bottom of the LPVB increases from east to west and toward the axis of the Las Posas syncline. At the eastern end of the LPVB, adjacent to the Santa Susana Mountains, the depth of the LPVB is less than 500 feet (CMWD 2016a). To the west, the depth can exceed 2,000 feet (CMWD 2016a).

2.2.4 Principal Aquifers and Aquitards

Shallow Alluvial Aquifer

The alluvial deposits that compose the Shallow Alluvial Aquifer include loose sand and gravel adjacent to Arroyo Simi–Las Posas in the ELPMA (SWRCB 1956; Weber and Kiessling 1976; Jakes 1979; CMWD 2016a). This aquifer coincides with the Holocene-age recent alluvium and upper Pleistocene-age older alluvium lithologic units defined in Section 2.2.1, Geology, of this GSP. The thickness of these units ranges from less than 50 feet at the boundary of the LPVB with the Santa Susana Mountains to approximately 200 feet adjacent to Arroyo Simi–Las Posas (Turner 1975; CMWD 2016a). ~~The alluvium is also present in the WLPMA in Beardsley Wash and Ferro Ditch (Figure 2-2).~~

Adjacent to Arroyo Simi–Las Posas and near Moorpark, the sediments of the Shallow Alluvial Aquifer are saturated, and the aquifer is unconfined (Las Posas Users Group 2012; CMWD 2016a). Recharge to the Shallow Alluvial Aquifer is typically from native and non-native flows within Arroyo Simi–Las Posas (Las Posas Users Group 2012; CMWD 2016a). The non-native flows consist of discharges from the Simi Valley Water Quality Control Plant (SVWQCP), 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 (Las Posas Users Group 2012; CMWD 2016a).

A qualitative evaluation of relative transmissivity from well log data suggests that the transmissivity of the Shallow Alluvial Aquifer typically ranges from 34.1 to 149.9 feet per day (CMWD 2016a). In general, the aquifer has higher transmissivities to the east and lower transmissivities to the west where Arroyo Simi–Las Posas bends to the southwest (CMWD 2016a). Well yields within the Shallow Alluvial Aquifer average approximately 400 gallons per minute (gpm; Turner 1975).

Recharge from non-native flows in Arroyo Simi–Las Posas has resulted in a mound of poor-quality water, characterized by concentrations of total dissolved solids (TDS), chloride, and sulfate that exceed concentrations in native flows. The effect of this recharge is evident on the south flank of the ELPMA west of Moorpark (CMWD 2016b).

Currently, relative to the total groundwater production in the ELPMA, there are few wells that produce water from the Shallow Alluvial Aquifer, which is likely a result of the marginal-quality water and low well yields compared to the FCA (Las Posas Users Group 2012). The Shallow Alluvial Aquifer is hydraulically connected to the LAS and is a conduit for recharge to the deeper aquifers via vertical leakage.

Epworth Gravels Aquifer

The Epworth Gravels Aquifer is a localized aquifer that is only present within an approximately 1,600 acres (2.5 square miles) area of the ELPMA, near Broadway Road (Figure 2-1; Las Posas Users Group 2012). This aquifer occurs near the top of the USP and is composed of up to 400 feet of upper Pleistocene-age gravels, gravelly clays, and silts that are likely remnants of an ancient alluvial fan (Turner 1975; CMWD 2016a). The Epworth Gravels Aquifer is exposed at the surface adjacent to the northern and eastern boundaries of the ELPMA. To the south and west, the Epworth Gravels Aquifer grades into silt and clay (Turner 1975). The Epworth Gravels Aquifer is separated from the underlying FCA by several hundred feet of the USP and therefore is not in hydraulic communication with the FCA.

The Epworth Gravels Aquifer is adjacent to, and may be in hydraulic communication with, the Fairview Area Unconfined Aquifer (Turner 1975; Las Posas Users Group 2012). The Fairview Area Unconfined Aquifer comprises both recent and upper Pleistocene alluvial sediments that were a locally important source of water prior to the mid-1970s (Turner 1975; Las Posas Users Group 2012). Wells completed within the Fairview Area Unconfined Aquifer had average yields of about 500 gpm; however, declining water levels in this Shallow Alluvial Aquifer likely resulted in construction of replacement wells in deeper water-bearing zones (Turner 1975; CMWD 2016a). Because the Fairview Area Unconfined Aquifer cannot be easily distinguished from the Epworth Gravels Aquifer in electronic well logs (CMWD 2016a), it is included as part of the Epworth Gravels Aquifer in this GSP.

Well yields in the Epworth Gravels Aquifer average approximately 300 gpm and range from 250 to 750 gpm (SWRCB 1956; Turner 1975; DWR 2003). The average specific yield of the water-bearing gravels in the Epworth Gravels Aquifer is 15% to 20% (SWRCB 1956; DWR 2003). Water produced from this aquifer has been used for agricultural and domestic consumption (Turner 1975).

Upper San Pedro/Saugus Formation

The sediments that compose the upper San Pedro/Saugus Formations (USP) are primarily interbedded silts, clays, and gravels with minor sand layers (SWRCB 1956; Weber and Kiessling 1976; Turner 1975; Jakes 1979; CMWD 2016a). The base of the USP is typically marked by a laterally continuous clay bed that varies in thickness and separates this hydrostratigraphic unit from the underlying FCA (CMWD 2016a). The thickness of the USP ranges from less than 50 feet on the northern and eastern margins of the LPVB to over 1,000 feet in the WLPMA and in the vicinity of the Fairview Fault in the ELPMA (CMWD 2016a).

Throughout much of the LPVB, the USP is confined, especially at depth (CMWD 2016a). Although several wells in the WLPMA produce water from lenses of permeable sediments within the USP, these lenses are laterally discontinuous and not well connected throughout the LPVB (Las Posas Users Group 2012). As a result, the USP is not considered an aquifer, but rather, likely functions as a leaky aquitard providing additional water to the underlying FCA.

Fox Canyon Aquifer

The FCA, which is the primary aquifer in the LPVB, occurs below the base of the USP in the lower portion of the San Pedro Formation and is laterally continuous within the boundaries of the LPVB. 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 were extensively folded post-deposition (Turner 1975). Along the axis of synclinal structures in the central portion of the LPVB, the depth to the upper surface of the FCA can exceed 1,000 feet below ground surface (bgs), and the thickness of the aquifer can exceed 800 feet (Turner 1975; CMWD 2016a). To the east, the FCA shallows and thins, pinching out in the vicinity of Happy Camp Canyon (SWRCB 1956). To the south, the FCA thins along the axis of the Moorpark anticline in the ELPMA and is exposed at the surface locally in the Las Posas and Camarillo Hills (Figure 2-2; DeVecchio et al. 2012b). The FCA is also exposed in a continuous band of outcrop in the South Mountain and Oak Ridge uplift to the north of the LPVB boundary (DeVecchio et al. 2012b).[2]

[2] For more detail on the LPVB boundary and the Fox Canyon Groundwater Management Agency boundary, see Section 1.3.1, Description, of this GSP.

The primary structural restriction to flow in the FCA is the north-to-northeast-trending Somis Fault (DeVecchio et al. 2012a; CMWD 2016a). Groundwater elevations on the eastern side of the Somis Fault are over 200 feet higher than those on the western side of the Somis Fault (CMWD 2016b). The restriction of flow across the inferred trace of the Somis Fault is the basis for separating the LPVB into two management areas: the ELPMA and the WLPMA.

The FCA occurs under confined conditions at most locations in the LPVB (CMWD 2016a). The average specific yield of the FCA is 15% to 20%, and the average yield of wells that are at least partially completed in the FCA is 900 to 1,000 gpm (SWRCB 1956; Turner 1975; DWR 2003). Typical well yields range from 500 to 2,000 gpm (Turner 1975; Las Posas Users Group 2012). In the ELPMA, the estimated hydraulic conductivity of the FCA, based primarily on conversion from specific capacity measurements, was generally higher within structural synclines, ranging from approximately 30 to greater than 150 feet per day (CMWD 2016a). In the WLPMA and in areas north of the Fairview Fault and along the eastern limb of the Long Canyon anticline in the ELPMA, the hydraulic conductivity of the FCA, also estimated from specific capacity, is typically less than 30 feet per day (CMWD 2016a).

In the ELPMA, water quality in the FCA has been affected by the percolation of wastewater treatment plant and shallow dewatering well discharges from Simi Valley that compose the base flow in Arroyo Simi–Las Posas (CMWD 2016b). Chloride concentrations in wells adjacent to Arroyo Simi–Las Posas increased from between 50 and 150 milligrams per liter (mg/L) in the early 1960s to between 150 and 250 mg/L in the mid-1980s (CMWD 2016b). Since the mid-1980s, chloride concentrations in these wells decreased to between 150 and 200 mg/L. Chloride concentrations in wells to the north of Arroyo Simi–Las Posas, however, have generally increased since the mid-1980s from less than 50 mg/L to 150 mg/L currently (CMWD 2016b). Based on the timing of the observed increases in chloride concentration, the rate of northward migration of poor-quality water has been estimated to average between 100 and 250 feet per year (CMWD 2014). Chloride concentration in the FCA north of the Moorpark anticline in the ELPMA and throughout the WLPMA is generally less than 125 mg/L.

In the WLPMA, water quality in the FCA is variable. Adjacent to the Camarillo Hills, in the southeastern WLPMA, TDS concentrations in groundwater range from 300 to 700 mg/L. TDS concentrations are higher in the central and western parts of the WLPMA, ranging from 900 to 5,000 mg/L.

Grimes Canyon Aquifer

The GCA comprises up to 300 feet of coarse to fine-grained gravel and sand deposits, with lenses of clay and silt within the upper Santa Barbara Formation (DWR 2003; CMWD 2016a). Throughout much of the WLPMA and along the northern part of the ELPMA, the GCA is separated from the overlying FCA by a clay-rich aquitard that is between 25 and 200 feet thick (CMWD 2016a). East of Stockton Road in the ELPMA, the GCA and FCA are difficult to distinguish from one another and are likely in direct contact with each other (CMWD 2016a).

Similar to the FCA, the GCA is exposed in a continuous band of outcrop in the South Mountain and Oak Ridge uplift to the north of the LPVB boundary (DeVecchio et al. 2012b). From the exposures in the South Mountain and Oak Ridge uplift, the GCA dips to the south and is generally thickest in the central portion of the LPVB. In the ELPMA, this unit thins and pinches out to the south of the Moorpark anticline. The GCA is not present near the Las Posas Hills (CMWD 2016a). In the WLPMA, the GCA deepens and thins to the west.

There are relatively few wells fully screened in the GCA, but this aquifer is thought to be an important source of water in areas of the LPVB where the FCA is thin or unsaturated (Las Posas Users Group 2012). The average specific yield of the GCA is 10% to 20% (SWRCB 1956; DWR 2003). The average hydraulic conductivity of the GCA, estimated from specific capacity, is approximately 7 feet per day (CMWD 2016a). Water quality data from the GCA in the LPVB have not been published.

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 aquifer properties are limited in all aquifers in the LPVB.
- The volume of leakage between the USP and the underlying FCA has been estimated to be approximately 14,600 AFY from the numerical model (Appendix C). This estimate and the effects of the leakage on the underlying FCA will need revision as additional data become available.
- The connectivity and vertical flow between the multiple distinct water-bearing zones within the USP has not been quantified.

The data gaps listed in this section create uncertainty in the understanding of the impacts of water level changes on change in storage in the aquifer. Additional aquifer tests and future groundwater quality sampling would help reduce the uncertainty associated with these data gaps.

2.3 GROUNDWATER CONDITIONS

2.3.1 Groundwater Elevation Data

Groundwater elevations in the LPVB were first measured in agricultural wells in the 1930s, and an annual groundwater monitoring program was initiated in the LPVB by the County of Ventura, United Water Conservation District (UWCD), and USGS in the 1990s (FCGMA 2007). Additionally, Calleguas Municipal Water District (CMWD) has monitored groundwater elevations in the LPVB since 2011. The Ventura County 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. Historically, the FCGMA annual reports have included water elevations for the LPVB in its potentiometric surface maps for wells screened in the LAS (FCGMA 2016).

To conform with Title 23 of the California Code of Regulations, Section 354.14, the following discussion of groundwater elevation is limited to production and monitoring wells screened in a single aquifer. Water level measurements collected between March 2 and March 29, 2015, are used to represent groundwater elevations in spring 2015. Water level measurements collected between October 2 and 29, 2015, are used to represent groundwater elevations in fall 2015.

Because many production wells within the LPVB are screened across multiple aquifers and there are a limited number of dedicated monitoring wells, the depiction of representative regional potentiometric surfaces in each aquifer is limited. Groundwater pumping data for the year 2015 were mapped to provide context for interpreting the potentiometric surfaces presented in this section (see Figure 2-5, Groundwater Extraction [acre-feet] in 2015 in the Las Posas Valley Basin). The majority of the production in the LPVB comes from the FCA in both the WLPMA and the ELPMA (Figure 2-5).

Non-native surface water flows in Arroyo Simi–Las Posas, groundwater production, climate cycles, groundwater storage, and surface water delivery programs have impacted groundwater elevations in the LPVB. Non-native surface water flows in Arroyo Simi–Las Posas caused groundwater elevations to rise beginning in the 1970s as these flows provided additional recharge to the Shallow Alluvial Aquifer, the USP, and the FCA. Groundwater production from the LPVB has caused water level declines, particularly during periods of drought. Groundwater storage and surface water delivery programs in the LPVB have affected local groundwater elevations in different ways. These activities include: (1) deliveries of in-lieu surface water to groundwater producers in the WLPMA (1995–2008) and ELPMA (1995–2016) by CMWD and (2) injection and recovery from the CMWD Aquifer Storage and Recovery Project (ASR) in the ELPMA.

Groundwater elevation data for the WLPMA and ELPMA are discussed in the subsections that follow. Within each management area, discussion of the groundwater elevation is divided by aquifer. Not all aquifers have sufficient data to analyze groundwater elevation trends and gradients.

2.3.1.1 West Las Posas Management Area

2.3.1.1.1 Upper San Pedro Formation

Spring and Fall 2015 Groundwater Elevations

In the spring of 2015, recorded groundwater elevations in the USP in the WLPMA ranged from −23.8 feet above mean sea level (msl) to 244.4 feet msl (Figure 2-6, Groundwater Elevation Contours in the Upper San Pedro Formation, March 2–29, 2015). In the fall of 2015, groundwater elevations ranged from −53.6 feet msl to 242.7 feet msl (Figure 2-7, Groundwater Elevation Contours in the Upper San Pedro Formation, October 2–29, 2015).

The highest groundwater elevations in the USP are measured in Well 02N21W16J01S in both the spring and fall of 2015 (Figures 2-6 and 2-7). This well is screened from 182 to 295 feet bgs. The lowest groundwater elevations in the USP are measured in Well 02N21W15M03S, which is approximately 1,100 feet east of Well 02N21W16J01S, but is screened from 406 to 1,030 feet bgs. The difference in groundwater elevations between these wells reflects the large vertical gradient within the USP. Additionally, the data suggest that there are multiple, distinct water-bearing zones within the USP. The heterogeneity of the sediments that compose the USP, the variation in well screen intervals, and the high vertical hydraulic gradient in the USP prohibit a determination of a lateral hydraulic gradient for the spring and fall of 2015.

Vertical Gradients

Groundwater elevations in the USP vary with depth (Figures 2-6 and 2-7; Table 2-2). The vertical gradient within the USP was determined from groundwater elevations measured in Wells 02N21W11J04S, 02N21W11J05S, and 02N21W11J06S, which are located in a multiple-depth nested monitoring well cluster installed by the USGS in the central WLPMA. In the spring of 2015, the vertical gradient between Wells 02N21W11J06S and 02N21W11J05S was 0.19 feet/feet, directed downward, and the vertical gradient between Wells 02N21W11J05S and 02N21W11J04S was 0.66 feet/feet, also directed downwards. In the fall of 2015, the gradient between Wells 02N21W11J06S and 02N21W11J05S was 0.21 feet/feet and the vertical gradient between Wells 02N21W11J05S and 02N21W11J04S was 0.68 feet/feet, directed downwards (Table 2-2).

Historical Groundwater Elevation Trends

Groundwater elevation trends vary with depth and geographic location within the WLPMA. Wells 02N21W16J01S, 02N21W11J05S, and 02N21W11J06S are screened within the San Pedro Formation, and had groundwater elevations consistently above sea level for the length of the historical observations (Figures 2-6 and 2-7 and Figure 2-8, Upper San Pedro Formation Groundwater Elevation Hydrographs: WLPMA). Groundwater elevations in Well 02N21W16J01S rose approximately 58 feet between 1972 and 2011, with no observed response to climatic cycles of precipitation (Figure 2-8). Between 2011 and 2015, groundwater elevations declined approximately 5 feet. This decline is coincident with the 2011 to 2015 drought, but it is likely also influenced by management actions in the basin. Groundwater elevations in this well remain approximately 50 feet higher than they were in 1972 (Figure 2-8).

Groundwater elevations in Wells 02N21W11J05S and 02N21W11J06S also rose, independent of climatic influence, from 1991 through 2015. Groundwater elevations in these wells did not decline during the drought from 2011 to 2015, although declines of approximately 5 feet were observed in both wells during 2016 (Figure 2-8). The trends observed in these wells are similar to those observed in Wells 02N21W01L01S and 02N21W11J04S, which were measured less frequently (Figure 2-8).

In contrast, groundwater elevations in Wells 02N21W15M03S and 02N21W11J04S show muted responses to climatic trends and management actions taken in the WLPMA over time. The groundwater elevation in Well 02N21W15M03S declined from approximately 7 feet msl to approximately −78 feet msl between 1983 and 1991 (Figure 2-8). Groundwater elevations in this well recovered between 1991 and 2009, reaching 5 feet msl in 2009. However, with reduced surface water spreading in the Oxnard Subbasin and the effects of the 2011 to 2015 drought, the groundwater elevation in this well declined approximately 60 feet between 2009 and 2015.

The response to climatic cycles is more muted in Well 03N21W36Q01S than it is in Well 02N21W15M03S; however, overall it shows similar trends, with groundwater elevations rising through the 1990s, reaching a maximum in the late 2000s, and declining between 2009 and 2015. The groundwater elevation in this well was −16.3 feet msl in October 2015 (Figure 2-8).

2.3.1.1.2 Fox Canyon Aquifer

Spring and Fall 2015 Groundwater Elevations

In the spring of 2015, recorded groundwater elevations in the FCA in the WLPMA ranged from −138.7 feet msl to 65.6 feet msl (Figure 2-9, Groundwater Elevation Contours in the Fox Canyon Aquifer, March 2–29, 2015). In the fall of 2015, groundwater elevations ranged from −154 feet msl to 46 feet msl (Figure 2-10, Groundwater Elevation Contours in the Fox Canyon Aquifer, October 2–29, 2015).

The highest groundwater elevation in the FCA is found in Well 03N21W35P02S on the northern margin of the LPVB (Figure 2-9). Groundwater elevations measured in Well 03N21W35P02S in the spring and fall were 65.6 and 46.2 feet msl, respectively. This well is hydrologically separated from the majority of the basin by the La Loma and Berylwood Faults, which parallel the southern boundary of the South Mountain uplift (Figure 2-9). Groundwater elevations to the south of the La Loma and Berylwood Fault Zones ranged from −8.1 to −138.7 feet msl in the spring of 2015 and from −51 to −154 feet msl in the fall of 2015 (Figures 2-9 and 2-10). Groundwater elevations south of these fault zones are highest adjacent to the Oxnard Subbasin and lowest near the Somis Fault.

The hydraulic gradient in the FCA in the spring and fall of 2015, is directed toward the southeastern corner of the management area (Figures 2-9 and 2-10). In the spring of 2015, the hydraulic gradient was approximately 0.008 feet/feet. In the fall of 2015 the hydraulic gradient ranged from approximately 0.007 to 0.022 feet/feet depending on location within the aquifer. These gradients may not fully depict the direction and magnitude of flow within the FCA because additional production wells are screened across multiple aquifers in the WLPMA. Groundwater elevations from these wells are not included in the calculation of gradients within the FCA. Additionally, there are limited data between the western boundary of the LPVB and the central portion of the WLPMA. Installation of monitoring wells in this area would provide additional information on the direction and magnitude of groundwater flow in the FCA in the WLPMA.

Vertical Gradients

Groundwater elevations in the FCA are lower than those in the overlying USP (Figures 2-7 and 2-10; Table 2-2). The vertical gradient between the USP and FCA was determined from groundwater elevations measured in Wells 02N21W11J03S and 02N21W11J04S, which are wells within a multiple-depth nested monitoring well installed in the central WLPMA by USGS. In the spring of 2015, the downward vertical gradient from the USP to the FCA was 0.10 feet/feet (Table 2-2). In the fall of 2015, the downward vertical gradient from the USP to the FCA was 0.13 feet/feet (Table 2-2).

Historical Groundwater Elevation Trends

Groundwater elevation trends in the FCA vary with geographic location in the WLPMA. In the western part of the WLPMA, adjacent to the Oxnard Subbasin water levels in the FCA have declined and recovered over climatic cycles (Figure 2-11, Fox Canyon Aquifer Groundwater Elevation Hydrographs: Western WLPMA). In addition to climate, the groundwater elevations in these wells have also been impacted by the construction and operation of water recharge facilities in the Oxnard Subbasin, to the west of the LPVB boundary (see Section 2.3.1, Groundwater

Elevation Data). Full hydrographs for LPVB wells with five or more water elevation measurements are included in Appendix D.

Declines in groundwater elevation occurred between 1984 and 1990 and between 2011 and 2016, coincident with periods of drought shown in the declining limb of the cumulative departure from the mean precipitation curve (Figure 2-11). Groundwater elevations recovered after the 1984 to 1990 drought period. In 1999, water levels exceeded the previous maximum in 1983 (Figure 2-11), likely due to several wet years during the 1990s and the influence of management actions taken and water conservation facilities constructed in the 1980s and 1990s (see Section 2.3.1).

Unlike the area of the WLPMA adjacent to the Oxnard Subbasin, groundwater elevations in the WLPMA closer to the Somis Fault are not correlated with the cumulative departure from the mean rainfall (Figure 2-12, Fox Canyon Aquifer Groundwater Elevation Hydrographs: Eastern WLPMA). Between 1950 and 1991, groundwater elevations in the eastern WLPMA declined by as much as 335 feet (Figure 2-12), despite a prolonged period of above-average precipitation between 1976 and 1982. Between 1995 and 2008 groundwater elevations recovered by as much as 80 feet (Figure 2-12). This recovery resulted from deliveries of in-lieu surface water by CMWD that reduced groundwater pumping by approximately 1,800 acre-feet per year (AFY) in this area. In-lieu water deliveries ceased in 2008. Since the in-lieu deliveries stopped, groundwater elevations have declined by up to 80 feet, approaching previously measured low groundwater elevations in 1994 and 1995.

2.3.1.1.3 Grimes Canyon Aquifer

Spring and Fall 2015 Groundwater Elevations

There are only eight wells currently screened solely within the GCA in the WLPMA. Of these wells, only two have recorded groundwater elevations in the spring and fall of 2015 (Figure 2-13, Groundwater Elevation Contours in the Grimes Canyon Aquifer, March 2–29, 2015, and Figure 2-14, Groundwater Elevation Contours in the Grimes Canyon Aquifer, October 2–29, 2015). In the spring of 2015, the groundwater elevation in Well 02N21W28A02S was −78.3 feet msl and the groundwater elevation in Well 02N21W22G01S was −83.2 feet msl (Figure 2-13). In the fall of 2015, the groundwater elevation in Well 02N21W28A02S was −90.4 feet msl and the groundwater elevation in Well 02N21W22G01S was −90.1 feet msl (Figure 2-14).

Both Well 02N21W28A02S and Well 02N21W22G01S are located in the Camarillo Hills in the southwestern area of the WLPMA. Because these were the only two wells screened solely within the GCA with recorded groundwater elevations, a hydraulic gradient could not be determined for the GCA in 2015.

Vertical Gradients

There are no wells screened in the FCA or USP with recorded groundwater elevations in 2015 in the vicinity of Wells 02N21W28A02S and 02N21W22G01S. Therefore, vertical gradients between the overlying aquifers and the GCA could not be determined in 2015. Additionally, the vertical gradient within the GCA could not be determined because Wells 02N21W28A02S and 02N21W22G01S are not separated geographically and are not screened within a multiple-completion nested monitoring well cluster.

Historical Groundwater Elevation Trends

Groundwater elevation trends in the GCA vary with location in the WLPMA. Groundwater elevations in Well 02N21W08G01S rose during periods of above-average precipitation from 1977 to 1983 and again from 1991 to 2002 (Figure 2-15, Grimes Canyon Aquifer Groundwater Elevation Hydrographs). In the intervening period, they declined, coincident with a period of drought from 1986 to 1991. This well is also located close to the boundary between the LPVB and the Oxnard Subbasin, and water level responses in this well are likely influenced by surface water spreading in the Forebay area of the Oxnard Subbasin.

In contrast to Well 02N21W08G01S, groundwater elevations in Wells 02N21W16J01S, 02N21W22A01S, and 02N21W28A02S were below sea level throughout the period of observation from 1999 to 2016 (Figure 2-15). Between 1999 and 2010, the groundwater elevation in Well 02N21W22A01S rose approximately 50 feet, but with the onset of drought in 2011, the groundwater elevation in this well declined to −63 feet msl by September 2015 (Figure 2-15). This elevation is higher than the groundwater elevation at the start of the record in 1999.

The groundwater elevation trends in Wells 02N21W16J01S and 02N21W28A02S are similar to those observed in Well 02N21W22A01S, although the groundwater elevations in these wells were relatively stable, and did not increase, between 2000 and 2011. Between 2011 and 2015, the groundwater elevation in these wells declined approximately 35 feet. In October 2015 the groundwater elevation in these wells was approximately −90 feet msl, the lowest recorded elevation since the start of the records in 1999 and 2005 for Wells 02N21W22A01S and 02N21W28A02S, respectively (Figure 2-15). The low groundwater elevation measured in October 2015 reflects the effects of the drought from 2011 to 2015.

2.3.1.2 East Las Posas Management Area

2.3.1.2.1 Shallow Alluvial Aquifer

Spring and Fall 2015 Groundwater Elevations

In the spring of 2015, recorded groundwater elevations in the Shallow Alluvial Aquifer in the ELPMA ranged from 186.1 to 485.9 feet msl (Figure 2-16, Groundwater Elevation Contours in the Shallow Alluvial Aquifer, March 2–29, 2015). In the fall of 2015, groundwater elevations ranged from 160.8 to 435.8 feet msl (Figure 2-17, Groundwater Elevation Contours in the Shallow Alluvial Aquifer, October 2–29, 2015). The large gap in the maximum elevation contours is caused by lack of data at the most upgradient monitoring location in fall of 2015.

The highest groundwater elevation in the Shallow Alluvial Aquifer was measured in Well 02N19W09E01S in the spring of 2015 (Figure 2-16). This well is the easternmost well with recorded groundwater elevations in the Shallow Alluvial Aquifer. The groundwater elevation in this well was not measured in the fall of 2015. In the fall of 2015, the highest groundwater elevation was measured in Well 02N19W07G01S, which is west of Well 02N19W09E01S. Groundwater elevations decline to the west in this aquifer, and the lowest groundwater elevations were measured in Well 02N20W17J06S, which is adjacent to the boundary with the PVB (Figures 2-16 and 2-17).

The observed gradient in the Shallow Alluvial Aquifer ranged from 0.007 feet/feet in the eastern part of the aquifer to 0.016 feet/feet in the western part of the aquifer in the spring of 2015. In the fall of 2015, the gradient ranged from 0.011 feet/feet in the eastern part of the aquifer to 0.021 feet/feet in the western part of the aquifer. This gradient drives lateral groundwater flow from east to west, generally following the trend of Arroyo Simi–Las Posas (Figures 2-16 and 2-17).

Vertical Gradients

Groundwater elevations in the Shallow Alluvial Aquifer were lower than those in the underlying USP, as measured in nested monitoring wells 02N19W07K03 and 02N19W07K04 (Table 2-2). The lower groundwater elevations in the Shallow Alluvial Aquifer produced an upward vertical gradient. In the fall of 2015, the gradient was approximately 0.03 feet/feet. This gradient indicates the potential for flow from the USP to the Shallow Alluvial Aquifer in this area, although the sediments of the USP have a low hydraulic conductivity that may limit flow into the Shallow Alluvial Aquifer.

Historical Groundwater Elevation Trends

Well 02N20W12G02S is the only well with a long-term record of groundwater elevations in the Shallow Alluvial Aquifer (Figures 2-16 and 2-17 and Figure 2-18, Shallow Alluvial Aquifer

Groundwater Elevation Hydrographs). Groundwater elevations declined approximately 25 feet in this well from 1927, when the first measurements were collected, to 1940 (Figure 2-18). Between 1940 and 1954, groundwater elevations were relatively stable. Beginning in 1977, groundwater elevations rose as a result of increased urban runoff, discharges from dewatering wells in Simi Valley, and wastewater discharges to Arroyo Simi–Las Posas from the Simi Valley Water Quality Control Plant and MWTP (Las Posas Users Group 2012; CMWD 2016a). Between 1977 and 1995, groundwater elevations rose approximately 45 feet, as non-native perennial stream flows recharged the aquifer (Figure 2-18). The groundwater elevation record for Well 02N20W12G02S ends in 2002. Groundwater elevations in this well were relatively stable between 1995 and 2002. Although it is screened in the USP, below the base of the Shallow Alluvial Aquifer, groundwater elevations from Well 02N19W05K01S are also plotted on Figure 2-18 to bridge the gap in data between 2002 and 2014, when transducers were installed in several wells in the Shallow Alluvial Aquifer. The groundwater elevations in this well are used only as representative of the trends and conditions in the Shallow Alluvial Aquifer from 2002 to 2014. These groundwater elevations indicate that elevations in the Shallow Alluvial Aquifer were likely stable during this period. In the western part of the Shallow Alluvial Aquifer, and in areas adjacent to the PVB, groundwater elevations have declined in recent years as the non-native perennial surface water flow in Arroyo Simi–Las Posas less frequently reaches the boundary between the LPVB and the PVB (CMWD 2016c). The decreased surface flows may reflect the decrease in wastewater discharge to Arroyo Simi–Las Posas from the MWTP percolation ponds since the late 1990s (CMWD 2016c).

2.3.1.2.2 Epworth Gravels Aquifer

Spring and Fall 2015 Groundwater Elevations

Five currently active wells are screened solely within the Epworth Gravels Aquifer (Figure 2-19, Groundwater Elevation Contours in the Epworth Gravels Aquifer, March 2–29, 2015). Of these, Wells 03N19W30M02S and 03N19W29F06S have recorded groundwater elevation measurements for spring and fall 2015 (Figure 2-19 and Figure 2-20, Groundwater Elevation Contours in the Epworth Gravels Aquifer, October 2–29, 2015). The remaining wells have only one recorded groundwater elevation, from January 2015. In the spring of 2015, the groundwater elevation in Well 03N19W30M02S was 619.5 feet msl and the groundwater elevation in Well 03N19W29F06S was 601.5 feet msl. In the fall, the groundwater elevation was 622 feet msl in Well 03N19W30M02S and 598.6 feet msl in Well 03N19W29F06S.

Vertical Gradients

There are no multiple-depth nested monitoring wells with screen intervals in the Epworth Gravels Aquifer, so vertical gradients cannot be calculated for this aquifer. Groundwater elevations in the

Epworth Gravels Aquifer are, however, several hundred feet higher than in the underlying FCA, resulting in a downward potential vertical hydraulic gradient. As discussed above, the Epworth Gravels Aquifer is separated from the FCA by the USP. Therefore, although there is a downward gradient, flow from the Epworth Gravels Aquifer to the FCA is impeded by the low-permeability sediments of the USP.

Historical Groundwater Elevation Trends

Groundwater elevations in the Epworth Gravels Aquifer were as high as 712 feet msl in 1932, and declined steadily until 1980, when groundwater elevations were approximately 575 feet msl (Figure 2-21, Epworth Gravels Aquifer Groundwater Elevation Hydrographs). These declines were independent of climatic cycles in the basin. Groundwater elevations continued to decline, although at a slower rate, between 1980 and 1992, when the groundwater elevation was approximately 565 feet msl (Figure 2-21). Between 1992 and 2010, groundwater elevations recovered by 70 feet in Well 03N19W29F06S, partly in response to decreased production from the Epworth Gravels Aquifer as water levels declined and production wells were drilled in the FCA instead. After recovering between 1992 and 2010, groundwater levels declined by 20 feet between 2010 and 2015 (Figure 2-21). Groundwater elevations in the Epworth Gravels Aquifer remain approximately 100 feet below the highest recorded elevations in 1932 (Figure 2-21).

2.3.1.2.3 Upper San Pedro Formation

Spring and Fall 2015 Groundwater Elevations

There are nine currently active wells screened within the USP in the ELPMA (Figure 2-6). In the spring of 2015, recorded groundwater elevations in the USP ranged from 272.6 to 371.2 feet msl (Figure 2-6). In the fall of 2015, recorded groundwater elevations ranged from 272.8 to 437.6 feet msl (Figure 2-7).

In the spring, the highest groundwater elevation in the USP was measured in Well 02N19W06F01S, and in the fall, the highest groundwater elevation was measured in Well 02N19W07K03S, because no water level measurement was recorded for this well between March 2 and March 29, 2015 (Figures 2-6 and 2-7). Well 02N19W07K03S is screened from 240 to 300 feet bgs and is adjacent to Arroyo Simi–Las Posas. Groundwater elevations in this well are influenced by non-native surface water recharge from Arroyo Simi–Las Posas. The lowest recorded groundwater elevation in the USP was measured in Well 03N20W35R04S, which is screened from 490 to 530 feet bgs and is located approximately 2.5 miles northwest of Well 02N19W07K03S. The difference in groundwater elevations between these wells reflects the influence of recharge from non-native surface water flows in Arroyo Simi–Las Posas.

Vertical Gradients

The vertical gradient between the USP and the underlying FCA was determined from elevations measured in Wells 02N19W07K03S, 02N19W07K02S, 03N30W35R04S, and 03N30W35R03S. These wells are located in two separate multiple-depth nested monitoring well clusters. Wells 02N19W07K03S and 02N19W07K02S are located adjacent to Arroyo Simi–Las Posas, while Wells 03N20W35R04S and 03N20W35R03S are located in the central part of the ELPMA (Figures 2-6 and 2-9). In the fall of 2015, the vertical gradient between Wells 02N19W07K03S and 02N19W07K02S was 0.16 feet/feet, directed downward (Table 2-2). Groundwater elevations were not measured in these wells in the spring of 2015. In the spring of 2015, the vertical gradient between Wells 03N20W35R04S and 03N20W35R03S was 0.34 feet/feet, directed downward (Table 2-2). In the fall of 2015, the vertical gradient between these wells was 0.40 feet/feet directed downward (Table 2-2). The vertical gradient between the USP and the FCA is approximately 2.5 times greater in the vicinity of Wells 02N30W35R04S and 02N30W35R03S, in the central ELPMA, than it is in the vicinity of Arroyo Simi–Las Posas.

Historical Groundwater Elevation Trends

Groundwater elevation trends in the USP vary with screen interval depth and geographic location within the ELPMA. The groundwater elevation in Well 02N20W01M01S, the well with the longest historical record, declined approximately 30 feet between 1968 and 1977, after which the groundwater elevation remained stable until 2004 (Figure 2-22, Upper San Pedro Formation Groundwater Elevation Hydrographs: ELPMA). Between 2005 and 2010, the groundwater elevation declined an additional 60 feet, likely in response to production from the CMWD ASR well field between 2007 and 2010.

In contrast, the groundwater elevations in Wells 03N20W35R04S and 02N19W06F01S do not exhibit the same trends as those observed in Well 02N20W01M01S (Figure 2-22). Between 1991 and 2015, the groundwater elevation in Well 03N20W35R04S declined approximately 30 feet, independent of climatic cycles. The rate of decline slowed between 2002 and 2007, when CMWD was injecting water in its ASR wells between 2002 and 2007. When CMWD extracted water from the ASR wells between 2007 and 2011, groundwater levels in the well declined, though at a similar rate to the decline observed between 1991 and 2002. The groundwater elevation record in Well 02N19W06F01S has several gaps that limit the comparison between water levels and climate cycles. However, groundwater elevations in this well were approximately 150 feet higher in 2015 than they were in 1974 (Figure 2-22).

2.3.1.2.4 Fox Canyon Aquifer

Spring and Fall 2015 Groundwater Elevations

In the spring of 2015, groundwater elevations in the FCA ranged from 142.8 to 285.8 feet msl (Figure 2-9). In the fall the groundwater elevations ranged from 127.8 to 279.3 feet msl (Figure 2-10). The highest groundwater elevations in the FCA were measured in Well 02N20W07K02S, adjacent to Arroyo Simi–Las Posas, and the lowest groundwater elevations were measured in wells located in the central part of the ELPMA (Figure 2-10).

The observed gradient in the FCA drives lateral groundwater flow toward the central part of the ELPMA. In the vicinity of Arroyo Simi–Las Posas, the lateral hydraulic gradient was approximately 0.031 feet/feet to the north-northwest in the spring of 2015 and 0.034 feet/feet to the north-northwest in the fall of 2015 (Figures 2-9 and 2-10). Additionally, recharge along the flanks of South Mountain produces a lateral gradient to the southeast, toward the central area of the ELPMA (Figures 2-9 and 2-10). This southeastern gradient was 0.011 feet/feet in the spring of 2015 and 0.007 feet/feet in the fall of 2015.

Vertical Gradients

Groundwater elevations in the FCA are lower than those in the overlying USP and Shallow Alluvial Aquifer, as measured in nested monitoring wells 02N19W07K02 and 02N19W07K03 in the vicinity of Arroyo Simi–Las Posas and Wells 03N20W35R03S and 03N20W35R04S in the central part of the ELPMA (Table 2-2). Groundwater elevations were not recorded for Wells 02N19W07K02 and 02N19W07K03 in the spring of 2015. The vertical gradient in Wells 03N20W35R03S and 03N20W35R04S was 0.34 feet/feet directed downward in the spring of 2015. The higher groundwater elevations in the Shallow Alluvial Aquifer and USP produced a downward vertical gradient of 0.16 feet/feet in the fall of 2015 in Wells 02N19W07K02 and 02N19W07K03 and 0.40 feet/feet in Wells 03N20W35R03S and 03N20W35R04S. In areas where the USP directly underlies the Shallow Alluvial Aquifer, direct downward transport of water is limited. However, in areas where the Shallow Alluvial Aquifer directly overlies the FCA, the downward gradient has resulted in transport of water from the Shallow Alluvial Aquifer to the FCA, as evidenced by increasing groundwater elevations and decreasing water quality in the FCA underlying the Shallow Alluvial Aquifer (Las Posas Users Group 2012; CMWD 2016a).

Within the FCA, there was an upward vertical gradient in the spring of 2015 and a downward vertical gradient in the fall of 2015 (Table 2-2). The vertical gradient within the FCA is one to two orders of magnitude smaller than the vertical gradient between the USP and the FCA. In the spring of 2015, the upward-directed gradient within the FCA was 0.004 feet/feet, and in the fall of 2015 the downward-directed gradient was 0.03 feet/feet.

Historical Groundwater Elevation Trends

Historical groundwater elevations and trends in the FCA vary geographically within the ELPMA. Groundwater elevation trends in the western, central, and eastern areas of the ELPMA are discussed below.

Southwestern East Las Posas Management Area

In the southwestern part of the ELPMA, groundwater elevations declined by approximately 80 feet in Well 02N20W10G01S between 1950 and 1975 (Figure 2-23, Fox Canyon Aquifer Groundwater Elevation Hydrographs: Southwestern ELPMA). Between 1975 and 1998, groundwater elevations in Well 02N20W10G01S recovered approximately 180 feet, in response to recharge from urban runoff, wastewater discharges, and shallow groundwater dewatering discharges that resulted in perennial surface water flows in Arroyo Simi–Las Posas (CMWD 2012a). These surface water flows percolated into the Shallow Alluvial Aquifer and eventually into the FCA. Since 1998, groundwater elevations in Well 02N20W10G01S have declined approximately 40 feet. These declines may reflect the decrease in wastewater discharge to Arroyo Simi–Las Posas from the MWTP percolation ponds since the late 1990s (CMWD 2016c).

Wells that are farther from Arroyo Simi–Las Posas (e.g., Wells 02N20W09F01S and 02N20W10D02S) tend to have lower groundwater elevations than Well 02N20W10G01S, and water levels in these wells have declined by approximately 60 feet since 1998. However, the overall trend in recovery and decline is similar to that observed in Well 02N20W10G01S (Figure 2-23). The change in groundwater elevation observed throughout the southwestern part of the ELPMA is primarily driven by the effects of groundwater recharge through Arroyo Simi–Las Posas, rather than by climatic cycles.

Central East Las Posas Management Area

In the central part of the ELPMA, groundwater elevations in Well 02N20W02D02S declined approximately 89 feet between 1955 and 1977 (Figure 2-24, Fox Canyon Aquifer Groundwater Elevation Hydrographs: Central ELPMA). Similarly, groundwater elevations in Well 03N20W36G01S declined approximately 92 feet between 1950 and 1969. Beginning in 1978, groundwater elevations began to recover in Well 02N20W02D02S. Between 1977 and 1998, groundwater elevations rose approximately 109 feet and were higher than the measured groundwater elevation in 1955 (Figure 2-24). Groundwater elevation was not measured in Well 03N20W36G01S during this period. However, in 1999, the groundwater elevation in Well 03N20W36G01S was approximately 150 feet below the measured groundwater elevation in this well in 1950 (Figure 2-24). The different groundwater elevation trends in these wells are likely caused by the proximity of Well 02N20W02D02S to Arroyo Simi–Las Posas. Recharge from non-native surface water flows in Arroyo Simi–Las Posas produced the groundwater elevation recovery observed in Well 02N20W02D02S. In contrast, groundwater levels did not recover in Well 03N20W36G01S, which is farther from Arroyo Simi–Las Posas, suggesting that there may be a geologic structure limiting the hydraulic connection between this well and the wells closer to Arroyo Simi–Las Posas.

From 1998 to 2007, groundwater elevations in the central ELPMA were stable (Wells 03N20W36G01S and 03N20W35J01S) to declining (Wells 02N20W02D02 and 02N20W03H01S). The overall rate of decline in Wells 02N20W02D02 and 02N20W03H01S was approximately 1.6 feet per year (Figure 2-24). It is noted that water levels in this area were stable or declining slightly despite considerable groundwater storage via in-lieu deliveries and injection by CMWD during this period. Water levels continued to decline at a rate of approximately 1 to 1.9 feet per year in Wells 02N20W02D02 and 02N20W03H01S between 2007 and 2015. Over the same period, groundwater elevations declined at a rate of approximately 9 feet per year in Well 03N20W36G01S, although the primary decline occurred between 2007 and 2010. This well is close to the CMWD ASR project well field, and water level declines measured in Well 03N20W36G01S between 2007 and 2010 are the result of groundwater extractions from the ASR well field during that period. Groundwater elevations recovered approximately 45 feet in Well 03N20W36G01S between 2010 and 2012, after extraction from the ASR well field ceased. Groundwater elevations in this well have remained stable since 2012. It is noted that water levels in this area have been stable since 2012 despite considerable groundwater injection by CMWD. In the fall of 2015, the groundwater elevation in Well 03N20W36G01S was 127.8 feet msl, which is approximately 215 feet below the groundwater elevations in this well measured in the 1950s.

Eastern East Las Posas Management Area

The groundwater elevation in Well 03N19W29K04S, which has historical groundwater elevations dating back to 1972 (CMWD 2016c), declined approximately 200 feet during the 1970s, 1980s, and 1990s (Figure 2-25, Fox Canyon Aquifer Groundwater Elevation Hydrographs: Eastern ELPMA). The groundwater elevation decline measured in this well is larger than that observed in Well 03N19W19P02S, which declined approximately 30 feet over a similar period (Figure 2-25). From the early 1990s to 2007, groundwater elevations were stable in the eastern ELPMA (Figure 2-25). During this time, CMWD stored approximately 29,000 AF of groundwater in the ELPMA through in-lieu deliveries of surface water and direct injection of water in the ASR well field. Between 2007 and 2010, groundwater production from the CMWD ASR well field caused water level declines of between 40 and 100 feet (Figure 2-25). Groundwater elevations in Well 03N19W31B01 recovered approximately 40 feet between 2010 and 2012, and have remained stable since 2012 as a result of approximately 5,000 AF of water injected into the CMWD ASR well field during this time. Groundwater elevation has not been measured in Well 03N19W29K04S since 2012 (Figure 2-25). Groundwater elevations in the eastern ELPMA are primarily influenced by groundwater production and ASR activities in the ELPMA and are independent of climatic cycles.

2.3.1.2.5 Grimes Canyon Aquifer

There are no wells screened solely within the GCA in the ELPMA (Figures 2-13 and 2-14). Future groundwater monitoring efforts should include monitoring wells screened solely within the GCA to assess groundwater conditions in this aquifer.

2.3.2 Estimated Change in Storage

Estimated monthly change in storage values for the WLPMA and ELPMA were generated using numerical groundwater flow models. Values in the WLPMA came from the groundwater model prepared by UWCD (Appendix E). Change in storage estimates for the ELPMA came from the groundwater model prepared by CMWD (Appendix C). Monthly data reported from the model were summed to reflect the annual change in storage for water year 1986 through water year 2015 for the WLPMA and water year 1985 through water year 2015 for the ELPMA. Change in storage results for each management area are summarized in Figures 2-26 through 2-29, showing annual and cumulative changes in storage (by management area), and in the sections below.

2.3.2.1 West Las Posas Management Area

Change in storage in the WLPMA was calculated for the shallow aquifer system and the LAS. The water year average annual change in storage in the shallow aquifer system was a decrease in storage of approximately 230 AFY, with a maximum decrease in storage of approximately 3,150 AF in 2007 and a maximum increase in storage of approximately 5,000 AF in 2005 (Figure 2-26, West Las Posas Management Area Annual Change in Storage). In the LAS, the water year average annual change in storage was a decrease of approximately 2,100 AFY, with a maximum decrease in storage of approximately 15,900 AF in 1990 and a maximum increase in storage of approximately 14,900 AF in 1998 (Figure 2-26). The total average annual change in storage was a loss of approximately 2,300 AFY, with a maximum decrease in storage of approximately 18,400 AF in 1990 and a maximum increase in storage of approximately 18,500 AF in 1998 (Figure 2-26). The cumulative change in storage over the model period for the shallow aquifer system and the LAS was a loss of approximately 6,800 AF and a loss of approximately 63,400 AF, respectively, for a total cumulative loss in storage for the WLPMA of approximately 70,200 AF (Figure 2-27, West Las Posas Management Area Cumulative Change in Storage). Pumping within 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.

2.3.2.2 East Las Posas Management Area

Model calculated change in storage values for the ELPMA were obtained from the CMWD numerical model (Appendix C). Change in storage values were calculated for the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, USP, FCA, and GCA (Figure 2-28, East Las Posas

Management Area Annual Change in Storage). Average change in storage values for each aquifer, along with maximum and minimum change in storage values, are presented in Table 2-3. The total average annual change in storage was an increase in storage of approximately 3,600 AFY, with a maximum increase in storage in the basin of approximately 14,000 AF in 1986 and a maximum decrease in storage of approximately 8,300 AF in 2010. The cumulative change in storage from water year 1985 through water year 2015 for the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, USP, FCA, and GCA were increases of approximately 7,600 AF, 2,700 AF, 53,700 AF, 44,700 AF, and 3,800 AF, respectively, for a total cumulative storage increase in the basin of approximately 112,500 AF (Figure 2-29, East Las Posas Management Area Cumulative Change in Storage). The cumulative increase in storage has leveled off since 2010 (Figure 2-19). As noted previously, pumping in FCGMA jurisdiction is reported on a calendar-year basis, so pumping shown in the figures is per calendar year.

2.3.3 Seawater Intrusion

The western boundary of the LPVB is approximately 9 miles east of the Pacific Ocean. The western LPVB is in hydraulic communication with the Oxnard Subbasin, the western boundary of which is the Pacific Ocean and has experienced seawater intrusion in both the Upper Aquifer System (UAS) and the LAS. The UAS of the Oxnard Subbasin does not extend into the WLPMA. Additionally, the eastward extent of seawater intrusion in the Oxnard Subbasin is approximately 6 to 7 miles southwest of the boundary between the Oxnard Subbasin and the LPVB. Therefore, seawater intrusion is not currently a problem for the LPVB. Furthermore, the LPVB and Oxnard Subbasin are both managed by FCGMA, which has set targets and specified measurable objectives to attain control over seawater intrusion in the GSP for the Oxnard Subbasin. Therefore, seawater intrusion is not anticipated to occur within the LPVB in the future. However, groundwater pumping in the LAS in the WLPMA can directly affect seawater intrusion in the Oxnard Subbasin by lowering the groundwater elevations in the WLPMA thereby increasing groundwater flow from the Oxnard Subbasin into the WLPMA. There is no potential for seawater intrusion in the ELPMA and pumping there does not impact the ability of other basins to address seawater intrusion.

2.3.4 Groundwater Quality

FCGMA adopted Basin Management Objectives (BMOs) for chloride (Cl) and total dissolved solids (TDS) in the LPVB (FCGMA 2007; Table 2-4). The Water Quality Control Plan: Los Angeles Region (Basin Plan) also specifies Water Quality Objectives (WQOs) for total dissolved solids (TDS), chloride, nitrate (mg/L as nitrate, or NO_3), sulfate (SO_4), and boron (B) (LARWQCB 2014; Table 2-4). The current and historical distribution of these five constituents are discussed below, based on management area 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.

Groundwater quality monitoring within the LPVB occurs on different schedules for different wells. In order to assess the current groundwater quality conditions within the LPVB, the most recent concentration of each of the five constituents listed above was mapped for samples collected between 2011 and 2015. Historical groundwater quality hydrographs are presented in Appendix F. Statistics on the most recent sample date, the maximum and minimum concentrations measured, the number of times sampled, and the number of samples whose concentration exceeded the relevant water quality threshold are presented in Appendix G.

2.3.4.1 Total Dissolved Solids

The WQO for TDS is 700 mg/L for the eastern part of the WLPMA and 500 mg/L for the western part of the WLPMA (Figures 2-30A and 2-30B, Most Recent Total Dissolved Solids [mg/L] Measured 2011–2015; Table 2-4; LARWQCB 2014). The FCGMA BMO for TDS is 600 mg/L in the WLPMA (Table 2-4; FCGMA 2007).

In the ELPMA, the WQO for TDS ranges from 250 mg/L in the area near Grimes Canyon Road and Broadway to 2,500 mg/L east of Grimes Canyon Road and Hitch Boulevard (Table 2-4; Figures 2-30A and 2-30B). The FCGMA BMOs for TDS in the ELPMA range from 500 mg/L to 1,500 mg/L, depending on location and aquifer depth (Table 2-4). Sources of high-TDS water in the LPVB include upstream discharges to Arroyo Simi–Las Posas from dewatering wells in Simi Valley (see Section 1.3.2, Geography, of this GSP).

West Las Posas Management Area

The concentration of TDS in groundwater in the WLPMA ranged from 300 to 1,910 mg/L (Figures 2-30A and 2-30B). The highest concentration of TDS was measured in Well 02N21W18H01S, which is adjacent to the boundary between the LPVB and the Oxnard Subbasin and is screened across multiple aquifers (Figures 2-30A and 2-30B). Other wells in this area, screened solely within the FCA, have concentrations of TDS ranging from 1,050 to 1,400 mg/L. These concentrations are similar to those in the adjacent Oxnard Basin.

Groundwater sampled from Well 02N21W18H01S also has the highest concentration of chloride, nitrate, sulfate, and boron measured between 2011 and 2015 in the WLPMA (Figures 2-31 through 2-34). The consistently high concentrations in this well relative to nearby wells suggests that the water quality in this well may be influenced by shallow groundwater with higher concentrations of TDS, chloride, nitrate, sulfate, and boron.

The lowest concentrations of TDS are found in the eastern part of the WLPMA, near the Somis Fault (Figures 2-30A and 2-30B). With the exception of Well 03N20W32H03, which has a TDS concentration of 1,200 mg/L, wells screened in the FCA in this area have TDS concentrations of between 300 and 650 mg/L.

East Las Posas Management Area

The concentration of TDS in groundwater in the ELPMA ranged from 261 mg/L to 1,540 mg/L (Figures 2-30A and 2-30B). The highest concentration was measured in Well 02N20W09Q07S, which is adjacent to Arroyo Simi–Las Posas and is screened within the FCA (Figures 2-30A and 2-30B). Wells adjacent to Arroyo Simi–Las Posas have TDS concentrations that are higher than the majority of wells within the ELPMA, with concentrations between approximately 1,200 and 1,500 mg/L. The higher concentration of TDS along Arroyo Simi–Las Posas likely results from discharges of high-TDS water to the Arroyo Simi–Las Posas from shallow dewatering wells in Simi Valley, SVWQCP discharges, and discharges from the MWTP percolation ponds (Todd Groundwater 2016). In general, TDS concentrations in the ELPMA decrease to the north (Figures 2-30A and 2-30B). The lowest concentration of TDS was measured in Well 03N19W30E06S, screened in the FCA to the north of the Fairview Fault (Figures 2-30A and 2-30B). In the hills along the northern edge of the LPVB, outcrops of the FCA are recharged directly by infiltration of precipitation, which results in lower concentrations of TDS in the groundwater in these areas.

2.3.4.2 Chloride

The WQO for chloride is 100 mg/L for the eastern part of the WLPMA and 150 mg/L for the western part of the WLPMA (Figures 2-31A and 2-31B, Most Recent Chloride [mg/L] Measured 2011–2015; Table 2-4; LARWQCB 2014). The FCGMA BMO for chloride is 100 mg/L in the WLPMA (Table 2-4; FCGMA 2007).

In the ELPMA, the WQO for chloride ranges from 30 mg/L in the area near Grimes Canyon Road and Broadway to 400 mg/L east of Grimes Canyon Road and Hitch Boulevard (Table 2-4; Figures 2-31A and 2-31B). The FCGMA BMOs for chloride in the ELPMA range from 100 mg/L to 160 mg/L, depending on location and aquifer depth (Table 2-4). Sources of high-TDS water in the LPVB include upstream discharges to Arroyo Simi–Las Posas from dewatering wells in Simi Valley (see Section 1.3.2).

West Las Posas Management Area

The concentration of chloride in groundwater in the WLPMA ranges from 10 to 160 mg/L (Figures 2-31A and 2-31B). The highest concentration of chloride was measured in Well 02N21W18H01S, which is adjacent to the boundary between the LPVB and the Oxnard Subbasin and is screened across multiple aquifers (Figures 2-31A and 2-31B). Other wells in this area, screened solely within the FCA, have concentrations of chloride ranging from 51 to 84 mg/L.

Groundwater sampled from Well 02N21W18H01S also had the highest concentration of TDS, sulfate, and boron measured between 2011 and 2015 in the WLPMA. The consistently high concentrations in this well relative to nearby wells suggests that the water quality in this well may be influenced by shallow groundwater with higher concentrations of TDS, chloride, nitrate, sulfate, and boron.

The lowest concentrations of chloride are found in the eastern part of the WLPMA, near the Somis Fault (Figures 2-31A and 2-31B). Wells screened in the FCA in this area have chloride concentrations between 10 and 61 mg/L.

East Las Posas Management Area

The concentration of chloride in groundwater in the ELPMA ranges from 11 to 220 mg/L (Figures 2-31A and 2-31B). The highest concentration was measured in Well 02N20W09Q04S, which is adjacent to Arroyo Simi–Las Posas and screened in multiple aquifers (Figures 2-31A and 2-31B). Wells adjacent to Arroyo Simi–Las Posas have chloride concentrations that are higher than the majority of wells within the ELPMA, with concentrations ranging from 153 to 220 mg/L. The higher concentration of chloride along Arroyo Simi–Las Posas likely results from the combined discharges of water to the Arroyo from shallow dewatering wells in Simi Valley, SVWQCP discharges, and discharges from the MWTP percolation ponds (Todd Groundwater 2016). In general, chloride concentrations in the ELPMA decrease to the north (Figures 2-31A and 2-31B). The lowest concentration of chloride was measured in Well 03N20W36A02S, screened in the FCA to the south of the Fairview Fault (Figures 2-31A and 2-31B). In the hills along the northern edge of the LPVB, outcrops of the FCA are recharged directly by infiltration of precipitation, which results in lower concentrations of chloride in the groundwater in these areas.

2.3.4.3 Nitrate

The WQO for nitrate is 45 mg/L for both the WLPMA and ELPMA within the LPVB. There are no BMOs for nitrate in the LPVB.

West Las Posas Management Area

The concentration of nitrate as NO_3 in groundwater in the WLPMA ranged from 1 to 208 mg/L (Figures 2-32A and 2-32B, Most Recent Nitrate [mg/L as Nitrate] Measured 2011–2015). The highest concentration of nitrate was measured in Well 02N21W11A03S, which is located between Price Road and Aggen Road in the central WLPMA and is screened in the USP (Figures 2-32A and 2-32B). Only three wells exceeded 45 mg/L nitrate in the WLPMA between 2011 and 2015 (Figure 2-31a).

Groundwater sampled from Well 02N21W18H01S also had a nitrate concentration of 130 mg/L. Well 02N21W18H01S is located adjacent to the Oxnard Subbasin and is screened across multiple aquifers. Other wells in this area, screened solely within the FCA, have concentrations of nitrate ranging from 0.9 to 43 mg/L. Well 02N21W18H01S had the highest concentration of TDS, chloride, sulfate, and boron measured between 2011 and 2015 in the WLPMA. The consistently high concentrations in this well relative to nearby wells suggests that the water quality in this well may be influenced by shallow groundwater with higher concentrations of TDS, chloride, nitrate, sulfate, and boron.

The lowest concentrations of nitrate are found in the eastern part of the WLPMA, near the Somis Fault (Figures 2-32A and 2-32B). Wells screened in the FCA in this area have detectable nitrate concentrations between 0.5 and 12 mg/L.

East Las Posas Management Area

The detectable concentration of nitrate in groundwater in the ELPMA ranged from 0.6 to 89 mg/L (Figures 2-32A and 2-32B). The highest concentration was measured in Well 03N20W34K01S, which is adjacent to Balcom Canyon Road in the central ELPMA and is screened solely in the FCA (Figures 2-32A and 2-32B).

Groundwater concentrations of nitrate as NO_3 greater than 45 mg/L are found in four wells in the ELPMA. These wells are located in the central and northern parts of the ELPMA and do not follow a clear geographic trend. Two of the four wells are screened solely within the FCA, one is screened solely within the GCA, and one is screened across multiple aquifers. The majority of the wells in the ELPMA have nitrate as NO_3 concentrations below 10 mg/L.

2.3.4.4 Sulfate

The WQO for sulfate is 300 mg/L for the eastern part of the WLPMA and 250 mg/L for the western part of the WLPMA (Figures 2-33A and 2-33B, Most Recent Sulfate [mg/L] Measured 2011–2015; Table 2-4; LARWQCB 2014). In the ELPMA, the WQO for sulfate ranges from 30 mg/L in the area near Grimes Canyon Road and Broadway to 1,200 mg/L east of Grimes Canyon Road and Hitch Boulevard (Table 2-4; Figures 2-33A and 2-33B). There are no BMOs for sulfate in the LPVB.

West Las Posas Management Area

The concentration of sulfate in groundwater in the WLPMA ranges from 76 to 790 mg/L (Figures 2-33A and 2-33B). The highest concentration of sulfate was measured in Well 02N21W18H01S, which is adjacent to the boundary between the LPVB and the Oxnard Subbasin and is screened across multiple aquifers (Figures 2-33A and 2-33B). Other wells in this area that are screened solely within the FCA have concentrations of sulfate ranging from 320 to 534 mg/L. In the WLPMA, 13 wells exceeded 300 mg/L sulfate between 2011 and 2015 (Figure 2-33A).

Groundwater sampled from Well 02N21W18H01S also had the highest concentration of TDS, chloride, and boron measured between 2011 and 2015 in the WLPMA. The consistently high concentrations in this well relative to nearby wells suggests that the water quality in this well may be influenced by shallow groundwater with higher concentrations of TDS, chloride, nitrate, sulfate, and boron.

The lowest concentrations of sulfate are found in the eastern part of the WLPMA, near the Somis Fault (Figures 2-33A and 2-33B). With the exception of Well 03N20W32H03, which has a sulfate concentration of 490 mg/L, wells screened in the FCA in this area have sulfate concentrations between 85 and 290 mg/L.

East Las Posas Management Area

The concentration of sulfate in groundwater in the ELPMA ranges from 26 to 850 mg/L (Figures 2-33A and 2-33B). The highest concentration was measured in Well 02N20W09Q04S, which is adjacent to Arroyo Simi–Las Posas and is screened in multiple aquifers (Figures 2-33A and 2-33B). Wells adjacent to Arroyo Simi–Las Posas have sulfate concentrations that are higher than the majority of wells within the ELPMA, with concentrations ranging from 430 to 850 mg/L. The higher concentration of sulfate along Arroyo Simi–Las Posas likely results from discharges of water to the Arroyo Simi–Las Posas from shallow dewatering wells in Simi Valley, SVWQCP discharges, and discharges from the MWTP percolation ponds (Todd Groundwater 2016). In the ELPMA, five wells exceeded 300 mg/L sulfate between 2011 and 2015 (Figure 2-33B)

In general, sulfate concentrations in the ELPMA decrease to the north (Figures 2-33A and 2-33B). The lowest concentration of sulfate was measured in Well 03N19W29K06S, screened in the FCA, to the north of the Fairview Fault (Figures 2-33A and 2-33B). In the hills along the northern edge of the LPVB, outcrops of the FCA are recharged directly by infiltration of precipitation, which results in lower concentrations of sulfate in the groundwater in these areas.

2.3.4.5 Boron

The WQO for boron is 0.5 mg/L for the eastern part of the WLPMA and 1 mg/L for the western part of the WLPMA (Figures 2-34A and 2-34B, Most Recent Boron [mg/L] Measured 2011–2015; Table 2-4; LARWQCB 2014). In the ELPMA, the WQO for boron ranges from 0.2 mg/L in the area near Grimes Canyon Road and Broadway to 3 mg/L east of Grimes Canyon Road and Hitch Boulevard (Table 2-4; Figures 2-34A and 2-34B). There are no BMOs for boron in the LPVB.

West Las Posas Management Area

The concentrations of boron in groundwater in the WLPMA ranged from less than the detection limit to 0.9 mg/L (Figures 2-34A and 2-34B). The highest concentration of boron was measured in Well 02N21W22A01S, which is screened in the GCA (Figures 2-34A and 2-34B). Other wells in the GCA have concentrations of boron ranging from 0.6 to 0.8 mg/L.

The lowest concentrations of boron are found in the eastern part of the WLPMA, near the Somis Fault (Figures 2-34A and 2-34B). Several wells in this area did not have detectable concentrations of boron. The highest detectable concentration of boron was 0.1 mg/L for wells screened in the FCA in this area.

East Las Posas Management Area

The concentration of boron in groundwater in the ELPMA ranged from less than the detection limit to 0.9 mg/L (Figures 2-34A and 2-34B). The highest concentration was measured in Wells 02N20W09Q04S and 02N19W07B02S, which are adjacent to Arroyo Simi–Las Posas. The aquifer in which Well 02N20W09Q04S is screened is not known. Well 02N19W07B02S is screened in the FCA (Figures 2-34A and 2-34B). Wells adjacent to Arroyo Simi–Las Posas have boron concentrations that are higher than the majority of wells within the ELPMA, with concentrations ranging from 0.6 to 0.9 mg/L. In general, boron concentrations in the ELPMA decrease to the north (Figures 2-34A and 2-34B). The higher concentration of boron along Arroyo Simi–Las Posas likely results from discharges of water to the Arroyo Simi–Las Posas from shallow dewatering wells in Simi Valley, SVWQCP discharges, and discharges from the MWTP percolation ponds (Todd Groundwater 2016).

2.3.4.6 Maps of Features That Could Impact Groundwater Quality

Map of Oil and Gas Deposits

In the database maintained by the County of Ventura, six oil fields entirely or partially fall within the LPVB: Las Posas, Somis, South Mountain, Moorpark West, Moorpark, and Oak Park (Figure 2-35, Oil Fields in the Vicinity of FCGMA Groundwater Basins).

Map of Locations of Impacted Surface Water

Impaired surface waters (i.e., 303[d] Listed Reaches) that overlie the LPVB include Beardsley Wash, Fox Barranca, and Arroyo Simi–Las Posas (Figure 2-36, Impaired Surface Waters in the Vicinity of FCGMA Groundwater Basins; Appendix H [LPVB 303(d) List Reaches]; SWRCB 2004).

Map of Locations of Impacted Soil and Groundwater

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 GeoTracker website and the California Department of Toxic Substances Control EnviroStor website. Cases that were closed by the supervisory agency were not considered.

No open cases with impacted groundwater were identified in the LPVB. Consequently, it does not appear that existing groundwater contamination poses a substantial threat to beneficial use of groundwater in the LPVB.

2.3.5 Subsidence

Inelastic, or irrecoverable, land subsidence (subsidence) is a concern in areas of active groundwater extraction, including the LPVB. Active causes of land subsidence in LPVB include tectonic forces, petroleum reservoir compaction, and aquifer compaction (USGS 2003). Significant water level declines in the FCGMA groundwater basins since the early 1900s suggest that fluid extraction, in addition to tectonic forces, is a cause of land subsidence in the LPVB (USGS 2003). Subsidence resulting from any of these sources can cause infrastructure damage, increased flood risk, well casing collapse, and a permanent reduction in specific storage.

Direct measurement of historic subsidence in the LPVB is limited geographically and historically. Two subsidence survey monuments exist in the LPVD. UNAVCO monument MPWD is located in the foothills north of Moorpark, in the ELPMA, and monument P729 is located near Los Angeles Avenue on the western boundary of the LPVB (Figure 2-37, Subsidence Monuments in the Las Posas Valley Basin). UNAVCO is a non-profit university-governed consortium that facilitates geoscience research and education using geodesy (UNAVCO 2017). Each geo-located UNAVCO land surface monument is given a four-character identifier (e.g., MPWD).

There has been no measurable subsidence at monument MPWD since it was installed in 2000 (Figure 2-37). Monument P729 has experienced approximately 8 centimeters (3 inches) of subsidence since it was installed in 2007 (Figure 2-37). The subsidence measured at this monument reflects the combined effects of tectonic activity, groundwater withdrawals, and oil and gas withdrawals. Although these effects cannot be separated in the recorded subsidence at this monument, the majority of the subsidence at monument P729 has occurred since 2012, coincident with a period of drought, and with reduced surface water spreading in the Forebay area of the Oxnard Subbasin to the northwest of this monument.

DWR designated the LPVB as an area that has a medium to low potential for future subsidence. 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 (USGS 2003).

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 LPVB area.

2.3.6 Groundwater–Surface Water Connections

2.3.6.1 West Las Posas Management Area

There are no surface water bodies that are considered to be major contributors to groundwater in the WLPMA.

2.3.6.2 East Las Posas Management Area

Arroyo Simi and Arroyo Las Posas have been identified as surface water bodies that may have a connection to groundwater in the ELPMA. Dry weather flows in Arroyo Simi–Las Posas are the result of discharge from the SVWQCP, dewatering wells operated by the City of Simi Valley, and discharges from the MWTP percolation ponds adjacent to Arroyo Simi–Las Posas. During a study conducted in 2011 and 2012, gauges along Arroyo Simi–Las Posas were used to identify gaining and losing sections along the stream (CMWD 2012, 2013; Figure 2-16). Overall, the study identified an average yearly net loss from Arroyo Simi–Las Posas to groundwater of approximately 10,187 AFY.

2.3.7 Groundwater-Dependent Ecosystems

Arroyo Simi–Las Posas is the dominant surface water body in the LPVB. The watershed for Arroyo Simi–Las Posas extends beyond the boundaries of the LPVB. Examination of available County's air photos indicated that Arroyo Simi–Las Posas in the LPVB was dry without adjacent vegetation before the 1970s. Within LPVB, flow in Arroyo Simi–Las Posas has been perennial since the 1970s. Flow in Arroyo Simi–Las Posas is from both native and non-native flow sources (Bachman 2016; Las Posas Users Group 2012). The non-native flows consist of discharges from the SVWQCP, dewatering wells operated by the City of Simi Valley, and discharges from the MWTP percolation ponds adjacent to Arroyo Simi–Las Posas (Bachman 2016; Las Posas Users Group 2012). Irrigation water from agriculture and/or landscaping may also serve as a source of flow in the channel during some parts of the year.

Arroyo Simi–Las Posas was identified as a potential groundwater-dependent ecosystem (GDE) on the statewide potential GDE map (Figure 2-38, Potential Groundwater-Dependent Ecosystems for the Las Posas Valley Basin; Appendix I, The Nature Conservancy GDE Tech Memo). ~~However, the riparian vegetation in the Arroyo Simi Las Posas composing these potential GDEs was established and is maintained by discharges from wastewater plants and Simi Valley dewatering discharges to Arroyo Simi.~~ The connection between Arroyo Simi–Las Posas and the underlying Shallow Alluvial Aquifer varies with location in the ELPMA (CMWD 2012, 2013). Arroyo Simi–Las Posas is a losing stream from upstream of the basin boundary to approximately Leta Yancy Road in Moorpark, at which point it becomes a gaining stream to approximately a mile downstream of the MWTP (CMWD 2012, 2013). ~~The gaining reach is caused by surface water that is~~

resurfacing rather than by discharge of native groundwater (CMWD 2012, 2013). Downstream from this point, Arroyo Simi–Las Posas is a losing stream again, extending into the PVB to the south (Figure 2-16). Currently, perennial flow in Arroyo Simi–Las Posas ends upstream of the boundary between the LPVB and PVB, although in the past, perennial flow has reached the PVB. During 2014 and 2015, which were both drought years, the terminus of perennial flow retreated upstream (CMWD 2015, 2016d).

The Arroyo Simi–Las Posas potential GDE ranges from natural channel consisting of riparian woodland/wetland habitat (Caltrans 1987) to a confined channel with riprap on the sides and a soft bottom that is maintained in a largely vegetation-free state by the VCWPD (Appendix I). In the natural areas of the stream channels, the active channel generally supports a dense canopy of vegetation, although winter storm events can scour the active channel and mid- to lower terraces, leaving some areas free of vegetation for extended periods of time (VCWPD and Aspen Environmental Group 2013a).

The Basin Plan (LARWQCB 2014) for Arroyo Simi–Las Posas lists the following beneficial uses: groundwater recharge, warm freshwater habitat, cold freshwater habitat (potential), wildlife habitat, and freshwater replenishment. Arroyo Simi–Las Posas provides habitat for the state- and federally listed endangered least Bell's vireo (*Vireo bellii pusillus*) and supports the native arroyo chub (*Gila orcuttii*), southwestern pond turtle (*Actinemys pallida*), and the San Diego desert woodrat (*Neotoma lepida intermedia)* (CDFW 2017). Additionally, in the Virginia Colony Area, which is outside the FCGMA jurisdictional boundary but within the LPVB boundary, the GDE supports the federally threatened California gnatcatcher (*Polioptila californica californica*) (VCWPD and Aspen Environmental Group 2013b).

The depth to groundwater in Shallow Alluvial Aquifer wells adjacent to Arroyo Simi–Las Posas varies from less than 5 feet in Well 02N19W07K04S to more than 80 feet in Well 02N20W17J06S (Figure 2-39, Depth to Water in the Shallow Alluvial Aquifer). The depth to groundwater reported is what was measured in the wells. However, few of the wells screened in the Shallow Alluvial Aquifer lie within the boundaries of the potential GDE, and the measuring point for these wells is at a higher elevation than it would be if the well were located closer to Arroyo Simi–Las Posas. For instance, the ground surface elevation at Well 02N20W17J06S is approximately 274 feet msl. The elevation of the land surface in Arroyo Simi–Las Posas, approximately 300 feet to the southeast of Well 02N20W17J06S, is 30 feet lower than it is at the well. Therefore, the depth to groundwater within the potential GDE may be as much as 30 feet less than it is at Well 02N20W17J06S. Accounting for this difference in elevation, an approximate depth to water within the potential GDE is also shown on Figure 2-39. Using the approximate depth to water, Wells 02N19W07K04S, 02N20W17J06S, and 02N20W09Q08S may have groundwater elevations in the potential GDE that are less than 15 feet bgs (Figure 2-39). Therefore, the vegetation in the potential GDE may be supported by what is now shallow groundwater but was formerly surface water, which infiltrated through the sediments underlying Arroyo Simi–Las Posas. As described above, this process, which elevated groundwater levels in in the Shallow Alluvial Aquifer, is primarily the result of non-native surface water flows that have recharged the Shallow Alluvial Aquifer over time.

Wastewater recycling at the SVWQCP, which is one of the primary sources of surface water flow to Arroyo Simi–Las Posas, is anticipated to decrease surface water flows and recharge to the aquifer in the future. This potential change may negatively impact the potential GDE. Such a change, however, is unrelated to groundwater production from the Shallow Alluvial Aquifer, and is outside the jurisdictional powers of FCGMA to prevent. Better understanding of the hydrology along Arroyo Simi–Las Posas would aid in determining the impacts of decreasing groundwater levels on the riparian habitat and the potential for groundwater production to contribute to decreasing groundwater levels. ~~Until a connection between groundwater elevations under native flow conditions and the potential GDE is established, the Arroyo Simi–Las Posas potential GDE cannot be conclusively determined to be a GDE.~~ The future monitoring network should include wells dedicated to monitoring water levels in the potential GDE to assess the degree to which existing habitat is reliant on groundwater under native flow conditions.

2.3.8 Potential Recharge Areas

To evaluate potential future recharge areas within the LPVB, soil types were obtained from the Web Soil Survey (USDA 2019). Soil Ksat rates (saturated hydraulic conductivity rates) for soils of 92 micrometers per second or greater were plotted. Figure 2-40, Las Posas 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 Simi–Las Posas, along the north–south drainage at the eastern FCGMA boundary, and along small drainages north of Moorpark (Figure 2-40).

2.4 WATER BUDGET

This section presents the water budgets that have been prepared for the aquifer systems in the LPVB. These water budgets were completed in accordance with the DWR GSP Regulations. Separate water budgets were prepared for the WLPMA and ELPMA. The WLPMA and ELPMA water budgets were prepared for the 31-year period from 1985 through 2015, and are described in units of AF or AFY.

CMWD (Appendix C) developed the Groundwater Flow Model of the East and South Las Posas Sub-Basins, a MODFLOW numerical groundwater flow model, for the ELPMA of the LPVB. The groundwater budget analysis for the ELPMA is based on the 2016 modifications to the DWR Bulletin 118 basin boundary for the LPVB east of the Somis Fault (Central Las Posas Fault) as shown on Figure 2-2. As with all groundwater flow models, the CMWD model has undergone 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 September 2018, which was developed to support the GSP process. This version of the model was used for the ELPMA 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.

UWCD (Appendix E) developed the Ventura Regional Groundwater Flow Model, a MODFLOW numerical groundwater flow model, for the Oxnard Subbasin, the Mound Basin, the WLPMA, and the PVB. The groundwater budget analysis for the WLPMA are based on the 2016 modifications to the DWR Bulletin 118 basin boundary for the LPVB west of the Somis Fault (Central Las Posas Fault), as shown on Figure 2-2. 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 to support the GSP process. This version of the model was used for the current and historical WLPMA water budget analysis as well as for the future projected groundwater scenarios discussed in Section 2.4.5.

2.4.1 Sources of Water

The LPVB receives water from several water sources. Native sources consist predominantly of rainfall infiltration within the LPVB and along its margins (mountain-front recharge), including stormwater runoff from tributary canyons, subsurface inflows to the ELPMA from adjacent Simi Valley, and groundwater inflow to the WLPMA from the Oxnard Subbasin.

Water sources from human activities provide additional sources of water to the LPVB. These consist of deep percolation of a portion of the irrigation water that is applied to both agricultural and landscaped lands (i.e., irrigation return flows), leakage from water distribution systems, periodic direct injection of imported water at CMWD's ASR wellfield, percolation of treated wastewater from the MWTP, septic system discharges, percolation of treated wastewater from the SVWQCP discharged to Arroyo Simi, and percolation of pumping groundwater from Simi Valley dewatering discharged to Arroyo Simi.

Imported water supplies consist of imported Metropolitan Water District of Southern California water provided by the CMWD~~,~~ and a bl~~i~~end of CMWD-~~-~~supplied water (State Water Project or Colorado River water), Conejo Creek water, and/or pumped groundwater supplied by the Camrosa Water District from the PVB and Arroyo Santa Rosa Valley Basin.

Twenty-three water purveyors have service areas located wholly or partially within the LPVB (Figure 1-8). Eight of these water purveyors import some portion of their water through CMWD, while the rest of their water supply for service areas within the LPVB comes from pumped groundwater and, in the case of one purveyor, Ventura County Waterworks District (VCWD) No. 1, recycled water. The remaining 15 water purveyors provide exclusively groundwater to their service areas. The sources of water supplied by each water purveyor are summarized in Table 2-5.

2.4.1.1 Surface Water Flows

The Arroyo Simi–Las Posas is the lone perennial stream in the ELPMA. There are no permitted surface water diversions in the LPVB. In addition to storm flows, Arroyo Simi–Las Posas receives inflow from discharges in Simi Valley, which is located immediately upstream (east) of the LPVB (Figure 2-41, Las Posas Valley Basin Stream Gauges and Water Infrastructure). These dry-weather flows occur as discharges from the SVWQCP, dewatering wells, minor amounts of urban runoff, and natural groundwater discharges at the west end of Simi Valley. SVWQCP discharges and Simi Valley dewatering amounts are listed in Table 2-6. Discharge from the SVWQCP are estimated to have averaged 9,936 AFY from 1985 to 2015, and ranged from 8,506 to 11,171 AFY (Table 2-6). Discharge from Simi Valley dewatering operations are estimated to have averaged 1,618 AFY from 1985 to 2015, ranging between 0 to 1,949 AFY (Table 2-6).

In addition to the dry-weather SVWQCP and Simi Valley dewatering inflows, this creek system receives dry-weather (non-storm) inflows from seepage percolation of treated wastewater from the MWTP infiltration ponds. These percolation ponds have been active since at least 1960, and in 2015 they percolated 1,635 AF of secondary-treated wastewater into the ELPMA. Table 2-6 shows the amounts of secondary-treated wastewater percolated in these ponds since 1985. In 2001 and 2002, the MWTP also released 1,647 and 1,613 AF of tertiary-treated wastewater into Arroyo Simi–Las Posas. Figure 2-42, Wastewater Treatment Plant Discharges and Flows from Simi Valley, shows the amounts of MWTP discharges and Simi Valley inflows from 1985 to 2015.

Recharge from Surface Water

West Las Posas Management Area

Beardsley Wash in the WLPMA was discussed in the UWCD model (Appendix E) as a channel that could convey stormwater and agricultural return flows from the WLPMA to the Mugu Lagoon area in the Oxnard Subbasin. The UWCD model report states that Beardsley Wash in the western part of the WLPMA is likely to have had some sort of drainage system in place to reduce soil alkalinity and prevent waterlogging of the root zone for crops. Thus, no recharge from Beardsley Wash was calculated in the UWCD model in the WLPMA.

East Las Posas Management Area

In 2011 and 2012, Larry Walker & Associates (LWA) conducted dry-weather gauging along Arroyo Simi–Las Posas to evaluate streambed percolation for CMWD (CMWD 2012, 2013). The gauging locations (G1 to G11) used in the study are shown on Figure 2-41. LWA generally observed losing conditions from G1 to G4 and from G7 to G11, and gaining conditions from G4 to G7. Field studies have observed that the dry-weather discharge in Arroyo Simi–Las Posas during the current drought years ends before the stream exits the ELPMA; therefore, effluent discharge was observed to percolate, evaporate, or be transpired within the extent of the ELPMA.

The CMWD groundwater model (Appendix C) used these LWA reaches to estimate focused recharge from percolation of streamflow in Arroyo Simi–Las Posas for baseflow conditions. The baseflow focused recharge was estimated by scaling reach-specific streamflow differences measured by LWA to either (1) annual SVWQCP discharge to Arroyo Simi–Las Posas or (2) annual discharge to the Moorpark percolation ponds, depending on the location of the reach (Appendix C). Recharge from stormflow conditions when runoff and tributary inflows reach Arroyo Simi–Las Posas, which typically only occurs during the winter or during heavy periods of rain was not estimated because of the lack of stream gauging information and that the previous geochemical study by Izbicki and Martin (USGS 1997) reported that the tritium composition of groundwater in wells in the LPVB (the absence of tritium), that recharge from infiltration of runoff from intermittent streams was not an important source of recharge to the LAS (Appendix C). Additionally, much of the tributary inflows to Arroyo Simi–Las Posas is expected to leave the ELPMA as streamflow. Bachman (2016) analyzed baseflow and stormflow at the VCWPD Hitch gauge (Figure 2-41; 841 and 841A) from 1994 through 2010 and determined that about half the flow in the arroyo was baseflow and half was stormflow.

The CMWD groundwater model (Appendix C) estimated that the average inflow to the ELPMA from the percolation of Arroyo Simi–Las Posas from 1985 to 2015 was 13,966 AFY and ranged from 11,406 AFY to 19,241 AFY (Table 2-7).

2.4.1.2 CMWD Imported Water Supplies

CMWD sells imported water to eight water purveyors (Table 2-5) located within their service area. CMWD has also provided imported water to purveyors located within the LPVB for use in- lieu of groundwater pumping (Section 2.4.1.4, CMWD ASR Project and In-Lieu Storage Program). Table 2-8 indicates the volume of CMWD imported water delivered to water purveyors and used in the WLPMA and ELPMA. Figure 2-43, Imported Water Deliveries, indicates the amounts of imported water provided from 1985 to 2015. In addition, CMWD uses some imported water for their ASR project where imported water is injected into the aquifer system in the ELPMA (Section 2.4.1.4).

2.4.1.3 Other Water Supplies

Table 2-9 indicates the volume of recycled water that MWTP provides for municipal and industrial (M&I) use, and the volume of groundwater that Camrosa Water District provides that was extracted from the PVB and Arroyo Santa Rosa Valley Basin for agricultural and M&I uses in the LPVB. Additionally, since 2008, Camrosa Water District has provided some nonpotable surface water (Conejo Creek Project) for agricultural use to the ELPMA. Figure 2-44, Other Water Sources, shows the volume of other water supplies from 1985 to 2015.

Recharge from Imported and Other Water Supplies

Return flows from imported and other water supplies were calculated for both the WLPMA and ELPMA by the UWCD and CMWD models respectively. In urban settings, outdoor water use may percolate to groundwater if water remains after ET and runoff losses. In the model areas, M&I outdoor water use is predominantly used for irrigation of landscape vegetation, but may also include car washing, the filling of swimming pools and other uses. Recharge from M&I return flows are presented here with imported water and other water supplies for the LPVB, but some of this M&I return flow water is from urban use of pumped groundwater as noted by the water purveyors that use groundwater (Table 2-5).

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Table 2-10a and Table 2-10b provide the estimated recharge for the WLPMA shallow aquifer system and LAS, respectively. The recharge shown in Tables 2-10a and 2-10b includes recharge from precipitation, M&I return flows, and agricultural return flows. Table 2-11 shows the estimated recharge from M&I uses in the WLPMA from the UWCD model. The average calendar-year recharge from M&I from 1985 to 2015 was 1,225 AFY, which is about 18.6% of the total average recharge (6,597 AFY) shown in Table 2-11.

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In the ELPMA, most of the M&I water use is derived from imported water (Appendix C). Of the M&I water use, 65% was assumed to occur outdoors for irrigation and 10.5% of the outdoor use was assumed to percolate to groundwater. For the water budget period of 1985 to 2015, the average annual M&I return flow was 666 AF (Appendix C, p. 39).

As noted in the CMWD report (Appendix C) the question of whether return flows from the irrigation of agricultural lands (or M&I return flows here) have arrived at the water table should be considered. These return flow arrivals are based on the depth to the groundwater table and the permeability of the sediments between the land surface and the groundwater table. Isotopic groundwater studies by Izbicki and Martin (USGS 1997) suggest that return flows occurring above the Shallow Alluvial Aquifer and the Epworth Gravels Aquifer could have arrived at the water table based on estimated travel time. However, return flows occurring above the USP may not have reached the water table in areas where the water table is deep (more than 200 feet bgs) and overlain by clay confining beds.

2.4.1.4 CMWD ASR Project and In-Lieu Storage Program

CMWD has injected imported water into the ELPMA since 1993 through their ASR program. Table 2-12 shows the net annual injected amounts reported by the CMWD for the wells shown on Figure 2-41, and Table 2-7 provides the amounts of ASR water injected per year. The CMWD ASR project has also included delivery of imported water to LPVB users in- lieu of groundwater pumping in both the WLPMA and the ELPMA. Under this FCGMA-approved program, CMWD is credited an acre-foot of storage for every acre-foot of water that is delivered in lieu of pumping. Table 2-12 also shows the cumulative amount of CMWD water in storage in 2015 for their ASR project and in-lieu storage program. As of 2015, the CMWD had 25,192 AF stored in the WLPMA and 11,398 AF in the ELPMA, largely from in-lieu credits, for a total of 36,590 AF in the LPVB. Figure 2-45, CMWD ASR and In-Lieu Water, shows the amounts of ASR and in-lieu water provided to the LPVB from 1985 to 2015.

2.4.1.5 Percolation of Precipitation

Much of the rain that falls in the LPVB quickly returns to the atmosphere via evaporation, or runs off to creeks; the remainder percolates into the soil, where it is subject to ET, soil absorption, or plant use. 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. Thus, estimates of the percolation of precipitation are subject to substantial uncertainty.

West Las Posas Valley Management Area

UWCD downloaded monthly precipitation data for 180 rainfall gauge stations across the model domain from VCWPD (at http://www.vcwatershed.net/hydrodata/) (Appendix E, 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 included with recharge in Table 2-10a and Table 2-10b, but identified individually in Table 2-11. Of the average annual recharge shown in Table 2-11 (6,597 AFY), percolation of precipitation accounts for 3,875 AFY, or 58.7%.

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For the ELPMA, the CMWD model (Appendix C) calculated recharge using a two-step approach with two datasets. The first dataset was the Basin Characterization Model (BCM), a publicly available dataset for California. The BCM calculates the groundwater water balance for grid cells that simulate physical processes like snow accumulation, snowmelt, sublimation, and potential evaporation. CMWD did not use precipitation gauge data in the BCM model; instead, recharge was scaled by using precipitation data and the BCM dataset to produce estimates of recharge for the water budget. The Somis-Bard gauge (Station 190 on Figure 1-3) in the eastern portion of the WLPMA was used to linearly scale the average precipitation and average recharge from the BCM to provide a time series of recharge in the model area.

Precipitation Recharge

Groundwater recharge from precipitation was found to be highly variable over time, and the average annual recharge from precipitation between 1985 and 2015 was 5,119 AF (Appendix C, p. 40). Recharge from precipitation is included with "recharge except Arroyo Simi–Las Posas (includes MWTP)" in Table 2-7.

2.4.1.6 Basin Groundwater Subsurface Inflow and Outflow

Subsurface groundwater flow between the WLPMA and the adjacent Oxnard Subbasin and the PVB were provided by the UWCD groundwater numerical model, and are included in Table 2-10a and Table 2-10b. Groundwater flows occur between the WLPMA and the PVB in the shallow layers mostly because of mounding in the Camarillo area since about 1992 (Table 2-10a), and in the deep layers of the model east of the fault barrier between the basins near Highway 101. The UWCD model did not have subsurface flow between the ELPMA and the WLPMA. However, the CMWD model has subsurface flows from 104 AFY to 146 AFY from the ELPMA to the WLPMA (Table 2-7).

The CMWD model has subsurface inflows from the Simi Valley Basin, which were not estimated separately from total subsurface inflows into the ELPMA shown in Table 2-7. However, the groundwater subsurface inflows from the Simi Basin were estimated by Todd Groundwater (2016), and are considered to be minor and were assumed to be 100 AFY, as cited in the Simi Valley groundwater resources study (Todd Groundwater 2016). The CWMD model report found that this amount is consistent with the State Water Resources Control Board (SWRCB) finding of 100 AFY, but more than the 5 AFY calculated based on a hydraulic gradient of 0.005 feet/feet, the 1,000-foot width of the floodplain, a saturated alluvium thickness of 5 feet, and a hydraulic conductivity of 25 feet/day (Appendix C, p. 45).

Groundwater outflows to the PVB from the ELPMA were estimated from the CMWD model. These values are generally close to the initial values provided UWCD for inflows to the PVB from the ELPMA during model development, but are generally about 130 AFY or 8% higher.

2.4.1.7 Mountain-Front Recharge

West Las Posas Management Area

In the UWCD model, the mountain-front recharge is calculated based on the upstream watershed area, the precipitation intensity, and a fixed recharge ratio of 10%. Mountain-front recharge from the UWCD model is shown as recharge from USP outcrops in Table 2-10b for the WLPMA LAS. The mountain-front recharge averaged 1,734 AFY, with a range from 103 to 4,066 AFY from 1985–2015.

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In the CMWD model mountain-front recharge is included with inflow at basin boundary in Table 2-7. The inflow at the ELPMA basin boundary averaged 2,052 AFY from 1985 to 2015 and ranged from 1,795 AFY to 2,581 AFY (Table 2-7).

2.4.1.8 Septic Systems Recharge

The number and location of septic systems in the LPVB were estimated by DBS&A (2017) based on the Ventura County septic database (Ventura County Environmental Health Division 2017). If septic systems were present within any parcel within a tract, it was assumed that all parcels in the tract contained septic systems.

Household water use and annual disposal were estimated to decrease from 0.21 AFY per system for 1985 to 1997, to 0.20 AFY per system for 1988 to 2010, and to 0.16 AFY per system from 1998 to 2015 based on DeOreo and Mayer (2012, as cited in DBS&A 2017).

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The resulting percolation for the WLPMA from all septic systems was estimated to decrease from 463 AFY in 1985 to 341 AFY in 2015 (DBS&A, 2017). The UWCD groundwater model (Appendix E) 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.

East Las Posas Management Area

The CMWD model used the following assumptions to estimate septic system return flows for the ELPMA (Appendix C, p. 40):

- In the VCWD No. 1 (Moorpark) area, it was assumed that only the residences outside of the city limits use septic systems, and for VCWD No. 19 (Somis), it was assumed that 100% of the residences use septic systems, and none of the residences are connected to sewers. It was further assumed that only 30% of the septic usage in VCWD No. 19 occurs within the ELPMA.
- The estimated value for the residential water demand (146.4 gallons per capita per day) and household size (3.31 people) were used to produce an average household water use of 0.54 AFY. Assuming 35% of the water demand is for indoor use and 100% of the indoor use returns to the groundwater system, then 0.19 AFY per septic system would be available for percolation.

The result was that the water budget estimated septic system return flow was 385 AF in 1985 and decreased to 317 AF in 2015. The average annual septic system return flow was estimated as 374 AF over the water budget period. For comparison, the resulting percolation for the ELPMA from all septic system was estimated to decrease from 210 AFY in 1985 to 155 AFY in 2015 by DBS&A (2017).

2.4.1.9 Recharge from Water System Losses

West Las Posas Management Area

Recharge from leakage of water delivery systems was assumed to be 5% of all deliveries (Sharp 2010, as cited in DBS&A 2017). Using 5% of the total average water delivery values in Table 2-8, the estimated leakage of water delivery systems for the WLPMA is 61 AFY (1,212 AFY × 0.05). The UWCD groundwater model (Appendix E) did not consider water system losses as a distinct source of water separate from other urban return flows.

East Las Posas Management Area

For the CMWD model, over the water budget period of 1985 to 2015, the average annual percolation from distribution systems was estimated as 498 AF. Using 5% of the total average water delivery values in Tables 2-8 and 2-9, the estimated leakage of water delivery systems for the ELPMA is 480 AFY ([9,300 AFY + 300 AFY] × 0.05).

2.4.1.10 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. Water applied to the cropland surface may percolate below the root zone and reach the groundwater if the applied water is not consumed by vegetation. The source of agricultural return flows may include both pumped groundwater and imported water from outside of the basin.

West Las Posas Management Area

The UWCD groundwater model used extracted groundwater from wells, which was applied to irrigated land, and assumed an agricultural return flow of 14%. If the precipitation was more than 1 inch per month, the agricultural return flow ratio was compared with the precipitation recharge ratio. If the precipitation recharge ratio was larger than 14%, the agricultural return flow ratio was replaced by the precipitation recharge ratio.

Recharge from the agricultural return flow is included with recharge in Tables 2-10a and 2-10b, and identified individually in Table 2-11. Of the average annual recharge shown in Table 2-11 (6,597 AFY), agricultural return flow accounts for 1,497 AFY, or 22.7%.

East Las Posas Management Area

The CMWD model used the preliminary draft LPVB GSP water budget prepared for FCGMA (Dudek 2017), and the results of the DBS&A (2017) Distributed Parameter Watershed Model, which is run with daily time steps, to estimate the groundwater budget the ELPMA. From the Distributed Parameter Watershed Model, the average agriculture return flows was 10.5% of the average applied water for agriculture uses in the ELPMA during the period from 1985 to 2015 (DBS&A 2017). The CMWD model applied this return flow rate to the annual applied water for agricultural uses tabulated by Dudek (2017) and estimates average annual agricultural return flows of 2,117 AFY in the ELPMA over the water budget period of 1985 to 2015 (Appendix C, p. 39). An average annual agricultural return flow of 2,117 AFY is about 8% of the estimated total of 27,276 AFY shown in Table 2-7.

As noted in Section 2.4.1.3, Other Water Supplies, there is some question as to whether return flows from M&I and the irrigation of agricultural lands have arrived at the groundwater table. These return flow rates are based on the depth to the groundwater table and the permeability of the sediments between the land surface and the groundwater table. Isotopic groundwater studies by Izbicki and Martin (USGS 1997) suggest that return flows occurring above the USP may not have reached the groundwater table in areas where the groundwater table is deep (more than 200 feet bgs) and overlain by clay confining beds.

2.4.2 Sources of Water Discharge

Sources of groundwater discharge predominantly include groundwater pumping and ET. Groundwater pumped and used for agricultural, M&I, and domestic purposes can produce return flows, and subsurface groundwater flows (interbasin flows) can discharge groundwater from the LPVB to the adjacent groundwater (Section 2.4.1.6, Basin Groundwater Subsurface Inflow and Outflow).

2.4.2.1 Groundwater Pumping

Tables 2-13 and 2-14 summarize the estimated historical volumes of groundwater pumped during the 31-year period for the WLPMA and ELPMA for agricultural, M&I, and domestic use, by aquifer. The estimated pumping type percentages (agricultural, M&I, and domestic) were determined from semi-annual groundwater extraction reports to the FCGMA, and the groundwater amounts extracted by aquifer are from the UWCD model results (Appendix E for the WLPMA) and the CMWD (Appendix C for the ELPMA) model results. Figures 2-46 through 2-49 indicate the volume of agricultural, M&I, domestic, and total groundwater pumping in the ELPMA. Figure 2-50, WLPMA Total Groundwater Pumping, indicates the total volumes of agricultural, M&I, and domestic groundwater pumped and the total groundwater pumping by the shallow aquifer system and LAS in the WLPMA. Additional wells are present within the basin yet outside the FCGMA boundary, for which no pumping is reported. However, only a few wells are located outside the FCGMA boundary, so the volume of groundwater pumping from these wells should be minor. The pumping spike in 2007–2010 is due to CMWD ASR M&I pumping (Figure 2-17).

West Las Posas Management Area

The WLPMA contains 100 known wells, of which, 70 are in active use, 20 are destroyed, and 10 are inactive. During calendar year 2015, the UWCD model groundwater pumping totaled 16,383 AF, 85% of which was for agricultural use (13,887 AF), about 15% for municipal and industrial use (2,496 AF), and less than 1% for domestic use (1 AF) (Table 2-14).

East Las Posas Management Area

The ELPMA contains 248 known wells, of which 161 are in active use, 30 are destroyed, 50 are inactive, and 7 cannot be located. During calendar year 2015, the CMWD model pumping totaled 23,858 AF, 91% of which was for agricultural use (21,810 AF), about 8% for municipal and industrial use (2,025 AF), and less than 1% for domestic use (23 AF) (Table 2-14).

2.4.2.2 Riparian Evapotranspiration Losses

Riparian ET of groundwater by vegetation occurs when the water table is near the land surface and roots can penetrate the saturated zone below the water table allowing vegetation to directly transpire water from the groundwater system.

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As noted in Section 2.3.6.1 (see Section 2.3.6, Groundwater–Surface Water Connections), there are no surface water bodies that are considered to be major contributors to groundwater in the WLPMA, and the UWCD model (Appendix E) did not simulate any ET for the WLPMA.

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ET losses from deep-rooted vegetation (phreatophytes) occur near Arroyo Simi–Las Posas in riparian areas where groundwater is near land surface. In Arroyo Simi–Las Posas riparian areas, a common non-native phreatophyte is *Arundo donax* (Arundo; also known as giant reed, giant cane), which has a high rate of water use as well as other native phreatophytes (Appendix C; Appendix I). Arundo and other phreatophytes are common in many coastal watersheds in Southern California. ~~Consumptive water use by Arundo has been estimated to be as high as 24 acre-feet per acre.~~ The CMWD model (Appendix C) estimated the loss by ET from Arroyo Simi–Las Posas riparian areas~~,~~ ~~using the consumptive water use by Arundo of 24 acre-feet per acre~~. Because Arundo may annually consume~~s~~ about 6 times as much water as other phreatophytes and detailed mapping of Arundo is available in the basin, the CMWD model assumed that all riparian vegetation was Arundo to simplify estimates of groundwater ET for the water budget.

Because the consumptive use of water by phreatophytes varies over time in response to factors like air temperature, precipitation, and wind speed, the water consumption use was estimated using an annual average reference ET (ETo) value from the California Irrigation Management Information System (CIMIS) and the average crop coefficient of 1.26 for Arundo (Appendix C). Table 2-7~~8~~ shows the CMWD results for riparian ET. The average for calendar years 1985 to 2015 is 1,062 AFY with a range from 693 AFY to 1,236 AFY.

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 31- 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). Figure 2-26 shows the water year type from 1985 to 2015. The water year type for 2015 is dry.

2.4.3.2 Historical Conditions

DWR has designated the LPVB as a high-priority basin. DWR GSP Regulations, Section 354.18, Water Budget, states: "If overdraft conditions occur, as defined in Bulletin 118, the water budget shall include a quantification of overdraft over a period of years during which water year and water supply conditions approximate average conditions." Bulletin 118 Interim Update 2016 (DWR 2016) does not list the LPVB as being in critical overdraft. Although Bulletin 118 does not list the LPVB as being in critical overdraft, and GSP Regulations Section 354.18(b)(5) does not require a quantification of the overdraft over a period of years during which water years and water supply conditions approximated average conditions, this type of analysis for the WLPMA and ELPMA is useful in evaluating historical conditions for the WLPMA and ELPMA.

West Las Posas Management Area

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 in the WLPMA: 1988, 1991, 1992, 1994, 1996, 1997, 2000, 2001, 2003, 2006, 2008, 2010, and 2011 (see Figure 2-26).

The average change in groundwater storage for these calendar years in the shallow aquifer system was an increase of 292 AFY. Groundwater pumping averaged 1,346 AFY and the recharge was 5,652 AFY. The average change in groundwater storage for these calendar years in the LAS was a decrease of 263 AFY. Groundwater pumping averaged 13,274 AFY and the recharge was 1,372 AFY. The LAS received 8,852 AFY of water from the shallow aquifer system during these years. However, the WLPMA also received 25,192 AF of in-lieu water from the CMWD between 1995 and 2011, or an average of 1,023 AFY for the near average condition years (Table 2-~~13~~12). This would suggest that the total change in storage during these years was actually a decrease of 994 AFY.

East Las Posas Management Area

Using the water year types discussed in Section 2.4.3.1, 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 in the ELPMA: 1988, 1991, 1992, 1994, 1996, 1997, 2000, 2001, 2003, 2006, 2008, 2010, and 2011 (the same as for the WLPMA; see Figure 2-28). It should be noted here again that as discussed in Section 2.3, Groundwater Conditions; Section 2.4.1.3, Other Water Supplies; and Section 2.4.1.10, Percolation of Agricultural Irrigation Water (Agricultural Return Flows), the USP is unsaturated over a significant thickness and many of the wells in the ELPMA do not show groundwater levels that correlate with recharge and that are independent of climatic cycles (Section 2.3). Most of the wells in the WLPMA do show at least some correlation with recharge and the climatic cycles.

The average change in groundwater storage for these calendar years in the ELPMA and Epworth Gravels Management Area combined was an increase of 4,959 AFY. Groundwater pumping for both the ELPMA and Epworth Gravels Management Area averaged 18,487 AFY and the recharge was a total of 24,932 AFY. During average conditions, the net change in groundwater storage for the ELPMA alone was an increase of 4,638 AFY and groundwater pumping averaged 17,283 AFY during these calendar years. However, the ELPMA also received an average of 1,023 AFY of in-lieu water from the CMWD during these years and an average of 559 AFY of ASR water (Table 2-8 and Table 2-1312). This would suggest that the total change in storage during these years was an increase of 3,377 AFY.

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Using the water year types discussed in Section 2.4.3.1, and the above-normal (> 100% to <150% of average) and 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 in the Epworth Gravels Management Area: 1988, 1991, 1992, 1994, 1996, 1997, 2000, 2001, 2003, 2006, 2008, 2010, and 2011. The average change in groundwater storage for these calendar years in the Epworth Gravels Management Area was an increase of 184 AFY. Groundwater pumping during these years averaged 1,203 AFY.

2.4.3.3 Current (2015) Las Posas Valley Basin Conditions

Current (2015) condition of the LPVB indicates that total groundwater outflows were larger than total groundwater inflows for both the WLPMA and ELPMA, which show an imbalance of 11,966 AF and 3,171 AF, respectively (Tables 2-78, 2-11a10a, and 2-11b10b,). According to groundwater inflow and outflow estimates (Table 2-78), the ELPMA has shown groundwater outflows greater than groundwater inflow since about 2012, a period that corresponds to the current drought as shown on Figure 1-6. The major source of groundwater recharge to the ELPMA is recycled water from the SVWQCP, which has increased the TDS (Section 2.3.4, Groundwater Quality) in portions of the ELPMA.

Groundwater inflow and outflow estimates (Tables 2-~~11a~~ 10a and 2-~~11b~~10b) for the WLPMA have shown a groundwater outflow greater than groundwater inflow since about 2011, a period that corresponds to the current drought shown on Figure 1-6. Figure 2-27 shows that groundwater storage has declined since about 2011.

Since 1995, both the WLPMA (until 2007) and the ELPMA had in-lieu water deliveries, and the ELPMA has had ASR injection water, which may have kept groundwater levels and storage from declining. As of 2015, the CMWD has 36,590 AF in cumulative storage in the LPVB, of which, 25,192 AF is in the WLPMA, and 11,398 AF in the ELPMA (Table 2-~~13~~12). Groundwater levels and storage would be lower if CMWD cumulative storage were removed.

2.4.3.4 Estimates of Sustainable Yield

GSP Regulations Section 354.18(b)(7) states that an estimate of the historical sustainable yield for the basin shall be quantified in the water budget for the basin GSP.

The Final Draft Las Posas Basin-Specific Groundwater Management Plan (Las Posas Users Group 2012, pp. 39–40) put the total operational yield of the WLPMA at 11,000 AFY, and 18,000 to 19,000 AFY for the ELPMA.

For this GSP, the water budget estimate for the historical sustainable yield was based on the average groundwater inflows from 1985 to 2015 in Tables 2-10a and 2-10b, ~~and~~ excluded the CMWD in-lieu deliveries (Table 2-12), and was adjusted for the storage changes (Tables 2-10a and 2-10b). This water budget analysis produced an estimated historical sustainable yield for the WLPMA from about 10,000 AFY to 11,000 AFY.

Using a similar approach to the ELPMA is more difficult. Using the average groundwater inflows from Arroyo Simi–Las Posas is reasonable, but estimating the recharge from the rest of the basin is problematic due to the time delay in the USP (see Sections 2.3, 2.4.1.3, and 2.4.1.10). Assuming all of the Arroyo Simi–Las Posas recharge (Table 2-7), and half of the total reported recharge except Arroyo Simi–Las Posas (Table 2-7) from 1985 to 2015, and excluding the CMWD in-lieu and ASR deliveries (Table 2-12), and then adjusting for the change in storage (Table 2-7), the estimated sustainable yield for the ELPMA would be about 17,000 AFY to 19,000 AFY.- Half of the reported recharge except Arroyo Simi–Las Posas was used because about half of the area can be recharged through outcrops of the Fox Canyon, Grimes Canyon, and Shallow Aquifer System. The other half is covered by the San Pedro Formation that limits direct recharge.

An evaluation of historical hydrographs for Epworth Gravels Aquifer Wells 03N19W29F06S and 03N19W30M02S from 1984 and 1990, respectively, suggests that the historical average Epworth Gravels Aquifer pumping rate of 1,290 AFY (Table 2-14) is sustainable. The uncertainty of this historical evaluation suggests that the sustainable yield of the Epworth Gravels is 1,290 AFY plus or minus approximately 200 AFY.

GSP Regulations Section 354.18(b)(7) states that an estimate of the sustainable yield for the basin shall be quantified in the water budget for the basin GSP.

The Final Draft Las Posas Basin-Specific Groundwater Management Plan (Las Posas Users Group 2012, pp. 39–40) put the total operational yield of the WLPMA at 11,000 AFY, and 18,000 to 19,000 AFY for the ELPMA. The WLPMA revised estimate was for the base period of 1997–1998 through 2011–2012. Based on the average groundwater inflows from 1985 to 2015 in Tables 2-11a and 2-11b, and excluding the CMWD in-lieu deliveries (Table 2-13), and adjusting for the storage declines (Tables 2-11a and 2-11b), the estimated sustainable yield for the WLPMA would be about 10,000 to 11,000 AFY.

Using a similar approach to the ELPMA is more difficult. Using the average groundwater inflows from Arroyo Simi–Las Posas is reasonable, but estimating the recharge from the basin's precipitation, M&I return flows and agricultural return flows is problematic due to the time delay in the USP (see Sections 2.3, 2.4.1.3, and 2.4.1.10). Assuming all of the Arroyo Simi–Las Posas recharge, and half of the total basin precipitation, M&I return flows, and agricultural return flows from 1985 to 2015 in Table 2-8, and excluding the CMWD in-lieu and ASR deliveries (Table 2-13), and then adjusting for the change in storage (Tables 2-8), the estimated sustainable yield for the ELPMA would be about 17,000 to 19,000 AFY.

An evaluation of historical hydrographs for Epworth Gravels Aquifer Wells 03N19W29F06S and 03N19W30M02S from 1984 and 1990, respectively, suggests that the historical average Epworth Gravels Aquifer pumping rate of 1,518 AFY (Table 2-14) is sustainable. The uncertainty of this historical evaluation suggests that the sustainable yield of the Epworth Gravels is 1,518 AFY plus or minus approximately 200 AFY.

2.4.4 General Uncertainties in the Water Budget

There are several limitations and uncertainties associated with other water budget terms used for both the historical and future conditions due to necessary simplifying of assumptions and data gaps. Uncertainties about the groundwater models used are discussed in Sections 2.4.5.1.8 and 2.4.5.2.6, 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 non-reporting, inaccurate reporting and equipment problems. Additional future data collection is needed to verify the existence and extent of and to eliminate this potential 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 or representative conditions. As shown on Figure 1-6, Long-Term Precipitation Trends in the LPVB, this was a generally wetter-than-average period. This could suggest that the estimated sustainable yield for the WLPMA in Section 2.4.3.4, Estimates of Sustainable Yield, is too high. Because much of the ELPMA is unaffected by climate cycles due to the long time delay from precipitation and agricultural and M&I return flows (Section 2.4.1.3), the wetter-than-average period for 1985 to 2015 may not have much effect on the estimated sustainable yield for the ELPMA in Section 2.4.3.4.

3. Conclusions regarding uncertainties in the UWCD model are discussed in Section 2.4.5.1.8.

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. Attempts to estimate 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. Some shallow groundwater in the southwestern portion of the WLPMA is potentially captured by tile drains, rather than recharging the UAS. Attempts to estimate 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. 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. Aquifer-specific water-level maps could be used to check groundwater model change in storage calculations. Dedicated monitoring wells could 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

2.4.5.1 West Las Posas Management Area

Several UWCD model scenarios were developed to assess the future sustainable yield of the WLPMA, the PVB, and the Oxnard Subbasin. Each future scenario covered a 50-year time frame, from 2020 to 2069, which is referred to as 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 for the WLPMA was determined from the model scenarios that did not contribute to 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 2-51, Coastal Flux from the UWCD Model Scenarios). Because groundwater production in the WLPMA has the potential to adversely affect the ability of the Oxnard Subbasin to achieve its GSP sustainability goals, groundwater production from the WLPMA was evaluated in the context of the modeled net flux of seawater into either the UAS or the LAS in the Oxnard Subbasin.

Because the WLPMA is hydraulically connected to the Oxnard Subbasin, the sustainable yield of the WLPMA is influenced by groundwater production and projects in the Oxnard Subbasin. The UWCD model used to assess the sustainable yield of the WLPMA, the Oxnard Subbasin, and the PVB 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 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 ~~the~~ UWCD using Santa Clara River flows for historical periods, the 1930—~~to~~ 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 account~~s~~ for current environmental restraints and diversion operating conditions, and optimization of water deliveries for the P~~PVP~~leasant Valley Pipeline and spreading basins. Additional details about the UWCD future model scenarios are included in Appendix L.

- 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 LAS in 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 of the 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 for the other modeling simulations conducted. Additional details about the selection of the two 50-year average climate cycles is provided in Section 2.4.5.1.7, 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.

2.4.5.1.1 Future Baseline Model Simulation

DWR regulations require 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 WLPMA, PVB and the Oxnard Subbasin were sustainable at their current rates, the average 2015–2017 production rates were simulated. For the WLPMA, this rate is approximately 13,000 AFY for the LAS and 1,000 for the shallow aquifer system.

Future Baseline Scenario Model Assumptions

The Future Baseline model simulation included the following:

- Constant pumping at the 2015–2017 average rate adjusted for surface water deliveries 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 LAS and 1,000 AFY from the shallow aquifer system.
- 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 ~~Creek~~ to the PVB from the CMWD model
- Projects that are currently operating in the model area 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 WLPMA or 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 Camarillo North Pleasant Valley Desalter (desalination) project and Conejo Creek Diversion deliveries to Pleasant Valley. 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. Additionally, pumping from Well 02N21W34C01 increased by 1,300 AFY to reflect a shift in areas of production.

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. Camrosa Water District will increase pumping by potentially 4,500 AFY based on credits for surface water delivered. In running the future simulations, it became apparent the cells identified for production from the Camrosa Water District wells were not able to extract the full amount. The amount of simulated pumping that was achievable in the future baseline simulation was 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 2-15 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 (Figure 2-51) and the particle tracks from the Future Baseline scenario indicate that continuing the 2015–2017 extraction rate for the WLPMA, PVB, and the Oxnard Subbasin over the next 50 years would allow net seawater intrusion in both the UAS and the LAS, as well as ongoing inland migration of the 2015 saline water impact front (FCGMA, 2019). 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 distribution of groundwater production at the extraction rates in the WLPMA, PVB, and the Oxnard Subbasin was determined not to be sustainable.

2.4.5.1.2 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 actually reduce pumping by the amounts specified at the wells specified 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 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 VCWD No. 19 Wells 02N20W06R01 and 02N20W08B01. The pumping reductions of 1,762 AFY were applied uniformly and proportionally across the wells. This projects is discussed in detail in Chapter 5, Projects and Management Actions, of this GSP.

In the PVB, a proposed temporary fallowing project was simulated near the pumping trough. 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.

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 Groundwater Recovery Enhancement and Treatment (GREAT) ~~p~~Program to increase spreading by 4,500 AFY in the Saticoy Spreading Grounds, and a 504 AFY reduction of pumping through 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 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 ~~p~~Program.

To simulate the expansion of the GREAT ~~p~~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.

After incorporating the potential future projects, the average groundwater production rate for the WLPMA LAS was 11,000 AFY and 1,000 AFY in the shallow aquifer system for a total of 12,000 AFY, with about 2,000 AFY of additional in- lieu of groundwater extraction (Table 2-15). In the PVB, the average was 4,300 AFY in the UAS and 7,600 AFY in the LAS. 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.

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 (Figure 2-51). 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 distribution of groundwater production at the extraction rates modeled in the Future Baseline With Projects scenario was determined not to be sustainable.

2.4.5.1.3 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 WLPMA, the shallow aquifer system simulated groundwater production rate in model year 2020, at the beginning of the implementation period, was 900 AFY. The production rate in model year 2040, at the beginning of the sustaining period, was 740 AFY.[3] The average production from the shallow aquifer system for the sustaining period was 750 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 11,000 AFY and the simulated groundwater production rate in model year 2040 was 8,600 AFY. The average production rate from the LAS for the

3 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 WLPMA and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate from the shallow aquifer system in 2040 is 82% of the extraction rate in 2020, rather than the 35% reduction specified in the model scenario description.

sustaining period was 8,600 AFY. Additionally, approximately 2,000 AFY of water was delivered in lieu of groundwater extraction (Table 2-15).

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 (Figure 2-51). 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.

2.4.5.1.4 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.

In the WLPMA shallow aquifer system, the simulated groundwater production rate in model year 2020, at the beginning of the implementation period, was 1,800 AFY. The production rate in model year 2040, at the beginning of the sustaining period, was 1,000 AFY.[4] The average production from

[4] 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 WLPMA and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate

the shallow aquifer system for the sustaining period was 1,000 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~~9,700 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 10,000 AFY for the 30-year sustaining period (Table 2-15).

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. 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 (Figure 2-51). 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.

2.4.5.1.5 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.

from the shallow aquifer system in 2040 is 56% of the extraction rate in 2020, rather than the 25% reduction specified in the model scenario description.

In the WLPMA, the shallow aquifer system simulated groundwater production rate in model year 2020 (at the beginning of the implementation period) was 920 AFY. The production rate in model year 2040 (at the beginning of the sustaining period) was 740 AFY.[5] The average production from the shallow for the sustaining period was 1,000 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 11,000 AFY and the simulated groundwater production rate in model year 2040 was 8,600 AFY. The average production rate from the LAS for the sustaining period was 10,000 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 11,000 AFY for the 30-year sustaining period (Table 2-15).

Reduction Without Projects Scenario 2 Model Results

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 (Figure 2-51). As in the Reduction Without 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 Without 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.

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

In the WLPMA, the shallow aquifer system simulated groundwater production rate in model year 2020 (at the beginning of the implementation period) was 930 AFY. The production rate in model year 2040 (at the beginning of the sustaining period) was 920 AFY. The average production from

[5] 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 WLPMA and the Oxnard Subbasin and are not the exact percentage specified for any given year. Therefore, the extraction rate from the shallow aquifer system in 2040 is 80% of the extraction rate in 2020, rather than the 55% reduction specified in the model scenario description.

the shallow aquifer system for the sustaining period was 940 AFY. In the LAS, the simulated groundwater production rate in model year 2020 was 11,000 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 13,000 AFY. The resulting average combined extraction rate from the two aquifer systems was approximately 14,000 AFY for the 30-year sustaining period (Table 2-15).

Reduction Without Projects Scenario 3 Model Results

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 (Figure 2-51). 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 Without 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.

2.4.5.1.7 Alternative Climate and Rainfall Patterns

In order to begin to assess the potential impacts on the 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 factor, rather than the more conservative 2070 climate-change factors. This revised scenario is referred to as the Reduction Without Projects Scenario 1a. Second, the Reduction Without Projects Scenario 1 was simulated with the DWR 2030 climate-change factor applied to the historical precipitation and hydrology period from 1940 to 1989, rather than the original period from 1930 to 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 1989 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 Without 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 2-51). This is the result of lower water levels in the UAS and the LAS under this scenario than the Reduction Without 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.

2.4.5.1.8 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 J, UWCD Model Peer Review Report). 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 and/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, 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 WLPMA. This was done by using the uncertainty estimate for the Oxnard Subbasin and the ratio of model pumping in the WLPMA to the total model pumping for the three model basins: the Oxnard Subbasin, the PVB, and the WLPMA. This produced an uncertainty in the WLPMA pumping of plus or minus 1,200 AFY for both the shallow aquifer system 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.

2.4.5.1.9 Estimates of Future Sustainable Yield

Because the WLPMA cannot adversely affect the Oxnard Subbasin's ability to achieve the GSP sustainability goal of no net flux of seawater into either the UAS or the LAS, the sustainable yield for WLPMA was assessed by examining the modeled flux of seawater into the UWCD future water scenarios over 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. 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 WLPMA. Instead, the relationship between seawater flux and groundwater production from each of the model scenarios for both the 50-year period and the 30-year periods 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 sustaining periods in either the UAS or the LAS. This method is also discussed in Appendix J, Section 2.3.2.2, and the seawater flux and groundwater production plots are provided in Appendix J 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 WLPMA sustainable yield for the shallow aquifer system and the LAS was estimated to be 12,500 AFY plus or minus 1,200 AFY. Using the ratio of shallow aquifer system pumping to LAS pumping, this produces an estimate of 1,000 AFY for the shallow aquifer system and 11,500 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 WLPMAPVB. As this understanding improves, projects to support increases in the overall sustainable yield can be developed.

2.4.5.2 East Las Posas Management Area

The sustainable yield for the ELPMA was assessed using the CMWD model (Appendix C) to examine the simulated future groundwater elevations under differing groundwater extraction and project scenarios. Scenarios that resulted in chronic lowering of groundwater levels and a loss of groundwater storage over the 30-year sustaining period were found not to be sustainable. Scenarios in which groundwater elevations were stable, or increased were analyzed further to assess the potential impacts of the predicted elevations on users of groundwater in the ELPMA. Based on these combined analyses, the sustainable yield was found to equal a groundwater production rate that did not result in chronic lowering of groundwater levels and a loss of groundwater storage during the 30-year sustaining period. This rate differs between model scenarios. Therefore, the model was run multiple times to examine the potential range of sustainable yields depending on which projects, if any, may be implemented in the ELPMA and the production rates that would result in stable groundwater elevations in the absence of projects.

The model scenarios developed for the ELPMA included the following:

- Future Baseline Simulation (2015–2017 average production rates; existing projects; 2070 DWR climate change)
- Future Baseline Simulation With Projects (2015–2017 average production rates; existing projects; 2070 DWR climate change; potential future projects that met the conditions for incorporation in the GSP)
- Reduced Production With Projects (15% reduction of 2015–2017 average pumping rates in the Epworth Gravels; 10% reduction in the FCA and GCA, existing projects; 2070 DWR climate change; potential future projects)
- Reduced Production Without Projects
  - 10% reduction of 2015–2017 average pumping rates in the Epworth Gravels; 25% reduction in the FCA and GCA; existing projects; 2070 DWR climate change
  - 12% reduction of 2015–2017 average pumping rates in the Epworth Gravels; 15% reduction in the FCA and GCA; existing projects; 2070 DWR climate change

Two model scenarios for the ELPMA incorporated projects that were approved for analysis in the GSP by the FCGMA Board. These projects are removal of Arundo along Arroyo Simi–Las Posas, to decrease losses from ET, and purchase of wastewater from the SVWQCP in order to maintain flow in Arroyo Simi–Las Posas. No projects were simulated for the Epworth Gravels Aquifer.

In addition to the initial set of modeling simulations listed above, the Reduction Without Projects Scenario 1 (10% Epworth Gravels Aquifer, 25% FCA and GCA reduction) was simulated with the DWR 2030 climate-change factors and applied to 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.

The average annual production rate from each of the scenarios listed above and how these scenarios were used to assess the sustainable yield of the basins is discussed in further detail below.

2.4.5.2.1 Future Baseline Scenario

DWR regulations require that the GSP include an assessment of the future baseline conditions in each basin. In the case of ELPMA, discharge from dewatering by the City of Simi Valley was assumed to be zero AFY after 2022 based on the City of Simi Valley's plan to desalt and reuse the dewatering water. The discharges from the SVWQCP were reduced stepwise by 1,340, 4,340, 4,500, 5,000, 5,200 AFY in 2020, 2025, 2030, 2035, and 2040, respectively, based on the City of Simi Valley's intention to use the recycled water (VCWD No. 1 2016).

In ELPMA the existing projects include 850 AFY discharged to infiltration ponds from VCWD. The CMWD (Appendix C) model designates the reach downstream of the VCWD as a losing stream so this water ends up recharging the groundwater.

Chronic groundwater elevation declines were observed in all the groundwater elevation hydrographs analyzed from the future baseline model scenario. The primary cause of the simulated groundwater elevation declines in the FCA and GCA is the combination of groundwater production and reduced flow in Arroyo Simi-Las Posas. In the Epworth Gravels Aquifer, chronic lowering of groundwater levels are attributed to groundwater production in excess of the sustainable yield of the aquifer, and are not linked with reduced flow in Arroyo Simi–Las Posas, because there is no hydraulic connection between Arroyo Simi–Las Posas and the Epworth Gravels Aquifer. Under the conditions modeled in the future baseline scenario, the extraction rates were found to be unsustainable in the ELPMA.

2.4.5.2.2 Future Baseline With Projects Scenario

Several projects were proposed to enhance the yield of the ELPMA. Proposed projects included Arundo removal and purchase of SVWQCP effluent discharge to maintain flow in Arroyo Simi–Las Posas. The Nature Conservancy estimates that Arundo removal will result in a reduction in evapotranspiration (ET) losses and an increase in Arroyo Simi–Las Posas flow by up to 2,680 AFY (see Appendix I). Not all of the reduction in ET will be within the model domain, some will be upstream. The CMWD model incorporates approximately 1,900 AFY of ET losses attributed to Arundo. All of these losses were eliminated to simulate Arundo removal. The difference between The Nature Conservancy's estimate of 2,860 AFY losses from Arundo and the ET loss in the model was assumed to occur upstream of the model, and the surface water inflow was increased by this amount. These projects are discussed in detail in Chapter 5 of this GSP.

A project proposed by The Nature Conservancy to purchase 4,691 AFY of SVWQCP effluent to maintain flow in Arroyo Simi–Las Posas and resulting recharge to the LPVB was also incorporated into the future simulations with projects scenarios. This project was designed to maintain flow in Arroyo Simi–Las Posas that Simi Valley has indicated it would divert for other use.

The second model scenario incorporated these projects without reducing the average groundwater extraction rate from the future baseline scenario. The addition of the projects eliminated chronic lowering of groundwater levels in the Shallow Alluvial Aquifer and in wells screened in the FCA adjacent to Arroyo Simi–Las Posas. Chronic lowering of groundwater levels was simulated in the Epworth Gravels Aquifer, and in the FCA and GCA in the central and northern parts of the ELPMA. Because chronic lowering of groundwater levels persisted in the majority of the ELPMA, additional scenarios were developed to examine how changing groundwater production rates would impact groundwater level declines and loss of groundwater in storage.

2.4.5.2.3 Reduction With Projects Scenario

Subsequent model scenarios incorporated reductions in groundwater extractions from the Epworth Gravels, FCA, and GCA, in addition to the projects, and reductions in groundwater extractions without projects. Groundwater extraction reductions for the Epworth Gravels Aquifer were adjusted independently from the extraction reductions in the FCA and GCA, because the Epworth Gravels Aquifer is hydraulically separated from the underlying FCA by several hundred feet of the USP. All reductions in groundwater extractions are relative to the 2015–2017 average groundwater extraction rate, and the reductions were simulated to occur gradually over the 20-year implementation period. The groundwater extraction rate at the end of the 20-year implementation period was held constant for the 30-year sustaining period.

The scenario with projects and reduced extractions included a 15% reduction in the Epworth Gravels Aquifer and 10% reduction in the FCA and GCA, which translates to an average groundwater extraction rate of 20,000 AFY over the sustaining period (Table 2-16). This scenario is called the Reduction With Projects scenario. In the Reduction With Projects scenario, groundwater elevations in the Epworth Gravels Aquifer declined for the first 15 years of the implementation period, and then recovered throughout the sustaining period. In the Shallow Alluvial Aquifer, FCA, and GCA, the Reduction With Projects scenario resulted in stable groundwater elevations throughout the sustaining period. Therefore, the Reduction With Projects scenario was found to be sustainable for all aquifers in the ELPMA.

2.4.5.2.4 Reduction Without Projects Scenarios

Two scenarios were analyzed with reduced groundwater production and no projects. The first scenario included a 10% reduction in extractions from the Epworth Gravels Aquifer and 25% reduction in extractions from the FCA and GCA. This scenario is called the Reduction Without Projects Scenario 1. The average groundwater extraction rate for the sustaining period in the Reduction Without Projects Scenario 1 is 17,000 AFY (Table 2-16). In the Reduction Without Projects Scenario 1, groundwater elevations in the Epworth Gravels Aquifer declined during both the implementation period and the sustaining period. Therefore, a 10% reduction relative to 2015–2017 rates is not sustainable in the Epworth Gravels Aquifer. In the Shallow Alluvial Aquifer, FCA and GCA, the Reduction Without Projects Scenario 1 resulted in stable groundwater elevations throughout the sustaining period. Simulated groundwater elevations were lower in wells adjacent to Arroyo Simi–Las Posas than they were in the Reduction With Projects scenario. For wells in the central and northern portion of the ELPMA, the simulated groundwater elevations were higher in the Reduction Without Projects Scenario 1 than they were in the Reduction With

Projects scenario, reflecting the reduced influence of recharge along Arroyo Simi–Las Posas in these areas. Because groundwater elevations in the Shallow Alluvial Aquifer, FCA, and GCA were stable, or recovered during the sustaining period in the Reduction Without Projects Scenario 1, the groundwater extraction rate was found to be sustainable for these aquifers in the ELPMA.

The second scenario with reduced groundwater extractions and no projects included a 12% reduction in groundwater extractions from the Epworth Gravels Aquifer and 15% reduction in extractions from the FCA and GCA. This scenario is called the Reduction Without Projects Scenario 2. The average groundwater extraction rate for the sustaining period in the Reduction Without Projects Scenario 2 is 19,000 AFY (Table 2-16). In this scenario, groundwater elevations were stable during the sustaining period in the Epworth Gravels Aquifer. However, chronic lowering of groundwater levels was simulated throughout the Shallow Alluvial Aquifer, FCA and GCA. Therefore, the simulated production rates in the Reduction Without Projects Scenario 2 are only sustainable for the Epworth Gravels Aquifer, and are not sustainable for the Shallow Alluvial Aquifer, FCA, and GCA.

2.4.5.2.5 Evaluating the Impact of Chronic Lowering of Water Levels on Storage, Recharge, and Well Yields in the ELPMA

Dudek evaluated potential undesirable results associated with chronic lowering of groundwater levels in the ELPMA (see memo included as Appendix K to this GSP). The evaluation used the CMWD numerical model's 50-year simulation of future baseline conditions for the ELPMA to estimate potential changes in the amount of the groundwater in storage, potential changes in the production capacity of the FCA, and potential impacts on recharge due to conversion of the FCA from confined to unconfined conditions- (see Appendix C).

The model predicts that continued production at 22,000 AFY throughout the ELPMA (the average 2015–2017 rate) would result in an ELPMA-wide loss of more than 209,000 AF of groundwater in storage. This is equivalent to approximately 8% of groundwater in storage in 2015. Approximately 90,000 AF of this loss occurs in the USP, which is the reservoir containing accumulated recharge from past centuries that leaks downward to replenish the FCA. However, along the northern and southern basin margins and in the center of the basin along the Moorpark and Long Canyon Anticlines, the FCA would experience reductions in storage ranging from 25% to 36%. Additionally, there is a 45% reduction in groundwater in storage in the Epworth Gravels aquifer (Appendix K).

ELPMA-wide 50-year declines in water levels would reduce the production capacity of the FCA by 3%, areas along the northern and southern basin margin and in the center of the basin along the Moorpark Anticline would experience production decreases of 56% to 78%.

As water levels decline in the FCA, the top of the FCA becomes unsaturated in some areas. Leakage from the overlying USP is slightly impeded by unsaturated flow conditions and is reduced locally by approximately 10%. ELPMA-wide, this reduction is estimated to amount to approximately 650 AFY (Appendix K).

2.4.5.2.6 Uncertainty Analysis

A quantitative review of the CMWD model (is underway to provideincluded as Appendix M to this GSP) is an independent evaluation of the uncertainty associated with modeling estimates of the sustainable yield for the ELPMA. Initial results are provided in this draft GSP; final results will be available before the final GSP is released. The review complements a local sensitivity analysis performed by CMWD that evaluated how the model parameterization affected predictions of historical groundwater elevations. The peer review presented in Appendix M employed a global sensitivity analysis that keys off the local sensitivity analysis and allows for a quantitative assessment of uncertainty in predictions of key mechanisms, such as annual change in storage, recharge into the FCA, and infiltration from Arroyo Las Posas,recharge to the FCA, that are linked to sustainable yield estimates.

Quantifying Uncertainty

Analysis of uncertainty in model calculations of historical annual change in storage, recharge into the FCA, and infiltration from Arroyo Las Posas yielded confidence intervals of 1,700 AFY, 1,300 AFY, and 2,500 AFY, respectively (Appendix M, Section 3).- Annual average change in storage broadly reflects the effects of all stresses in the model and incorporates uncertainty embedded in the other two mechanisms. The relative magnitude of the uncertainty in recharge to the FCA and infiltration from the Aarroyo indicates that the Arroyo Las Posas remains a critical component of the overall uncertainty in storage changes in the ELPMA.

Avoiding long--term loss of storage is proposed to determine the sustainable yield of the ELPMA; applying the annual change in storage confidence interval to the estimated groundwater production that induces no long-term change in groundwater storage under future conditions without projects, produces a sustainable yield of 17,800 AFY ±-2,300 AFY for the ELPMA.

Analysis of predicted groundwater elevations from the Future Baseline Scenario simulation indicate that the sustainable yield for the ELPMA is largely determined by groundwater production and recharge into the FCA. Because groundwater extractions from the FCA are relatively well constrained, a large source of the sustainable yield uncertainty is linked to model estimates of recharge to the FCA. This uncertainty was characterized by quantifying the variance in recharge to the FCA under historical conditions using 100 alternate realizations of the CMWD model. These realizations were generated by randomly varying 23 parameters that produced the largest change in simulated groundwater elevations during the local sensitivity analysis performed by CMWD.

~~Eight of these parameters characterize regional conditions in the vicinity of the Arroyo Las Posas, which contributes approximately 50% of the recharge into the basin.~~

~~Preliminary results from 52 of the simulations indicate that the standard deviation of recharge into the FCA is 8% of the ensemble average. This suggests a corresponding sustainable yield uncertainty of 8%.~~

~~The future sustainable yield of the basin is estimated to be as high as 20,000 AFY if projects are implemented. Propagating the uncertainty in recharge to the FCA onto the sustainable yield estimate would lead to uncertainty bounds of ±1,600 AFY. If projects are not implemented, the sustainable yield is estimated to be as high as 17,000 AFY. Similarly, an 8% uncertainty would lead to a sustainable yield estimate of 17,000 AFY ± 1,360 AFY.~~

~~The global sensitivity analysis is ongoing to elucidate the primary mechanisms and parameters that drive uncertainty in the sustainable yield predictions and to further assess how this uncertainty impacts predicted groundwater elevations under future climate scenarios and corresponding changes to flow in the Arroyo Las Posas. Results from this global sensitivity analysis will be presented in a separate technical memorandum.~~

2.4.5.2.7 Estimates of Future Sustainable Yield

Analysis of the model scenarios, impacts of the chronic lowering of water levels on storage, recharge, and well yields, and the well screen analysis for the ELPMA indicates that the sustainable yield is dependent on the combined effects of projects and groundwater extraction rates. If projects are implemented, the sustainable yield for the total ELPMA may be as high as ~~20,000~~20,800 AFY. In the absence of projects, the total sustainable yield for the ELPMA may be closer to ~~17,000~~17,800 AFY. As with all models, there is uncertainty in the predicted sustainable yield. Additional work will be done to reduce the uncertainty over the next 5 years, and the sustainable yield may be better defined based on the implementation of any projects or management actions in the ELPMA.

The estimated sustainable yield for just the Epworth Gravels was determined from the Future Baseline scenario, Reduction With Projects scenario, Reduction Without Projects Scenario 1, and Reduction Without Projects Scenario 2, where results from 0%, 15%, 10%, and 12% reductions respectively, in the 2015 to 2017 average pumping in the Epworth Gravels could be evaluated relative to groundwater level hydrographs, (Table 2-16). The Epworth Gravels pumping rate in the Future Baseline scenario was 1,497 AFY, in the Reduction With Projects scenario it was 1,273 AFY, in the Reduction Without Projects Scenario 1 it was 1,348 AFY, and in the Reduction Without Projects Scenario 2 it was 1,318 AFY. The hydrographs suggest that an Epworth Gravels Aquifer pumping rate of about 1,320 AFY, plus or minus 20 AFY, would be sustainable. This is ~~lower than~~close to the ~~1,518~~1,290 AFY estimated for the historical sustainable yield of the

Epworth Gravels Aquifer discussed in Section 2.4.3.4, but within the uncertainty associated with the historical Epworth Gravels Aquifer sustainable yield.

2.5 MANAGEMENT AREAS

As discussed in Section 2.2, Hydrogeologic Conceptual Model, and Section 2.3, Groundwater Conditions, sustainable management of the LPVB requires dividing the LPVB into three management areas: the WLPMA, the ELPMA, and the Epworth Gravels Management Area. The WLPMA and ELPMA are separated by the Somis Fault, which limits the hydraulic communication between these management areas, and results in an over 300-foot difference in the groundwater elevation across the fault in the FCA (Figures 2-9 and 2-10; Section 2.2.4, Principal Aquifers and Aquitards). Additionally, the water budget indicates that the primary sources of recharge differ between the WLPMA and ELPMA (Section 2.4, Water Budget). Recharge in the WLPMA is dominated by percolation from precipitation and agricultural irrigation infiltration, along with subsurface flows from the Oxnard Subbasin (Section 2.4). In contrast, recharge to the ELPMA has been dominated by recharge from non-native surface water flows in Arroyo Simi–Las Posas (Sections 2.2, 2.3, and 2.4). As a result of both the geologic separation and differing controls on recharge to the WLPMA and ELPMA, these management areas require separate minimum thresholds and management objectives to achieve sustainability. These thresholds and objectives are addressed in Chapter 3, Sustainable Management Criteria, according to management area.

In addition to the WLPMA and ELPMA, the Epworth Gravels Management Area is the third management area defined in the LPVB. Geologically, the Epworth Gravels Aquifer is a localized aquifer that is only present within an approximately 1,600-acre (2.5-square-mile) area of the ELPMA (Section 2.2). A separate management area is defined for this aquifer because it is a locally significant source of water but is not believed to be in hydraulic communication with the other aquifers of the LAS (Section 2.2; Turner 1975). Production from this aquifer caused groundwater elevation declines in the past that did not impact groundwater elevations in the underlying FCA. These aquifers are separated by the USP, which is less transmissive, thereby isolating the effects of drawdown in the Epworth Gravels Aquifer from the FCA. In the fall of 2015, groundwater elevations in the Epworth Gravels Aquifer were several hundred feet higher than they were in the FCA (Figures 2-10 and 2-20). The primary source of recharge to the Epworth Gravels Aquifer is precipitation (Section 2.4). As a result of the geologic separation and isolation of the Epworth Gravels Aquifer from the underlying FCA and the other sources of recharge to the ELPMA, this management area requires separate minimum thresholds and management in order to achieve sustainability. These thresholds and objectives are addressed in Chapter 3.

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Table 2-1
Las Posas Valley Basin Lithologic and Hydrostratigraphic Nomenclature

Geologic Period	Geologic Epoch	Kew (1924); Bailey (1951)[a]	Jakes (1979)	Weber and Kiessling (1976)	Dibblee (1992a, 1992b)	DeVecchio et al. 2012b	CMWD 2016a	CMWD 2016a	Units Used in This GSP	DWR (2003)	USGS 2003; CMWD 2016a	USGS 2003; CMWD 2016a
		Lithologic Units and Formations					*Stratigraphic Column*	*Hydrostratigraphic Units*	*Hydrostratigraphic Unit or Formation*	*Water-Bearing Formations*	*Regional Aquifer Designations*	*Regional Aquifer Systems*
Quaternary	Holocene	Recent Alluvium: active lagoonal, beach, river, and floodplain, and alluvial deposits				Alluvium: active alluvium	Undifferentiated Alluvium	Shallow Alluvial Aquifer	Shallow Alluvial Aquifer (ELPMA) Shallow aquifer system (WLPMA)	Alluvium	Recent alluvial and semi-perched	Upper Aquifer System
	Upper Pleistocene	Terrace deposits: Deformed river deposits	Older Alluvium: Deformed beach, river, floodplain and terrace deposits			Older Alluvium: Incised and gently folded fluvial deposits					Oxnard	
											Mugu	
		Saugus Formation: Terrestrial and marine sand and gravel		Saugus Formation: Terrestrial fluvial	Saugus Formation: Terrestrial	Saugus Formation	Epworth Gravels (where present)	Epworth Gravels (where present)	Epworth Gravels (where present)	San Pedro Formation	Hueneme	Lower Aquifer System
				San Pedro Formation: Marine clays and sand and terrestrial sediment		Las Posas Sand: Shallow marine sand thickening westward	Upper San Pedro / Saugus Formation	Upper San Pedro Formation	Upper San Pedro Formation			
	Lower Pleistocene				Las Posas Sand: Shallow marine sand		Clay Marker Bed	Fox Canyon Aquifer	Fox Canyon Aquifer		Fox Canyon Aquifer	
							Fox Canyon Aquifer					
				Santa Barbara Formation: Shallow marine sand			Upper Santa Barbara Formation (clay-rich)	Grimes Canyon	Grimes Canyon Aquifer	Santa Barbara Formation	Grimes Canyon Aquifer	
							Grimes Canyon Aquifer					
Tertiary	Pliocene	Fernando Group	Pico Formation			Absent	Undifferentiated Tertiary Formation (effective Base of Fresh Water)		Undifferentiated Tertiary Formation (effective Base of Fresh Water)	Non-water-bearing	No water-bearing units of regional significance/non-freshwater-bearing	Not included in regional flow system
	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										

Notes: CMWD = Calleguas Municipal Water District; DWR = California Department of Water Resources; GSP = Groundwater Sustainability Plan; USGS = U.S. Geological Survey.
[a] As cited in DeVecchio et al. 2012a.

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Table 2-2
Vertical Gradient

Location	Nested Group (First 9 Digits of SWN)	Well (Penultimate 2 Digits of SWN)	Screen Interval		Spring 2015 Elevation (ft msl)	Spring 2015 Gradient (ft/ft)[a]	Fall 2015 Elevation (ft msl)	Fall 2015 Gradient (ft/ft)[a]	Aquifer
			Top	*Bottom*					
WLPMA	02N21W11J	06	190	230	201.5	—	201.0	—	USP
		05	340	380	172.7	−0.192	169.5	−0.21	USP
		04	615	655	−8.6	−0.659	−16.3	−0.675	USP
		03	1,020	1,080	−51	−0.102	−69	−0.130	FCA
ELPMA	02N19W07K	04	90	150	—	—	433.1	—	Alluvium
		03	240	300	—	—	437.6	0.030	USP
		02	680	730	—	—	368.5	-0.159	FCA
	03N20W35R	04	490	530	272.6	—	272.8	—	USP
		03	800	900	155.6	−0.344	136.6	−0.401	FCA
		02	1050	1110	156.6	0.004	128.7	−0.034	FCA

Notes: ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; ft/ft = feet per feet; ft msl = feet above mean sea level; SWN = State Well Number; USP = Upper San Pedro Formation; WLPMA = West Las Posas Management Area.

[a] Negative gradients are directed downward.

Table 2-3
Average, Maximum, and Minimum Annual Change in Storage in ELPMA Aquifers

Aquifer	Average Annual Change in Storage (AFY)[a]	Maximum Annual Decrease In Storage (AF),[a] *Year*	Minimum Annual Increase in Storage (AF),[a] *Year*
Shallow Alluvial	247	−441, *2013*	1,686, *1990*
Epworth Gravels	86	−805, *1985*	727, *1998*
USP	1,730	−830, *2014*	4,611, *1986*
FCA	1,441	−7,763, *2010*	7,912, *1986*
GCA	122	−1,520, *2010*	973, *1995*

Notes: AF = acre-feet; AFY = acre-feet per year; ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer; USP = Upper San Pedro Formation.

[a] Negative numbers represent a loss in groundwater storage in the aquifer.

Table 2-4
Basin Plan and FCGMA Water Quality Thresholds for Groundwater in the LPVB

Basin/ Subbasin	Threshold Source	Sub-Area/Zone Description	Basin Plan Zone	Threshold Concentration (mg/L)				
				TDS	*Chloride*	*Nitrate*	*Sulfate*	*Boron*
Las Posas Valley	LARWQCB Basin Plan WQO	NW of Grimes Cyn Rd & LA Ave & Somis Rd	1	700	100	45	300	0.5
		E of Grimes Cyn Rd & Hitch Blvd	2	2,500	400	45	1,200	3
		S of LA Ave between Somis Rd & Hitch Blvd	3	1,500	250	45	700	1
		Grimes Cyn Rd & Broadway Area	4	250	30	45	30	0.2
		North Las Posas Area	5	500	150	45	250	1
	FCGMA 2007 BMO	East Las Posas		<500	<100	—	—	—
		West Las Posas		<600	<100	—	—	—
		South Las Posas		<1,500	<160	—	—	—

Sources: LARWQCB 2014; FCGMA 2007; Las Posas Users Group 2012.

Notes: BMO = Basin Management Objective; CMWD = Calleguas Municipal Water District; FCGMA = Fox Canyon Groundwater Management Agency; LARWQCB = Los Angeles Regional Water Quality Control Board; LPVB = Las Posas Valley Basin; mg/L = milligrams per liter; TDS = total dissolved solids; WQO = Water Quality Objective.

Table 2-5
Las Posas Valley Basin Water Purveyors

Water Purveyor	Water Supplied by CMWD	Recycled Water	Water Supplied by Groundwater
Arroyo Las Posas MWC			X
Balcom Bixby Water Association			X
Balcom Canyon Water Well Association			X
Berylwood Heights MWC	X		X

Table 2-5
Las Posas Valley Basin Water Purveyors

Water Purveyor	Water Supplied by CMWD	Recycled Water	Water Supplied by Groundwater
Camrosa Water District[a]	X		
Crestview MWC	X		X
California American Water Co.	X		
Del Norte MWC			X
Epworth MWC			X
Fairview Ranch MWC			X
Fuller Falls MWC			X
La Loma Ranch MWC			X
Las Lomas Water System			X
Lloyd-Butler MWC			X
Rancho Canada Water Co.			X
Rancho de Courtesy			X
~~Saticoy Country Club~~City of San Buenaventura (Ventura)			X
Solano Verde MWC	X		
Thermic MWC			X
Waters Road Users Group			X
VCWD No. 1 (MWTP)	X	X	X
VCWD No. 19	X		X
Zone MWC	X		X

Notes: CMWD = Calleguas Municipal Water District; MWC = Mutual Water Company; MWTP = Moorpark Wastewater Treatment Plant; VCWD = Ventura County Waterworks District.

[a] Camrosa Water District also uses pumped groundwater from the Pleasant Valley and Arroyo Santa Rosa Valley Basins.

Table 2-6
Moorpark Wastewater Treatment Plant Discharges and Simi Valley Flows (AF)

Calendar Year	MWTP Flows to Percolation Ponds	MWTP Creek Discharge	Simi Valley Dewatering[a]	Simi Valley Water Quality Control Plant[b]	Subsurface Inflow from Simi Valley[c]
1985	1,559	0	0	8,933	100
1986	1,639	0	0	9,957	100
1987	1,892	0	1,740	10,313	100
1988	2,190	0	1,740	10,235	100
1989	2,155	0	1,740	9,743	100
1990	2,041	0	1,740	9,651	100
1991	1,903	0	1,740	9,264	100

Table 2-6
Moorpark Wastewater Treatment Plant Discharges and Simi Valley Flows (AF)

Calendar Year	MWTP Flows to Percolation Ponds	MWTP Creek Discharge	Simi Valley Dewatering[a]	Simi Valley Water Quality Control Plant[b]	Subsurface Inflow from Simi Valley[c]
1992	2,041	0	1,740	10,114	100
1993	2,201	0	1,740	10,472	100
1994	2,236	0	1,740	9,557	100
1995	2,281	0	1,740	9,436	100
1996	2,224	0	1,740	9,315	100
1997	2,362	0	1,740	9,771	100
1998	2,534	0	1,740	10,602	100
1999	2,339	0	1,740	10,093	100
2000	2,362	0	1,740	10,215	100
2001	2,430	1,647	1,740	10,399	100
2002	2,488	1,613	1,740	10,193	100
2003	2,522	0	1,740	10,263	100
2004	2,247	0	1,740	10,011	100
2005	2,270	0	1,740	11,171	100
2006	2,247	0	1,740	9,914	100
2007	2,201	0	1,949	9,912	100
2008	2,178	0	1,882	10,794	100
2009	2,127	0	1,867	10,725	100
2010	2,096	0	1,782	10,457	100
2011	2,010	0	1,828	9,884	100
2012	1,879	0	1,522	9,574	100
2013	1,747	0	1,569	9,501	100
2014	1,627	0	1,523	9,051	100
2015	1,635	0	1,428	8,506	100
Maximum	2,534	1,647	1,949	11,171	100
Minimum	1,559	0	0	8,506	100
Average	2,118	105	1,618	9,936	100

Sources: DBS&A 2017; Todd Groundwater 2016. See lettered notes below for specifics.
Notes: AF = acre-feet; MWTP = Moorpark Wastewater Treatment Plant.

[a] DBS&A 2017, p. 22, Table 12; Todd 2016, Table 5, for Simi Valley dewatering data. For the years from 1987 (estimates start of dewatering) to 1997 it was assumed that average pumping from 2007 through 2014 (1,740 AFY) was discharged from 1987 to 2006 to fill in historical record.

[b] DBS&A 2017, p. 22, Table 12; Calleguas Creek HSPF Model for discharge from SVWQCP from 1/1/1985 to 5/31/2010 (as cited in DBS&A 2017); City of Simi Valley annual reports for data from 6/1/2010 to 12/31/2015 (as cited in DBS&A 2017).

[c] Todd Groundwater 2016.

~~DRAFT – SUBJECT TO CHANGE~~

Table 2-7
Water Balance for the ELPMA from the CMWD Model

	Model Calculated Inflows				Model Calculated Outflows							Yearly Change
Calendar Year	*Reported Recharge Except Arroyo Simi–Las Posas (Includes MWTP)*	*Injected ASR Water*	*Inflow at Basin Boundary*	*Inflow from Arroyo Simi–Las Posas Percolation*	*Subsurface Outflow to PVB*[a]	*Riparian ET*	*Extraction*[b]	*Outflow to WLPMA*	*Outflow at Basin Boundary*	Total Groundwater Inflow	Total Groundwater Outflow	*Storage*[3]
1985	9,620	0	1,846	12,648	209	693	17,696	104	1,160	24,114	19,861	-4,252
1986	9,682	0	1,795	18,824	620	720	16,260	105	1,017	30,301	18,722	-11,579
1987	10,002	0	1,935	16,697	519	747	19,038	105	988	28,634	21,397	-7,237
1988	10,197	0	1,950	17,668	806	776	20,593	107	977	29,815	23,258	-6,557
1989	10,262	0	1,932	13,658	662	801	23,252	107	1,028	25,852	25,850	-1
1990	10,014	0	1,886	14,449	774	828	22,629	108	967	26,348	25,306	-1,042
1991	9,906	0	1,853	16,679	986	855	18,498	109	977	28,438	21,425	-7,014
1992	10,016	0	1,843	19,241	1,418	884	15,064	111	869	31,100	18,347	-12,754
1993	10,362	105	1,875	17,317	1,719	909	16,105	112	886	29,659	19,731	-9,928
1994	10,517	326	1,908	15,163	1,706	936	18,305	113	946	27,914	22,006	-5,908
1995	10,812	379	1,883	16,340	1,962	963	15,386	115	928	29,414	19,354	-10,060
1996	10,687	250	1,924	14,494	1,976	993	11,935	117	999	27,355	16,020	-11,335
1997	10,902	257	1,910	13,532	1,949	1,017	16,892	118	1,009	26,601	20,986	-5,615
1998	11,306	1	1,918	14,426	2,220	1,044	15,499	121	962	27,651	19,845	-7,806
1999	11,059	112	1,959	13,366	2,101	1,064	19,965	123	1,010	26,495	24,262	-2,233
2000	11,125	1	2,060	13,306	2,091	1,234	18,612	125	1,052	26,493	23,114	-3,379
2001	11,181	0	2,045	13,658	2,222	1,230	14,013	126	1,022	26,884	18,614	-8,269
2002	11,292	436	1,978	12,961	2,060	1,230	19,909	128	1,109	26,668	24,436	-2,232
2003	11,207	1,229	1,955	12,565	2,308	1,230	16,544	130	1,038	26,956	21,250	-5,705
2004	10,936	961	1,980	12,491	2,268	1,234	18,344	132	1,089	26,368	23,067	-3,301
2005	11,224	1,785	1,907	12,386	2,396	1,230	13,941	133	1,015	27,301	18,715	-8,586
2006	11,405	4,285	1,906	11,406	2,378	1,230	18,624	135	979	29,001	23,347	-5,655
2007	11,327	198	1,997	12,031	2,310	1,230	23,745	137	944	25,553	28,366	2,812
2008	11,173	64	2,161	11,973	2,284	1,234	24,565	138	1,011	25,371	29,232	3,861
2009	10,946	600	2,344	12,060	2,275	1,230	30,315	140	1,054	25,949	35,013	9,064
2010	10,800	84	2,546	12,374	2,327	1,230	26,954	141	954	25,804	31,607	5,803
2011	10,800	765	2,581	12,141	2,339	1,230	19,729	142	912	26,287	24,352	-1,935
2012	10,718	1,577	2,536	12,063	2,253	1,234	23,122	144	884	26,894	27,636	742
2013	10,244	1,461	2,543	11,701	2,027	1,236	27,434	144	867	25,950	31,708	5,758
2014	9,970	3,838	2,412	13,462	1,970	1,230	26,064	145	846	29,682	30,256	574
2015	9,891	703	2,251	11,870	1,832	1,230	23,858	146	820	24,715	27,886	3,171
Maximum	11,405	4,285	2,581	19,241	2,396	1,236	30,315	146	1,160	31,100	35,013	9,064
Minimum	9,620	0	1,795	11,406	209	693	11,935	104	820	24,114	16,020	-12,754
Average	10,632	626	2,052	13,966	1,773	1,062	19,771	125	978	27,276	23,709	-3,568

Sources: CMWD Model; FCGMA/CMWD.
Notes: AF = acre-feet; CMWD = Calleguas Municipal Water District; FCGMA = Fox Canyon Groundwater Management Agency.
[a] These numbers are updated, and are different from those used by UWCD for subsurface inflow into the PVB for the GSP.

b Adjusted to account for ASR Injection and extraction starting in 1993.
c A negative number indicates that water entered storage.

Table 2-8
Sales and Usage of CMWD Imported Water Supplied (AF)

Year[a]	Berylwood Heights MWC	CA-American Water Co.[b]	CWD[c]			Crestview MWC	Solano Verde MWC[d]			VCWD No. 1[e]			VCWD No.19[f]							Zone MWC			Total Imported Water Delivered						
	ELPMA	WLPMA	ELPMA			WLPMA	WLPMA			ELPMA			WLPMA			ELPMA				WLPMA	ELPMA	Total	WLPMA			ELPMA			
	Ag	M&I	Ag	M&I	Total	M&I	Ag	M&I	Total	Ag	M&I	Total	Ag	M&I	Total	Ag	M&I	Total	Total	Ag			Ag	M&I	Total	Ag	M&I	Total	Total
1985	0	538	86	64	150	31	0	0	0	1,873	5,620	7,494	282	117	398	188	78	266	664	146	97	243	427	686	1,113	2,244	5,762	8,006	9,120
1986	2	538	81	60	141	49	0	0	0	1,786	5,359	7,145	238	99	336	159	66	224	561	90	60	150	328	686	1,013	2,088	5,484	7,572	8,585
1987	7	538	95	70	165	4	0	0	0	2,039	6,118	8,157	337	139	476	224	93	317	793	48	32	80	385	682	1,067	2,397	6,281	8,678	9,745
1988	19	538	121	90	211	63	0	0	0	2,266	6,798	9,065	197	82	278	131	54	186	464	173	116	289	370	683	1,053	2,652	6,943	9,595	10,648
1989	28	538	141	104	245	313	0	0	0	2,384	7,152	9,535	287	119	407	192	79	271	678	186	124	310	473	971	1,444	2,868	7,335	10,203	11,648
1990	13	538	141	105	246	245	0	0	0	2,418	7,254	9,672	726	301	1,027	484	201	684	1,711	8	6	14	734	1,084	1,818	3,062	7,559	10,621	12,439
1991	0	538	85	63	148	219	0	0	0	1,943	5,830	7,773	319	132	451	213	88	301	752	6	4	11	325	889	1,215	2,245	5,981	8,226	9,440
1992	4	538	80	60	140	354	0	0	0	2,016	6,047	8,063	339	141	480	226	94	320	800	25	17	42	365	1,033	1,398	2,343	6,201	8,544	9,942
1993	1	538	76	57	133	446	0	0	0	2,137	6,412	8,550	158	66	224	105	44	149	373	11	7	18	169	1,050	1,219	2,327	6,512	8,839	10,058
1994	0	538	79	59	137	321	0	0	0	1,974	5,921	7,895	131	54	186	87	36	124	309	0	0	0	131	914	1,045	2,140	6,016	8,156	9,201
1995	1	538	81	60	140	140	1	0	0	1,784	5,351	7,135	144	60	203	96	40	135	339	0	0	0	145	737	882	1,961	5,451	7,412	8,294
1996	0	538	82	61	143	0	0	0	0	1,921	5,764	7,685	59	25	84	39	16	56	140	0	0	0	59	563	622	2,043	5,841	7,884	8,506
1997	0	538	97	72	170	140	0	0	0	2,121	6,364	8,486	103	43	146	69	28	97	243	6	4	10	109	721	830	2,291	6,465	8,757	9,587
1998	0	538	42	31	72	1	0	0	0	1,704	5,111	6,815	132	55	187	88	37	125	312	0	0	0	133	595	727	1,834	5,178	7,012	7,739
1999	0	538	58	43	101	75	0	0	0	2,178	6,534	8,711	162	67	229	108	45	152	381	0	0	0	162	680	842	2,344	6,621	8,965	9,807
2000	0	538	67	50	117	306	0	0	0	2,274	6,822	9,096	70	29	100	47	19	66	166	0	0	0	70	873	944	2,388	6,891	9,279	10,223
2001	0	538	70	52	122	363	0	0	0	2,246	6,739	8,986	51	21	72	34	14	48	121	0	0	0	51	923	974	2,351	6,806	9,156	10,131
2002	0	538	92	68	159	14	0	0	0	2,798	8,395	11,194	411	170	581	274	113	387	968	0	0	0	411	723	1,133	3,164	8,577	11,741	12,874
2003	0	538	96	71	167	258	0	0	0	2,595	7,784	10,378	74	31	104	49	20	70	174	0	0	0	74	827	901	2,740	7,875	10,615	11,516
2004	0	538	116	86	202	289	0	0	0	2,716	8,149	10,866	388	161	549	259	107	366	915	0	0	0	388	988	1,376	3,091	8,342	11,433	12,810
2005	0	538	87	64	151	269	0	0	0	2,320	6,959	9,279	128	53	181	85	35	121	302	0	0	0	128	861	989	2,492	7,059	9,550	10,539
2006	0	577	99	73	172	249	127	7	134	2,507	7,521	10,029	365	151	516	243	101	344	860	0	0	0	492	984	1,476	2,849	7,696	10,545	12,021
2007	0	621	120	89	209	266	287	15	302	2,942	8,826	11,768	171	71	242	114	47	162	404	0	0	0	458	973	1,431	3,176	8,962	12,138	13,569
2008	0	647	111	88	200	272	285	15	301	2,801	8,404	11,205	498	206	704	332	137	469	1,173	0	0	0	783	1,140	1,923	3,245	8,630	11,874	13,797
2009	3	579	104	83	187	176	290	15	306	2,567	7,700	10,267	428	178	606	286	118	404	1,010	0	0	0	719	948	1,667	2,960	7,901	10,861	12,528
2010	0	445	88	70	158	233	209	11	220	2,119	6,358	8,478	260	108	368	174	72	246	614	0	0	0	470	797	1,267	2,381	6,500	8,881	10,148
2011	2	471	82	65	147	197	243	13	256	1,996	5,987	7,982	81	34	115	54	22	76	191	0	0	0	324	714	1,038	2,133	6,074	8,207	9,245
2012	3	483	92	73	165	205	309	16	325	2,131	6,393	8,524	41	17	58	27	11	39	97	0	0	0	350	721	1,072	2,254	6,478	8,731	9,803
2013	0	592	106	85	190	280	336	18	354	2,158	6,473	8,631	350	145	495	233	97	330	825	0	0	0	686	1,035	1,721	2,497	6,654	9,151	10,872
2014	0	569	115	93	208	282	396	21	417	2,219	6,656	8,875	423	175	598	282	117	399	997	0	0	0	819	1,047	1,866	2,616	6,866	9,481	11,347
2015	16	400	90	58	148	299	329	17	346	1,929	5,788	7,717	324	134	459	216	90	306	765	0	0	0	653	851	1,504	2,252	5,936	8,188	9,691
Maximum	28	647	141	105	246	446	396	21	417	2,942	8,826	11,768	726	301	1,027	484	201	684	1,711	186	124	310	819	1,140	1,923	3,245	8,962	12,138	13,797
Minimum	0	400	42	31	72	0	0	0	0	1,704	5,111	6,815	41	17	58	27	11	39	97	0	0	0	51	563	622	1,834	5,178	7,012	7,739

Table 2-8
Sales and Usage of CMWD Imported Water Supplied (AF)

Year[a]	Berylwood Heights MWC	CA-American Water Co.[b]	CWD[c]			Crestview MWC	Solano Verde MWC[d]			VCWD No. 1[e]			VCWD No.19[f]							Zone MWC			Total Imported Water Delivered						
	ELPMA	*WLPMA*	*ELPMA*			*WLPMA*	*WLPMA*			*ELPMA*			*WLPMA*			*ELPMA*				*WLPMA*	*ELPMA*	*Total*	*WLPMA*			*ELPMA*			
	Ag	*M&I*	*Ag*	*M&I*	*Total*	*M&I*	*Ag*	*M&I*	*Total*	*Ag*	*M&I*	*Total*	*Ag*	*M&I*	*Total*	*Ag*	*M&I*	*Total*	*Total*	*Ag*			*Ag*	*M&I*	*Total*	*Ag*	*M&I*	*Total*	*Total*
Average	3	538	93	70	163	205	91	5	95	2,221	6,664	8,886	248	103	350	165	68	234	584	23	15	38	361	851	1,212	2,498	6,802	9,300	10,512

Sources: Bondy, pers. comm. 2017; CWD 2017; VCWD pers. comm. 2016. See lettered notes below for specifics.
Notes: AF = acre-feet; Ag = agricultural; CA-American Water Co. = California-American Water Company; CMWD = Calleguas Municipal Water District; CWD = Camrosa Water District; ELPMA = East Las Posas Management Area; M&I = municipal and industrial; MWC = Mutual Water Company; VCWD = Ventura County Waterworks District; WLPMA = West Las Posas Management Area.

[a] "Year" refers to calendar year.
[b] Data for 2006 to 2015 from Bondy, pers. comm. 2017; 1985 to 2005 is the average of 2006 to 2015.
[c] Data from CWD, pers. comm. 2017.
[d] Large-lot estates with both domestic and agricultural water usage; assumes 95% outdoor usage.
[e] 75% M&I and 25% Ag in 2015 (Ventura County Public Works Agency, Waterworks District email on 04-19-2016).
[f] 29.3% M&I and 70.7% Ag in 2015 (Ventura Public County Works Agency, Waterworks District email on 04-19-2016).

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Table 2-9
Other Imported Water (AF)

Calendar Year	MWTP[a]	Camrosa Water District Deliveries Used in ELPMA[b]					Total M&I	Total Ag	Total
	Recycled Water for M&I	*PVB Groundwater Used for M&I*	*PVB Groundwater Used for Ag*	*ASRVB Pumped Groundwater for M&I*	*ASRVB Pumped Groundwater for Ag*	*Nonpotable Water Delivered by CWD for Ag*			
1985	0	0	0	6	8	0	6	8	14
1986	0	0	0	5	7	0	5	7	13
1987	0	0	0	6	9	0	6	9	15
1988	0	0	0	8	11	0	8	11	19
1989	0	0	0	9	13	0	9	13	22
1990	0	0	0	9	13	0	9	13	22
1991	0	0	0	18	24	0	18	24	42
1992	0	0	0	17	23	0	17	23	40
1993	0	0	0	16	22	0	16	22	38
1994	0	0	0	17	23	0	17	23	39
1995	0	0	0	21	29	0	21	29	50
1996	0	9	12	13	17	0	22	30	52
1997	0	7	10	23	31	0	30	41	71
1998	0	2	3	12	17	0	14	19	33
1999	0	4	6	15	20	0	19	26	45
2000	0	4	5	18	25	0	22	30	52
2001	0	5	7	19	25	0	24	32	57
2002	0	7	9	25	34	0	32	43	75
2003	291	9	12	24	33	0	325	45	370
2004	571	13	17	27	36	0	611	54	665
2005	526	8	10	22	29	0	556	40	595
2006	493	5	6	27	36	0	524	43	567
2007	515	9	12	31	42	0	556	54	610
2008	482	9	11	31	39	16	521	66	587

Table 2-9
Other Imported Water (AF)

Calendar Year	MWTP[a]	Camrosa Water District Deliveries Used in ELPMA[b]					Total M&I	Total Ag	Total
	Recycled Water for M&I	*PVB Groundwater Used for M&I*	*PVB Groundwater Used for Ag*	*ASRVB Pumped Groundwater for M&I*	*ASRVB Pumped Groundwater for Ag*	*Nonpotable Water Delivered by CWD for Ag*			
2009	403	10	12	27	34	60	440	107	547
2010	381	11	14	19	24	104	411	142	554
2011	426	9	12	18	23	148	453	183	637
2012	549	6	8	26	33	163	581	204	785
2013	616	0	0	38	48	178	654	226	880
2014	616	10	12	32	40	193	658	245	904
2015	616	7	11	21	32	207	644	251	895
Maximum	616	13	17	38	48	207	658	251	904
Minimum	0	0	0	5	7	0	5	7	13
Average	209	5	6	19	26	34	233	66	300

Sources: MWTP pers. comm. 2016; CWD pers. comm. 2017.

Notes: AF = acre-feet; Ag = agriculture; ASRVB = Arroyo Santa Rosa Valley Basin; CWD = Camrosa Water District; ELPMA = East Las Posas Management Area; M&I = Municipal and Industrial; MWTP = Moorpark Wastewater Treatment Plant; PVB = Pleasant Valley Basin.

[a] Data from MWTP on August 22, 2016.

[b] Data from Camrosa Water District on August 21, 2017.

Table 2-10a
Water Balance for the WLPMA Shallow Aquifer from the UWCD Model (AF)

Calendar Year	Inflows			Outflows			Total Inflows	Total Outflows	Model Change in Groundwater Storage[a]
	Recharge	*Subsurface Flow from Oxnard Subbasin*	*Subsurface Flow from PVB*	*Outflow to LAS*	*Pumping*	*Subsurface Flow to Oxnard Subbasin*			
1985	3,663	0	0	−5,915	−667	−589	3,663	−7,170	3,507
1986	6,611	2,695	1	−8,184	−973	0	9,307	−9,157	−150
1987	4,482	472	0	−5,808	−1,439	0	4,954	−7,247	2,294
1988	4,857	2,125	11	−6,424	−1,237	0	6,994	−7,661	667

Table 2-10a
Water Balance for the WLPMA Shallow Aquifer from the UWCD Model (AF)

Calendar Year	Inflows			Outflows			Total Inflows	Total Outflows	Model Change in Groundwater Storage[a]
	Recharge	*Subsurface Flow from Oxnard Subbasin*	*Subsurface Flow from PVB*	*Outflow to LAS*	*Pumping*	*Subsurface Flow to Oxnard Subbasin*			
1989	3,574	787	1	−5,136	−1,693	0	4,363	−6,828	2,466
1990	3,937	109	0	−5,657	−823	0	4,046	−6,480	2,434
1991	6,346	2,707	1	−7,834	−612	0	9,054	−8,446	−608
1992	7,392	7,198	68	−9,795	−677	0	14,658	−10,473	−4,186
1993	7,541	8,452	198	−12,095	−915	0	16,191	−13,011	−3,180
1994	4,202	4,505	166	−8,390	−1,431	0	8,872	−9,821	949
1995	8,245	7,544	237	−11,939	−1,245	0	16,025	−13,184	−2,841
1996	6,097	4,677	233	−10,008	−1,313	0	11,007	−11,321	314
1997	5,748	3,825	308	−9,366	−1,511	0	9,881	−10,877	997
1998	9,132	7,690	994	−12,825	−392	0	17,816	−13,216	−4,599
1999	3,685	2,240	800	−7,788	−1,247	0	6,725	−9,036	2,310
2000	5,013	3,085	715	−7,788	−1,544	0	8,813	−9,332	519
2001	6,905	4,630	921	−9,810	−1,453	0	12,456	−11,263	−1,193
2002	4,280	1,874	731	−6,980	−2,237	0	6,886	−9,217	2,332
2003	4,476	2,717	833	−6,817	−1,665	0	8,026	−8,482	456
2004	5,788	2,456	728	−7,711	−1,952	0	8,971	−9,663	692
2005	7,710	9,803	1,194	−12,004	−1,805	0	18,707	−13,808	−4,898
2006	4,969	6,418	994	−9,878	−1,899	0	12,381	−11,777	−603
2007	3,340	1,748	906	−6,725	−2,334	0	5,994	−9,059	3,065
2008	5,538	4,397	843	−9,299	−1,900	0	10,779	−11,199	421
2009	4,637	1,891	786	−7,752	−1,481	0	7,314	−9,233	1,920
2010	7,171	3,092	1,082	−10,105	−1,003	0	11,345	−11,108	−237
2011	4,762	6,146	1,196	−9,560	−1,250	0	12,104	−10,810	−1,294
2012	4,271	2,540	870	−8,256	−1,863	0	7,682	−10,119	2,438

Table 2-10a
Water Balance for the WLPMA Shallow Aquifer from the UWCD Model (AF)

Calendar Year	Inflows			Outflows			Total Inflows	Total Outflows	Model Change in Groundwater Storage[a]
	Recharge	*Subsurface Flow from Oxnard Subbasin*	*Subsurface Flow from PVB*	*Outflow to LAS*	*Pumping*	*Subsurface Flow to Oxnard Subbasin*			
2013	3,005	1,405	493	−5,602	−2,028	0	4,902	−7,630	2,728
2014	4,611	1,603	265	−6,649	−1,690	0	6,478	−8,339	1,862
2015	2,975	1,304	240	−5,114	−1,033	0	4,519	−6,147	1,628
Maximum	9,132	9,803	1,196	−5,114	−392	0	18,707	−6,147	3,507
Minimum	2,975	0	0	−12,825	−2,334	−589	3,663	−13,808	−4,898
Average	5,321	3,553	510	−8,297	−1,397	−19	9,384	−9,713	329

Notes: AF = acre-feet; LAS = Lower Aquifer System; PVB = Pleasant Valley Basin; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.
Components are from the UWCD model.
[a] A negative number indicates that water entered storage.

Table 2-10b
Water Balance for the WLPMA LAS from the UWCD Model (AF)

Calendar Year	Inflows					Outflows			Inflows	Outflows	Model Change in Storage[a]
	Recharge from USP Outcrops	*Recharge*	*From Alluvium*	*Subsurface Flow from Oxnard Subbasin*	*Subsurface Flow from PVB*	*Subsurface Flow to Oxnard Subbasin*	*Pumping*	*Subsurface Flow to PVB*			
1985	823	899	5,915	0	0	−292	−13,940	−1,425	7,636	−15,657	8,021
1986	2,440	1,625	8,184	292	0	0	−13,226	−686	12,541	−13,912	1,371
1987	1,098	1,049	5,808	0	0	−1,091	−15,416	−1,343	7,955	−17,851	9,895
1988	1,412	1,113	6,424	0	0	−470	−16,397	−678	8,949	−17,546	8,596
1989	419	703	5,136	0	0	−1,569	−17,505	−961	6,257	−20,035	13,778
1990	466	748	5,657	0	0	−1,838	−20,321	−1,259	6,871	−23,417	16,546
1991	2,314	1,453	7,834	0	0	−911	−15,268	−830	11,601	−17,008	5,407
1992	3,067	1,844	9,795	1,474	407	0	−13,551	0	16,588	−13,551	−3,037
1993	3,040	1,879	12,095	2,170	879	0	−14,263	0	20,064	−14,263	−5,801
1994	1,090	1,025	8,390	719	466	0	−13,849	0	11,690	−13,849	2,159
1995	3,856	2,119	11,939	1,393	811	0	−11,383	0	20,117	−11,383	−8,735
1996	2,485	1,492	10,008	866	420	0	−11,617	0	15,271	−11,617	−3,655
1997	1,872	1,376	9,366	557	314	0	−14,392	0	13,485	−14,392	907
1998	4,066	2,303	12,825	2,093	1,085	0	−10,670	0	22,372	−10,670	−11,702
1999	896	866	7,788	834	259	0	−13,098	0	10,643	−13,098	2,455
2000	1,654	1,215	7,788	450	39	0	−12,989	0	11,146	−12,989	1,844
2001	3,103	1,725	9,810	620	219	0	−9,455	0	15,477	−9,455	−6,021
2002	1,153	1,020	6,980	0	0	−470	−13,139	−303	9,153	−13,911	4,759
2003	1,378	1,111	6,817	0	125	−36	−10,751	0	9,431	−10,786	1,356
2004	2,074	1,412	7,711	0	0	−529	−11,596	−54	11,198	−12,179	981
2005	3,285	1,903	12,004	1,799	614	0	−10,678	0	19,604	−10,678	−8,927
2006	1,780	1,210	9,878	999	693	0	−9,375	0	14,560	−9,375	−5,185
2007	595	776	6,725	55	383	0	−13,974	0	8,533	−13,974	5,441
2008	1,846	1,363	9,299	0	621	−195	−14,957	0	13,129	−15,152	2,023
2009	1,297	1,069	7,752	0	853	−772	−15,318	0	10,971	−16,090	5,119
2010	2,710	1,755	10,105	136	1,438	0	−14,243	0	16,144	−14,243	−1,902
2011	1,259	1,157	9,560	1,115	1,701	0	−15,720	0	14,792	−15,720	927
2012	905	996	8,256	0	1,429	−463	−18,183	0	11,586	−18,646	7,061
2013	103	643	5,602	0	381	−1,061	−17,262	0	6,728	−18,323	11,595
2014	1,020	1,056	6,649	0	0	−1,681	−15,410	−73	8,726	−17,164	8,438
2015	263	630	5,114	0	269	−1,264	−15,350	0	6,276	−16,614	10,338
Maximum	4,066	2,303	12,825	2,170	5,796	0	−9,375	0	22,372	−9,375	16,546
Minimum	103	630	5,114	0	0	−1,838	−20,321	−1,425	6,257	−23,417	−11,702
Average	1,734	1,275	8,297	502	432	−408	−13,977	−246	12,242	−14,631	2,389

Notes: AF = acre-feet; LAS = Lower Aquifer System; USP = Upper San Pedro Formation; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.
Components are from the UWCD model.
[a] A negative number indicates that water entered storage.

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Table 2-11
Recharge Type (AF)

Calendar Year	Precipitation Recharge	M&I Recharge	Ag Recharge	Total
1985	2,044	1,189	1,329	4,561
1986	5,808	1,064	1,363	8,236
1987	2,548	1,397	1,586	5,531
1988	2,976	1,423	1,572	5,971
1989	986	1,449	1,842	4,277
1990	953	1,642	2,090	4,685
1991	4,921	1,307	1,572	7,800
1992	6,700	1,227	1,310	9,236
1993	6,799	1,220	1,401	9,420
1994	2,600	1,265	1,361	5,226
1995	8,142	1,019	1,202	10,363
1996	5,327	817	1,445	7,589
1997	4,310	1,049	1,764	7,124
1998	9,416	745	1,275	11,435
1999	2,047	1,013	1,491	4,551
2000	3,675	1,113	1,439	6,227
2001	6,578	867	1,185	8,630
2002	2,433	1,298	1,568	5,300
2003	3,400	915	1,273	5,587
2004	4,701	1,101	1,398	7,200
2005	7,382	980	1,251	9,613
2006	3,906	1,098	1,175	6,179
2007	1,227	1,389	1,499	4,116
2008	3,877	1,577	1,447	6,901
2009	2,836	1,457	1,413	5,706
2010	6,242	1,256	1,427	8,926
2011	3,053	1,225	1,641	5,919
2012	1,870	1,425	1,972	5,267
2013	218	1,626	1,803	3,647
2014	2,517	1,468	1,683	5,667
2015	634	1,352	1,618	3,605
Maximum	9,416	1,642	2,090	11,435
Minimum	218	745	1,175	3,605
Average	3,875	1,225	1,497	6,597

Notes: AF = acre-feet; Ag = agricultural; M&I = municipal and industrial.

Table 2-12
Calleguas Municipal Water District Aquifer Storage and Recovery Program (AF)

Calendar Year	In-Lieu Water Deliveries		Net ASR System Injection in ELPMA	Pumping Allocation in ELPMA	Cumulative Storage		
	WLPMA	*ELPMA*			*WLPMA*	*ELPMA*	*Total*
1985	0	0	0	0.0	0	0	0
1986	0	0	0	0.0	0	0	0
1987	0	0	0	0.0	0	0	0
1988	0	0	0	0.0	0	0	0
1989	0	0	0	0.0	0	0	0
1990	0	0	0	0.0	0	0	0
1991	0	0	0	0.0	0	0	0
1992	0	0	0	0.0	0	0	0
1993	0	0	65	2.5	0	67	67
1994	0	0	248	2.5	0	318	318
1995	380	276	371	2.3	380	967	1,347
1996	2,088	5,501	−11	2.3	2,468	6,460	8,928
1997	1,933	3,047	87	2.3	4,401	9,596	13,997
1998	914	628	−61	2.3	5,315	10,165	15,480
1999	2,000	0	6	2.3	7,315	10,174	17,489
2000	2,279	1,871	1	2.2	9,594	12,046	21,640
2001	2,125	140	0	2.2	11,719	12,186	23,905
2002	2,000	0	225	2.2	13,719	12,414	26,133
2003	2,498	1,374	1,157	2.2	16,217	14,947	31,164
2004	2,171	2,307	919	2.2	18,388	18,175	36,563
2005	1,956	2,118	1,690	2.2	20,344	21,985	42,329
2006	1,975	2,446	4,227	2.2	22,319	28,660	50,979
2007	2,472	551	−2,167	2.2	24,791	27,047	51,838
2008	401	0	−5,110	2.2	25,192	21,939	47,131
2009	0	0	−9,770	2.1	25,192	12,171	37,363
2010	0	946	−9,035	1.9	25,192	4,084	29,276
2011	0	724	−422	1.9	25,192	4,388	29,580
2012	0	437	1,171	1.9	25,192	5,998	31,190
2013	0	491	419	1.9	25,192	6,910	32,102
2014	0	510	2,938	1.9	25,192	10,360	35,552
2015	0	433	604	1.7	25,192	11,398	36,590
Maximum	2,498	5,501	4,227	2	25,192	28,660	51,838
Minimum	0	0	−9,770	0	0	0	0
Average	813	768	−402	2	11,565	8,466	20,031

Source: FCGMA email November 11, 2017.
Notes: AF = acre-feet; ELPMA = East Las Posas Management Area; WLPMA = West Las Posas Management Area.
Net ASR System Injection in ELPMA negative numbers indicate net pumping during the year.

Table 2-13
WLPMA UWCD Model Pumping by FCGMA Types (AF)

Calendar Year	Agricultural Pumpage			M&I Pumpage			Domestic Pumpage			Totals		
	Pumping Shallow	*Pumping LAS*	*Total Agricultural Pumping*	*Pumping Shallow*	*Pumping LAS*	*Total M&I Pumping*	*Pumping Shallow*	*Pumping LAS*	*Total Domestic Pumping*	*Total Pumping Shallow*	*Total Pumping LAS*	*Total Groundwater Pumping*
1985	667	13,303	13,969	0	638	638	0	0	0	667	13,940	14,607
1986	973	12,321	13,294	0	905	905	0	0	0	973	13,226	14,199
1987	1,439	13,447	14,886	0	1,970	1,970	0	0	0	1,439	15,416	16,855
1988	1,237	14,700	15,937	0	1,697	1,697	0	0	0	1,237	16,397	17,634
1989	1,693	16,593	18,286	0	912	912	0	0	0	1,693	17,505	19,198
1990	823	18,515	19,338	0	1,806	1,806	0	0	0	823	20,321	21,144
1991	611	14,272	14,883	0	996	996	1	0	1	612	15,268	15,880
1992	675	12,328	13,003	0	1,223	1,223	2	0	2	677	13,551	14,228
1993	907	12,802	13,709	6	1,462	1,468	2	0	2	915	14,263	15,179
1994	1,429	12,431	13,859	0	1,418	1,418	2	0	2	1,431	13,849	15,280
1995	1,243	9,947	11,190	0	1,436	1,436	2	0	2	1,245	11,383	12,628
1996	1,310	9,595	10,904	0	2,022	2,022	3	0	3	1,313	11,617	12,929
1997	1,508	12,298	13,806	0	2,094	2,094	3	0	3	1,511	14,392	15,903
1998	383	9,049	9,433	0	1,620	1,620	8	0	8	392	10,670	11,062
1999	1,245	10,897	12,143	0	2,201	2,201	2	0	2	1,247	13,098	14,345
2000	1,542	10,432	11,974	0	2,557	2,557	3	0	3	1,544	12,989	14,533
2001	1,450	7,406	8,856	0	2,049	2,049	3	0	3	1,453	9,455	10,908
2002	2,235	10,202	12,436	0	2,937	2,937	2	0	2	2,237	13,139	15,376
2003	1,662	8,368	10,030	0	2,383	2,383	3	0	3	1,665	10,751	12,416
2004	1,950	9,097	11,046	0	2,499	2,499	2	0	2	1,952	11,596	13,548
2005	1,801	8,546	10,347	0	2,132	2,132	4	0	4	1,805	10,678	12,483
2006	1,895	7,478	9,374	0	1,896	1,896	4	0	4	1,899	9,375	11,274
2007	2,331	11,420	13,751	0	2,554	2,554	4	0	4	2,334	13,974	16,308
2008	1,898	12,219	14,117	0	2,738	2,738	3	0	3	1,900	14,957	16,858
2009	1,480	12,598	14,078	0	2,720	2,720	1	0	1	1,481	15,318	16,799
2010	1,001	12,343	13,344	0	1,900	1,900	2	0	2	1,003	14,243	15,246
2011	1,242	13,112	14,354	0	2,608	2,608	8	0	8	1,250	15,720	16,970
2012	1,856	15,031	16,887	0	3,152	3,152	7	0	7	1,863	18,183	20,047
2013	2,025	14,368	16,393	0	2,894	2,894	3	0	3	2,028	17,262	19,290
2014	1,689	12,714	14,402	0	2,696	2,696	2	0	2	1,690	15,410	17,100
2015	1,033	12,854	13,887	0	2,496	2,496	1	0	1	1,033	15,350	16,383
Maximum	2,331	18,515	19,338	6	3,152	3,152	8	0	8	2,334	20,321	21,144
Minimum	383	7,406	8,856	0	638	638	0	0	0	392	9,375	10,908
Average	1,395	11,958	13,352	0	2,020	2,020	2	0	2	1,397	13,977	15,374

Sources: UWCD model (pumping amounts); FCGMA well database (usage type).
Notes: AF = acre-feet; FCGMA = Fox Canyon Groundwater Management Agency; LAS = Lower Aquifer System; M&I = municipal and industrial; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.

Table 2-14
ELPMA CMWD Model Groundwater Pumping by FCGMA Type (AF)

Calendar Year	Ag Pumping						M&I Pumping						Domestic Pumping						Total Reported GWP					
	EGA	*SAA*	*USP*	*FCA*	*GCA*	*Total Ag*	*EGA*	*SAA*	*USP*	*FCA*	*GCA*	*Total M&I*	*EGA*	*SAA*	*USP*	*FCA*	*GCA*	*Total Domestic*	*EGA*	*SAA*	*USP*	*FCA*	*GCA*	*Total GWP*
1985	1,444	346	991	11,350	652	14,784	251	60	172	1,973	113	2,570	33	8	23	262	15	342	1,729	414	1,187	13,586	780	17,696
1986	1,222	277	1,046	9,880	641	13,066	282	64	241	2,279	148	3,015	17	4	14	136	9	180	1,521	345	1,302	12,295	797	16,260
1987	1,078	305	1,384	11,550	825	15,143	276	78	355	2,961	212	3,882	1	0	1	9	1	12	1,356	384	1,740	14,520	1,038	19,038
1988	1,019	265	1,454	12,996	1,122	16,855	224	58	320	2,857	247	3,706	2	0	3	25	2	32	1,245	323	1,776	15,878	1,370	20,593
1989	1,303	333	1,444	15,023	1,306	19,409	254	65	282	2,930	255	3,785	4	1	4	45	4	58	1,561	398	1,730	17,998	1,565	23,252
1990	1,628	271	1,341	13,587	1,437	18,264	385	64	317	3,211	340	4,317	4	1	4	36	4	49	2,017	336	1,661	16,835	1,780	22,629
1991	1,422	281	1,207	11,766	1,274	15,951	224	44	190	1,854	201	2,514	3	1	3	25	3	33	1,649	326	1,400	13,645	1,477	18,498
1992	1,082	234	745	9,913	1,114	13,088	160	35	110	1,464	165	1,933	4	1	2	32	4	43	1,246	269	857	11,410	1,282	15,064
1993	1,260	242	856	10,899	1,220	14,477	138	26	94	1,193	134	1,584	4	1	3	33	4	44	1,402	269	952	12,124	1,357	16,105
1994	1,377	270	1,072	11,485	1,289	15,493	246	48	191	2,050	230	2,766	4	1	3	34	4	46	1,627	319	1,267	13,570	1,523	18,305
1995	1,032	219	1,233	9,455	938	12,876	197	42	236	1,806	179	2,460	4	1	5	36	4	49	1,233	262	1,473	11,297	1,121	15,386
1996	1,278	209	1,133	7,594	1,127	11,341	62	10	55	367	54	548	5	1	5	31	5	46	1,345	220	1,192	7,992	1,186	11,935
1997	1,233	284	1,323	11,878	1,349	16,066	59	14	63	567	64	768	4	1	5	43	5	58	1,296	299	1,391	12,488	1,418	16,892
1998	574	909	1,199	10,767	1,037	14,486	39	61	81	723	70	973	2	2	3	30	3	40	614	972	1,283	11,520	1,109	15,499
1999	898	305	1,428	14,053	1,514	18,197	85	29	135	1,327	143	1,719	2	1	4	38	4	49	985	335	1,566	15,418	1,661	19,965
2000	911	419	1,475	13,992	1,371	18,167	20	9	32	306	30	397	2	1	4	37	4	47	933	429	1,511	14,335	1,404	18,612
2001	755	383	1,064	9,688	1,150	13,040	54	27	76	692	82	932	2	1	3	30	4	41	811	411	1,144	10,411	1,236	14,013
2002	1,094	859	1,622	13,056	1,421	18,052	110	86	163	1,313	143	1,816	3	2	4	30	3	42	1,207	947	1,789	14,399	1,567	19,909
2003	1,227	310	1,384	11,309	1,279	15,510	79	20	89	726	82	995	3	1	3	28	3	39	1,308	331	1,476	12,063	1,365	16,544
2004	1,403	488	1,474	13,138	1,510	18,014	20	7	21	187	22	257	6	2	6	54	6	73	1,429	497	1,501	13,379	1,538	18,344
2005	654	385	1,125	10,154	1,141	13,459	21	13	37	333	37	441	2	1	3	31	3	41	677	399	1,166	10,517	1,182	13,941
2006	1,251	327	1,362	14,158	1,103	18,200	28	7	31	317	25	408	1	0	1	12	1	16	1,280	334	1,393	14,488	1,128	18,624
2007	1,149	480	1,314	15,798	1,482	20,223	199	83	228	2,740	257	3,508	1	0	1	11	1	14	1,349	563	1,543	18,549	1,741	23,745
2008	616	350	1,035	14,709	1,484	18,195	215	122	362	5,140	519	6,358	0	0	1	10	1	12	832	473	1,398	19,859	2,003	24,565
2009	712	285	1,023	15,434	1,403	18,858	432	173	621	9,367	852	11,445	0	0	1	10	1	12	1,145	458	1,645	24,811	2,256	30,315
2010	657	136	690	14,063	1,288	16,834	394	81	414	8,440	773	10,103	1	0	1	14	1	17	1,051	217	1,105	22,517	2,063	26,954
2011	873	182	993	13,233	1,396	16,677	159	33	181	2,410	254	3,038	1	0	1	11	1	14	1,033	216	1,175	15,654	1,652	19,729
2012	1,148	252	1,304	16,358	1,614	20,676	135	30	153	1,924	190	2,432	1	0	1	12	1	15	1,284	282	1,458	18,293	1,805	23,122
2013	1,278	240	1,654	18,870	2,367	24,409	157	29	203	2,321	291	3,002	1	0	2	17	2	23	1,436	269	1,859	21,209	2,661	27,434
2014	1,615	319	1,349	17,690	2,103	23,076	208	41	174	2,277	271	2,970	1	0	1	14	2	18	1,824	360	1,524	19,980	2,376	26,064
2015	1,432	186	1,523	16,879	1,790	21,810	133	17	141	1,567	166	2,025	1	0	2	18	2	23	1,567	203	1,665	18,464	1,959	23,858
Maximum	1,628	909	1,654	18,870	2,367	24,409	432	173	621	9,367	852	11,445	33	8	23	262	15	342	2,017	972	1,859	24,811	2,661	30,315
Minimum	574	136	690	7,594	641	11,341	20	7	21	187	22	257	0	0	1	9	1	12	614	203	857	7,992	780	11,935
Average	1,117	334	1,234	12,927	1,314	16,926	169	48	186	2,182	211	2,796	4	1	4	37	3	49	1,290	383	1,424	15,145	1,529	19,771

Notes: AF = acre-feet; Ag = agricultural; CMWD = Calleguas Municipal Water District; EGA = Epworth Gravels Aquifer; ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; FCGMA = Fox Canyon Groundwater Management Agency; GCA = Grimes Canyon Aquifer; GWP = groundwater pumping; M&I = municipal and industrial; SAA = Shallow Alluvial Aquifer; USP = Upper San Pedro Formation.

Table 2-15
UWCD Model Scenario Extraction Rates for the WLPMA (AFY)

UWCD Model Scenario	Shallow Aquifer Groundwater Extractions	LAS Groundwater Extractions	Total Groundwater Extractions	Project Water	Total Scenario
Future Baseline	1,000	13,000	14,000	0	14,000
Future Baseline With Projects	1,000	11,000	12,000	2,000	14,000
Reduction With Projects	1,000	9,000	10,000	2,000	12,000
Reduction Without Projects Scenario 1	1,000	10,000	11,000	0	11,000
Reduction Without Projects Scenario 2	1,000	10,000	11,000	0	11,000
Reduction Without Projects Scenario 3	1,000	13,000	14,000	0	14,000

Notes: AFY = acre-feet per year; LAS = Lower Aquifer System; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.

Table 2-16
Modeled 2040–2069 Groundwater Extraction Rates for the ELPMA

CMWD Model Scenario	Model Extraction Rates (AFY)
Future Baseline	22,000
Future Baseline With Projects	22,000
Reduction With Projects (15% Epworth Gravels Aquifer; 10% FCA and GCA)	20,000
Reduction Without Projects (1) (10% Epworth Gravels Aquifer; 25% FCA and GCA)	17,000
Reduction Without Projects (2) (12% Epworth Gravels Aquifer; 15% FCA and GCA)	19,000

Notes: AFY = acre-feet per year; CMWD = Calleguas Municipal Water District; ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer.

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Figure 2-1 Map of the Las Posas Valley Basin

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Figure 2-2 Geology of the Las Posas Valley Basin

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Figure 2-3 Conceptual Cross Section A–A′

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Figure 2-4 Conceptual Cross Section B–B′

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Figure 2-26 West Las Posas Management Area Annual Change in Storage

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Figure 2-27 West Las Posas Management Area Cumulative Change in Storage

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Figure 2-28 East Las Posas Management Area Annual Change in Storage

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Figure 2-29 East Las Posas Management Area Cumulative Change in Storage

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Figure 2-30A Most Recent Total Dissolved Solids (mg/L) Measured 2011-2015

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Figure 2-30B Most Recent Total Dissolved Solids (mg/L) Measured 2011-2015

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Figure 2-31A Most Recent Chloride (mg/L) Measured 2011-2015

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Figure 2-31B Most Recent Chloride (mg/L) Measured 2011-2015

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Figure 2-32A Most Recent Nitrate (mg/L as Nitrate) Measured 2011-2015

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Figure 2-32B Most Recent Nitrate (mg/L as Nitrate) Measured 2011-2015

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Figure 2-33A Most Recent Sulfate (mg/L) Measured 2011-2015

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Figure 2-33B Most Recent Sulfate (mg/L) Measured 2011-2015

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Figure 2-34A Most Recent Boron (mg/L) Measured 2011–2015

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CHAPTER 3
SUSTAINABLE MANAGEMENT CRITERIA

3.1 INTRODUCTION TO SUSTAINABLE MANAGEMENT CRITERIA

In the Las Posas Valley Basin (LPVB), chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply, along with a corresponding loss of storage and potential for subsidence due to groundwater withdrawal, are the primary undesirable results that can occur when groundwater production exceeds the sustainable yield. In order to sustainably manage the groundwater resources of the LPVB, the LPVB has been divided into three management areas (see Section 2.5, Management Areas, and Figure 1-2, Administrative Boundaries for the Las Posas Valley Basin, of this Groundwater Sustainability Plan [GSP]). These areas are defined by differences in their hydrogeologic properties or historical groundwater elevations.

Declines in groundwater elevation in the West Las Posas Management Area (WLPMA) affect the groundwater gradient across the boundary between the LPVB and the Oxnard Subbasin of the Santa Clara River Valley Groundwater Basin (Oxnard Subbasin). Changes to this gradient impact seawater intrusion in the Oxnard Subbasin, which is in hydraulic communication with the WLPMA (Chapter 2, Basin Setting). The boundary between the WLPMA and the Oxnard Subbasin is not a barrier to flow, but rather is based on a change of lithology in the Upper Aquifer System (UAS) (see Chapter 2). In the Lower Aquifer System (LAS), the Fox Canyon Aquifer (FCA) and the Grimes Canyon Aquifer are continuous across the boundary. Therefore, although the WLPMA has not experienced direct seawater intrusion historically, determination of the sustainable management criteria for the WLPMA is coupled to sustainable management of the Oxnard Subbasin.

Groundwater elevations in the East Las Posas Management Area (ELPMA) are not influenced by and do not influence groundwater elevations in the adjacent groundwater basins, or the other management areas of the LPVB. The same is true for groundwater elevations in the Epworth Gravels Management Area.

On October 28, 2015, the Fox Canyon Groundwater Management Agency (FCGMA) Board of Directors (Board) adopted the following planning goals regarding management of the basins within its jurisdiction (FCGMA 2015):

- Control saline water impact front at its current position.
- Do not allow groundwater quality to further degrade without mitigation.
- No net subsidence due to groundwater withdrawal.
- Promote water levels that mitigate or minimize undesirable results (including pumping trough depressions, surface water connectivity, and chronic lowering of water levels).

These goals, which apply to all basins within FCGMA jurisdiction, guide the definition of undesirable results, minimum thresholds, and measurable objectives in the subsequent sections.

Groundwater elevations are the primary metrics by which progress toward meeting the sustainability goal in the LPVB will be measured. Sustainable management of the LPVB does not necessarily mean, however, that springtime high groundwater levels in the basin remain the same year over year. Rather sustainability can be achieved over cycles of drought and recovery, so long as the impacts to the basin that may occur during periods of drought are not significant or unreasonable. Thus, year over year, groundwater levels may decline during a drought, but sustainable management will result in groundwater levels—and, by extension, land surface elevations and groundwater in storage—returning to pre-drought levels in the wet years following a drought.

3.2 SUSTAINABILITY GOAL

The sustainability goal in the LPVB is to maintain a sufficient volume of groundwater in storage in each management area so that there is no significant and unreasonable net decline in groundwater elevation or storage over wet and dry climatic cycles. Further, groundwater levels in the WLPMA will 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 (see Section 3.3.3, Seawater Intrusion) after 2040.

The sustainability goal for the LPVB recognizes the influence of climatic cycles on groundwater elevations over multi-year periods and requires that assessment of undesirable results in the LPVB be tied to a time period over which net impacts are measured. Critically for the LPVB, climate cycles exert little measurable influence on groundwater elevations (see Chapter 2).

This GSP assesses net impacts to the LPVB over both a 50-year period beginning in 2020 and a 30-year period beginning in 2040. Undesirable results may occur in the LPVB between 2020 and 2039, as progress is made toward achieving the sustainability goal. By 2040, however, management of the LPVB will achieve the sustainability goal. The 30-year period from 2040 through 2069 is referred to as the sustaining period in this GSP, as it is the period on which the evaluation of sustainability is based.

In order to achieve the sustainability goal, groundwater production from the three management areas of the LPVB will need to be reduced relative to historical groundwater production rates. During the first 5 years following GSP adoption, it is anticipated that the groundwater production will begin to be reduced toward the estimated sustainable yield, accounting for the uncertainty assessed in the model water budget and sustainable yield projections for the different management areas (see Section 2.4, Water Budget).

Proposed reductions in groundwater production should take into account both the potential economic disruption to the users of groundwater and the uncertainty in the estimated sustainable yield of the LPVB. Because the management areas of the LPVB are hydrologically separated from each other, the estimated sustainable yield of the LPVB is broken out by management area. The sustainable yield of the WLPMA is approximately 12,500 acre-feet per year (AFY), with an uncertainty estimate of ±1,200 AFY (see Section 2.4.5.1.9, West Las Posas Management Area: Estimates of Future Sustainable Yield). The average 2015–2017 groundwater production rate was approximately 14,000 AFY. The difference between the estimated sustainable yield and the average 2015 production rate is 1,500 AFY. If production is reduced linearly between 2020 and 2040, the estimated groundwater production reduction necessary throughout the geographic extent of the WLPMA over the first 5 years is approximately 375 AFY. To reflect the uncertainty in the estimated sustainable yield estimate, the difference between the upper estimate of the sustainable yield (13,700 AFY) and the 2015 production rate (1,400 AFY) is also examined. This difference is 300 AFY. If production is reduced linearly between 2020 and 2040, the estimated groundwater production reduction necessary throughout the geographic extent of the WLPMA over the first 5 years is approximately 70 AFY. The sustainability goal allows for operational flexibility, as groundwater production patterns are anticipated to change during the GSP implementation period. Progress toward sustainability will be evaluated throughout the 20-year implementation period from 2020 through 2039. The estimated sustainable yield may be revised based on progress toward sustainability in the WLPMA and the Oxnard Subbasin.

In the ELPMA and the Epworth Gravels Management Area combined, the sustainable yield is estimated to be between 17,800 AFY ±2,300 AFY (see Section 2.4.5.2.7, East Las Posas Management Area: Estimates of Future Sustainable Yield). This estimate includes production from the Epworth Gravels Management Area. In the Epworth Gravels Management Area, the sustainable yield is estimated to be approximately 1,300 AFY (see Section 2.4.5.2.7). If the estimated sustainable yield of the Epworth Gravels Management Area is subtracted, the estimated sustainable yield for the ELPMA is approximately 15,700 ±1,250 AFY to 18,700 ±1,500 AFY. The average 2015–2017 groundwater production rate was approximately 20,500 AFY, excluding production from the Epworth Gravels Management Area. To reflect the uncertainty in the estimated sustainable yield, the difference between the upper and lower estimates of the sustainable yield were examined. The difference between the upper estimate of the sustainable yield (20,200 AFY) and the 2015 production rate (20,500 AFY) is 300 AFY. If production is reduced linearly between 2020 and 2040, the estimated groundwater production reduction necessary for the aquifers of the ELPMA over the first 5 years is approximately 75 acre-feet (AF), or 15 AFY. The difference between the lower estimate of the sustainable yield and the average 2015 production rate is 6,000 AFY. If production is reduced linearly between 2020 and 2040 the reduction in groundwater production over the first 5 years is approximately 1,500 AF, or 300 AFY.

The average 2015 production rate in the Epworth Gravels Aquifer was approximately 1,500 AFY. The difference between the estimated sustainable yield and the 2015 production rate is 200 AFY. If production is reduced linearly between 2020 and 2040, the estimated groundwater production reduction necessary for the aquifers of the ELPMA over the first 5 years is approximately 50 AFY. As is true for the WLPMA, the sustainability goal in the ELPMA and the Epworth Gravels Aquifer allows for operational flexibility and progress toward sustainability will be evaluated throughout the 20-year implementation period. The estimated sustainable yield may be revised based on progress toward sustainability over the next 5 years.

The following sections describe the undesirable results that have occurred and may occur within the LPVB, the minimum thresholds developed to avoid future undesirable results, and the measurable objectives 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.

3.3 UNDESIRABLE RESULTS

Under the Sustainable Groundwater Management Act (SGMA), undesirable results occur when the effects caused by groundwater conditions occurring throughout the basin cause significant and unreasonable impacts to any of the six sustainability indicators. These sustainability indicators are:

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

The definition of what constitutes a significant and unreasonable impact for each sustainability indicator is determined locally using the processes and criteria set forth in this GSP. Each of the sustainability indicators is discussed below, in the context of undesirable results.

3.3.1 Chronic Lowering of Groundwater Levels

Chronic lowering of groundwater levels resulting in a significant and unreasonable depletion of supply is an undesirable result applicable to the LPVB. Chronic lowering of groundwater levels in the LPVB is also associated with depletion of groundwater in storage, degradation of groundwater quality, and subsidence. Depletion of groundwater in storage will occur in the LPVB if groundwater production exceeds the natural and artificial recharge over a multi-year period that includes both wetter than average and drier than average conditions. Degradation of groundwater quality may occur in the ELPMA if groundwater production results in migration of poor-quality recharge water along Arroyo Simi–Las Posas. Subsidence can occur in the LPVB if groundwater elevations fall below historical low water levels for a sufficient time to allow collapse of the pore structure and settling of geologic formations.

Direct seawater intrusion is not a concern in the LPVB (see Section 3.3.3); however, groundwater elevations in the WLPMA impact groundwater elevations in the Oxnard Subbasin to the west. Consequently, chronic lowering of groundwater levels in the WLPMA has the potential to exacerbate seawater intrusion in the Oxnard Subbasin and may inhibit the ability of the Oxnard Subbasin to prevent net landward migration of the saline water impact front after 2040. This potential is greatest in the western part of the WLPMA, adjacent to the Oxnard Subbasin. Declines in groundwater elevation in the eastern part of the WLPMA are less likely to influence seawater intrusion in the Oxnard Subbasin.

The primary cause of groundwater conditions in the LPVB that would lead to chronic lowering of groundwater levels is groundwater production in excess of natural and artificial recharge. Groundwater production from the LPVB would result in significant and unreasonable lowering of groundwater levels if the groundwater levels were lowered to an elevation below which:

- Groundwater levels do not recover to pre-drought conditions during multi-year periods of above-average precipitation that follow a drought.
- The Oxnard Subbasin is unable to prevent net landward migration of the saline water impact front after 2040.
- Subsidence that substantially interferes with surface land uses is induced.

Of these criteria, chronic lowering of groundwater levels and impacting the landward migration of the saline water impact front are the most likely to occur in the LPVB. Historically, the LPVB has not experienced subsidence that substantially interfered with surface land uses.

West Las Posas Management Area

Based on need for the coordinated management of the LPVB and the Oxnard Subbasin, the criteria used to define undesirable results for chronic lowering of groundwater levels in the western part of the WLPMA are groundwater levels that indicate a long-term decline over periods of drought and recovery, and net landward migration of the 2015 saline water impact front after 2040. It is expected that there will be some landward migration of this front between 2020 and 2040 as FCGMA undertakes the necessary projects and management actions toward achieving sustainability in 2040. The minimum thresholds metric against which chronic lowering of groundwater levels will be measured is groundwater levels from which complete recovery can be achieved over anticipated periods of drought and above average precipitation. These groundwater levels, which are higher than previous historical low groundwater levels, are anticipated to prevent net landward migration of the 2015 saline water impact front in the Oxnard Subbasin. (Table 3-1, Minimum Threshold Groundwater Elevations by Well, Management Area, and Aquifer for Key Wells in the Las Posas Valley Basin; Figure 3-1, Key Wells Screened in the Fox Canyon Aquifer for the Las Posas Valley Basin, and Figure 3-2, Key Wells Screened in the Shallow Alluvial Aquifer and Epworth Gravels Aquifer for the Las Posas Valley Basin).

The criterion used to define undesirable results for chronic lowering of groundwater levels in the eastern part of the WLPMA is groundwater levels that indicate a long-term decline over periods of drought and recovery. The minimum thresholds metric against which chronic lowering of groundwater levels will be measured is groundwater levels from which complete recovery can be achieved over anticipated periods of drought and above-average precipitation.

East Las Posas Management Area

Groundwater elevation declines in the ELPMA result in differential impacts depending on location within the management area. In the vicinity of the Moorpark anticline and on the northern and southern boundaries of the ELPMA, declines in groundwater elevation will result in currently confined areas of the FCA becoming unconfined. In order to limit the area of the FCA that becomes unconfined and to preserve groundwater storage for users of groundwater in the ELPMA, a storage loss of greater than 20% of the 2015 groundwater storage in the areas prone to greater impacts from conversion of the FCA to unconfined conditions was defined as the undesirable result. Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply.

The criteria used to define undesirable results for chronic lowering of groundwater levels in the ELPMA are groundwater levels that indicate a long-term decline over periods of drought and recovery, and groundwater levels that result in localized loss of storage in excess of 20% of the estimated 2015 groundwater storage. The minimum thresholds metric against which chronic lowering of groundwater levels will be measured is groundwater levels that prevent greater than 20% loss of storage in the areas of the ELPMA that will be most impacted by ongoing declines in groundwater elevation.

Epworth Gravels Management Area

Historical groundwater elevation declines in the Epworth Gravels Aquifer have resulted in loss of groundwater supply in this aquifer. As deeper wells, screened in the FCA, replaced wells in the

Epworth Gravels Aquifer, groundwater elevations in the Epworth Gravels Aquifer recovered (see Chapter 2). In order to maintain a sufficient volume of groundwater in storage in the Epworth Gravels Aquifer, the criteria used to define undesirable results for chronic lowering of groundwater levels in the Epworth Gravels Management Area is the same as it is for the ELPMA: groundwater levels that indicate a long-term decline over periods of drought and recovery and groundwater levels that result in loss of storage in excess of 20% of the estimated 2015 groundwater storage. The minimum thresholds metric against which chronic lowering of groundwater levels will be measured is groundwater levels from which complete recovery can be achieved over anticipated periods of drought and above-average precipitation.

3.3.2 Reduction of Groundwater Storage

Significant and unreasonable reduction of groundwater storage is an undesirable result applicable to the LPVB. Reduction of groundwater storage in the LPVB is also associated with chronic lowering of groundwater levels and subsidence. Additionally, because reduction of groundwater storage in the WLPMA is correlated with declines in groundwater elevations, reduction in groundwater storage in the WLPMA has the potential to exacerbate seawater intrusion in the Oxnard Subbasin and may inhibit the ability of the Oxnard Subbasin to prevent net landward migration of the 2015 saline water impact front after 2040.

The primary cause of groundwater conditions in the LPVB that would lead to reduction in groundwater storage is groundwater production in excess of recharge over cycles of drought and recovery. Groundwater production from the LPVB may result in a significant and unreasonable reduction of groundwater in storage if the volume of groundwater produced from the basin exceeds the volume of freshwater recharging the basin over a cycle of drought and recovery. Changes in groundwater in storage that would indicate significant and unreasonable depletions differ between management areas.

Reduction of groundwater storage has the potential to impact the beneficial uses and users of groundwater in the LPVB by limiting the volume of groundwater available for agricultural, municipal, industrial, and domestic use. These impacts can affect all users of groundwater in the LPVB.

Groundwater elevations within each management area of the LPVB will be used to determine whether significant and unreasonable reduction of groundwater in storage is occurring. All of the management areas have wells in which groundwater levels can be monitored.

West Las Posas Management Area

In the WLPMA, reduction in groundwater in storage would become significant and unreasonable if (1) groundwater levels were lowered to an elevation below which they could not recover during a multi-year period of above-average precipitation or (2) groundwater levels were lowered to elevations below which the Oxnard Subbasin would experience net seawater intrusion in the UAS and LAS over cycles of drought and recovery from 2040 through 2069.

Numerical model groundwater model simulations indicate that since 1985 the volume of groundwater in storage has decreased in both the shallow aquifer system and the LAS (Section 2.3.2, Estimated Change in Storage; Appendix E, UWCD Model Report). The cumulative decrease in groundwater storage in the shallow aquifer system was 6,800 AF between 1985 and 2015. In the LAS, the cumulative decrease in groundwater storage over the same period was approximately 63,400 AF. The decrease in storage in the LAS reflects falling groundwater levels between water years 1985 and 1991, as well as between 2010 and 2015 (Figure 2-27, West Las Posas Management Area Cumulative Change in Storage). These groundwater levels are independent of water year type because they were driven by two periods of groundwater production in excess of recharge that were offset by delivery of surface water in lieu of groundwater production.

Based on the sustainability goal for the WLPMA, the criteria used to define undesirable results for reduction in groundwater storage are groundwater levels that indicate a long-term decline over periods of drought and recovery, and landward migration of the 2015 saline water impact front in the Oxnard Subbasin after 2040. The minimum thresholds metric against which reduction in groundwater storage will be measured in the western WLPMA is groundwater levels that were selected to prevent net landward migration of the 2015 saline water impact front, and net seawater intrusion after 2040. These groundwater elevations are higher than previous historical low groundwater levels (Table 3-1). The minimum thresholds metric against which reduction in groundwater storage will be measured in the eastern part of the WLPMA is a groundwater level that allows for complete recovery during multi-year periods of above-average precipitation that follow a drought.

East Las Posas Management Area

In the ELPMA, reduction in groundwater in storage would become significant and unreasonable if groundwater levels were lowered to an elevation below which parts of the ELPMA experience greater than 20% loss of storage relative to the 2015 groundwater storage estimates from the CMWD model. Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply.

Numerical groundwater model simulations indicate that since 1985 the volume of groundwater in storage has increased in all of the aquifers of the ELPMA (Section 2.3.2; Appendix E). The cumulative change in storage from water year 1985 through water year 2015 for the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, Upper San Pedro Formation, FCA, and Grimes Canyon Aquifer were increases of approximately 7,600 AF, 2,700 AF, 53,700 AF, 44,700 AF, and 3,800 AF, respectively, for a total cumulative storage increase in the basin of approximately 112,500 AF (Figure 2-29). The change in storage in the FCA and Grimes Canyon Aquifer is not uniform geographically. Groundwater elevations and groundwater storage in 2015 were higher than they were in 1985 in areas of the FCA that are adjacent to Arroyo Simi–Las Posas and south of the Moorpark anticline. In areas north of the Moorpark anticline, or more distant from Arroyo Simi–Las Posas, groundwater elevations were lower in 2015 than in 1985. The increase in groundwater in storage in the south offset declines in storage north of the Moorpark anticline. The different groundwater level response between these areas reflects the influence of additional recharge along Arroyo Simi–Las Posas since the 1970s as well as the influence of geologic structures in impacting subsurface groundwater flow. Simi Valley Water Quality Control Plant (SVWQCP) and shallow dewatering well discharges in Simi Valley reached the ELPMA via Arroyo Simi–Las Posas, and provided additional recharge to the management area. The Moorpark anticline acted as a partial barrier to subsurface flow in the ELPMA, limiting the impact of this recharge to the areas south of the anticline and adjacent to Arroyo Simi–Las Posas.

Based on the sustainability goal for the ELPMA, the criteria used to define undesirable results for reduction in groundwater storage are groundwater levels that indicate a long-term decline over periods of drought and recovery, and result in greater than 20% loss of storage in areas of the ELPMA that are most impacted by declines in groundwater level. The minimum thresholds metric against which reduction in groundwater storage will be measured in the ELPMA is groundwater levels that were selected to prevent both long-term declines over periods of drought and recovery, and storage loss of greater than 20% in areas of the ELPMA that are most impacted by declines in groundwater level. In areas of the ELPMA that receive recharge from Arroyo Las Posas, these groundwater elevations are equal to the historical low groundwater elevations (Table 3-1). In areas of the ELPMA that do not receive recharge from Arroyo Las Posas, these groundwater elevations are lower than the historical low groundwater elevation because groundwater elevations have been continuously declining and are currently at the historical low (Table 3-1). In these areas of the ELPMA, the minimum threshold prevents further long-term loss of storage, but allows for some decline between 2020 and 2040.

Epworth Gravels Management Area

In the Epworth Gravels Management Area, reduction in groundwater in storage would become significant and unreasonable if groundwater levels were lowered to an elevation below which parts of the ELPMA experience greater than 20% loss of storage relative to the 2015 groundwater storage estimates from the CMWD model. Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply.

Historically, groundwater elevations in the Epworth Gravels Management Area have fallen to levels that caused significant and unreasonable results in the Epworth Gravels Aquifer. When groundwater elevations declined in the past, well owners drilled deeper wells into the FCA. When this occurred, production from the Epworth Gravels Aquifer was reduced and groundwater elevations recovered. In order to prevent groundwater elevations from declining to a level at which well owners would drill deeper in the future, the criteria used to define undesirable results for reduction in groundwater storage are groundwater levels that indicate a long-term decline over periods of drought and recovery, and result in greater than 20% loss of storage compared to 2015 groundwater storage estimates.

3.3.3 Seawater Intrusion

Seawater intrusion is not an undesirable result that applies to the LPVB. Direct seawater intrusion has not occurred historically in the LPVB. Seawater intrusion has impacted the Oxnard Subbasin, which is adjacent to and in hydraulic communication with the WLPMA. Currently, the area of the Oxnard Subbasin impacted by concentrations of chloride greater than 500 milligrams per liter (mg/L) is generally west of Highway 1 and south of Hueneme Road. Sources of water high in chloride in the Oxnard Subbasin include modern seawater as well as brines and connate water in fine-grained marine-deposited sediments. Therefore, this area 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.

Because the WLPMA and the Oxnard Subbasin are in hydraulic communication, it is theoretically possible for seawater intrusion to impact the WLPMA. However, particle tracks from groundwater model simulations that continue the present groundwater production rates in the WLPMA and the Oxnard Subbasin over the next 50 years suggest that the current extent of the saline water impact front will remain over 5 miles away from the WLPMA boundary (FCGMA 2019). Additionally, FCGMA is one of the GSAs for both the Oxnard Subbasin and the LPVB and has the authority to manage groundwater flows between the Oxnard Subbasin and the WLPMA to prevent the net landward migration of the 2015 saline water impact front. Therefore, seawater intrusion is unlikely to occur in the LPVB in the future. Because seawater intrusion has not occurred historically in the LPVB and is not likely to occur in the LPVB in the future, specific criteria for undesirable results related to seawater intrusion are not established in this GSP.

3.3.4 Degraded Water Quality

Degraded water quality is an undesirable result applicable to the LPVB. This undesirable result primarily applies to the WLPMA and the ELPMA. The Epworth Gravels Management Area has limited historical water quality data. The available data indicate that the water quality in the Epworth Gravels Management Area has not exceeded the water quality objectives. This management area receives recharge primarily from precipitation infiltration and the water quality in the management area reflects the water quality of the recharge. The sections below discuss water undesirable results related degraded water quality in the WLPMA and the ELPMA.

West Las Posas Management Area

Concentrations of total dissolved solids (TDS), nitrate, sulfate, and boron exceed the water quality objectives (WQOs) in the WLPMA. TDS and nitrate concentrations exceeding the WQOs are localized to the area adjacent to the Oxnard Forebay. These concentrations are not caused by groundwater conditions occurring throughout the WLPMA. Rather, concentrations of TDS and nitrate above WQOs and Basin Management Objectives are likely a legacy of historical septic discharges and historical agricultural fertilizer application practices.[1] Concentrations of sulfate and boron that exceed the WQOs occur over a larger area of the WLPMA. These concentrations may reflect native groundwater concentrations in the aquifers. There is no indication that groundwater production has contributed to an increase in these concentrations over time (Appendix F, Water Quality Hydrographs).

Degradation of groundwater quality from increased concentrations of TDS, nitrate, sulfate, and boron has the potential to impact the beneficial uses and users of groundwater in the WLPMA by (1) limiting the volume of groundwater available for agricultural, municipal, industrial, and domestic use or (2) requiring construction of treatment facilities to remove the constituents of concern.

The primary cause of groundwater conditions in the WLPMA that would lead to degradation of water quality from increased concentrations of TDS, nitrate, sulfate, and boron is resumption of previous land use practices. Groundwater production from the WLPMA may result in a significant and unreasonable degradation of water quality if areas that have not previously been impacted become impacted by TDS, nitrate, sulfate, and boron concentrations that limit agricultural and potable use. This could occur if groundwater production creates groundwater gradients that cause migration of water with concentrations of TDS, nitrate, sulfate, and boron that limit agricultural use into areas that were not previously degraded.

Based on the sustainability goals for the LPVB, the criteria used to define undesirable results for degraded water quality in the WLPMA are groundwater elevations that indicate a long-term decline over periods of drought and recovery. The minimum thresholds metric against which degradation of water quality will be measured is groundwater levels that were selected to prevent long-term

[1] Ventura County extended sewer lines into this area in the years between 2000 and 2011 to address additional discharges of nitrate.

declines over periods of drought and recovery. These groundwater elevations are equal to, or higher than, previous historical low water levels (Table 3-1).

Sustainable groundwater management of the LPVB will mitigate or minimize the undesirable result of degraded water quality related to groundwater production. Water quality will continue to be monitored over the next 5 years (see Chapter 4, Monitoring Networks). As additional data are collected, the effectiveness of applying a water level threshold to groundwater quality degradation will continue to be assessed.

East Las Posas Management Area

Increasing TDS concentrations in the groundwater have been observed in the ELPMA, where perennial flows of SVWQCP and shallow dewatering well discharge along Arroyo Simi–Las Posas have recharged the groundwater aquifers. Degradation of groundwater quality from increased concentrations of TDS has the potential to impact the beneficial uses and users of groundwater in the ELPMA by (1) limiting the volume of groundwater available for agricultural, municipal, industrial, and domestic use or (2) requiring construction of treatment facilities to remove the constituents of concern.

Groundwater production from the ELPMA may result in a significant and unreasonable degradation of water quality if the groundwater gradient causes expansion of the currently impacted area into areas that were not previously impacted, thereby limiting agricultural and potable use. Particle track simulations from the CMWD groundwater model indicate that groundwater production has little influence on the overall migration of percolated surface water that recharged the management area through Arroyo Simi–Las Posas (Figures 3-3 through 3-7, Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS [mg/L] Measured 2011–2015 under various scenarios). Changing groundwater production rates uniformly in the future model simulations did not substantially alter the area of the ELPMA impacted by water that is recharging along Arroyo Simi–Las Posas, because reducing the groundwater production rates did not result in rising water levels throughout the ELPMA. The larger influence on the spread of recharge water was flow in the Arroyo, because Arroyo Simi–Las Posas is the primary source of recharge to the ELPMA. When flow was maintained in Arroyo Simi–Las Posas, groundwater elevations in the vicinity of the Arroyo remained high, and the groundwater gradient between the Arroyo and the central part of the ELPMA caused the particles to travel farther than they did when flow was reduced in the Arroyo (Figures 3-3 through 3-7).

Based on the sustainability goals for the LPVB, the criteria used to define undesirable results for degraded water quality in the ELPMA are groundwater elevations as they relate to the groundwater gradient that indicate a long-term decline over periods of drought and recovery. The minimum thresholds metric against which degradation of water quality will be measured is groundwater levels that were selected to accomplish this goal. These groundwater elevations are equal to, or higher than, previous historical low water levels in the southern part of the ELPMA where groundwater quality has been impacted by SVWQCP and shallow dewatering well recharge along Arroyo Simi–Las Posas (Table 3-1). In the northern part of the ELPMA, the minimum threshold groundwater elevations are lower than historical low water levels, but historical water levels, the hydrogeologic conceptual model, and particle track simulations all indicate that this area is not likely to be influenced by recharge from Arroyo Simi–Las Posas.

Water quality will continue to be monitored over the next 5 years (see Chapter 4). As additional data are collected, the effectiveness of applying a groundwater level threshold to groundwater quality degradation will continue to be assessed.

3.3.5 Land Subsidence

The undesirable result associated with land subsidence in the LPVB is subsidence that substantially interferes with surface land uses. One of the FCGMA Board-adopted planning goals discussed in Section 3.1, Introduction to Sustainable Management Criteria, calls for groundwater management that will not result in net subsidence due to groundwater withdrawal. Subsidence related to groundwater withdrawal can occur as groundwater elevations decline below previous historical low groundwater levels, because the groundwater acts to reduce the effective stress, or pressure, on the sediments in the aquifers. As groundwater levels decline, the pressure on the sediment matrix increases, and the pore structure of the sediment can collapse, resulting in subsidence.

It is important to note that groundwater production is only one cause of subsidence in the LPVB. In addition to groundwater production, tectonic forces can also result in subsidence in the LPVB (Section 2.3.5, Subsidence). Currently, there are no monitoring stations that separate the effects of groundwater withdrawal from those of the other causes of subsidence.

Groundwater production from the LPVB as it relates to groundwater levels may result in significant and unreasonable land subsidence if the subsidence “substantially interferes with surface land uses” (California Water Code, Section 10721[x][5]). Using this definition, historical records of land subsidence in the LPVB do not indicate that land subsidence as a result of past groundwater production with resultant groundwater levels has caused, or is likely to cause, undesirable results.

The minimum thresholds metric against which subsidence will be measured in the western WLPMA is groundwater levels that were selected to prevent to prevent net landward migration of the 2015 saline water impact front, and net seawater intrusion after 2040. These groundwater elevations are higher than previous historical low groundwater levels (Table 3-1). The minimum thresholds metric against which reduction in groundwater storage will be measured in the eastern part of the WLPMA is a groundwater level that allows for complete recovery during multi-year periods of above-average precipitation that follow a drought. In the ELPMA and the Epworth Gravels Management Area the minimum thresholds metric against which land subsidence will be measured is groundwater levels that were selected to prevent both long-term declines over periods of drought and recovery, and storage loss of greater than 20% in areas of the ELPMA that are most impacted by declines in groundwater level. Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply.

In the WLPMA and the southern part of the ELPMA these groundwater elevations are equal to, or higher than, previous historical low groundwater levels, which will limit the potential for future land subsidence resulting from groundwater withdrawal (Table 3-1). In the northern part of the ELPMA, groundwater elevations have declined historically without inducing undesirable results related to land subsidence (see Section 2.3, Groundwater Conditions). Future management of the ELPMA will result in stable groundwater elevations, thereby limiting the potential for future land subsidence related to groundwater withdrawal.

Land subsidence related to groundwater production and resultant groundwater levels has the potential to impact the beneficial uses and users of groundwater in the LPVB by interfering with surface land uses in a way that causes additional costs for releveling fields, replacing surface infrastructure, and otherwise interfering with surface land uses. Even though substantial interference with land surface uses is not anticipated, actions to reduce groundwater production to a rate that prevents future long-term declines in groundwater elevation and maintains groundwater levels at or above historic lows will mitigate future seawater intrusion as well as reducing the potential for additional subsidence in the LPVB related to groundwater production.

3.3.6 Depletions of Interconnected Surface Water

The undesirable result associated with depletion of interconnected surface water in the LPVB is loss of Groundwater-Dependent Ecosystem (GDE) habitat. No GDEs or potential GDEs were identified in the WLPMA. In ELPMA, Arroyo Simi–Las Posas was identified as a potential GDE.

Current groundwater conditions in the LPVB do not impact the volume of flow in Arroyo Simi–Las Posas and groundwater production from the ELPMA has not resulted in depletion of interconnected surface water with significant and unreasonable adverse effects on beneficial uses of surface water.

Ongoing surface water discharges to Arroyo Simi–Las Posas are not guaranteed in the future. If discharge from the Simi Valley and Moorpark wastewater treatment plants and Simi Valley dewatering wells decreases in the future, this may lead to depletions of interconnected surface water and impacts to the Arroyo Simi–Las Posas potential GDE. Decreased discharge will lead to decreased surface water flows, decreased recharge, and lowered groundwater elevations throughout much of the ELPMA. Changes in groundwater elevation in the Shallow Alluvial Aquifer related to decreased surface water flows cannot be mitigated by management actions related to groundwater pumping. The measurable objectives selected to maintain groundwater elevations adjacent to Arroyo Las Posas at levels that promote the health of the vegetation in the Arroyo Simi–Las Posas potential GDE are established "for the purpose of improving overall conditions" in the ELPMA, "but failure to achieve those objectives shall not be grounds for finding of inadequacy of the Plan" (23 CCR 354.30[g]). FCGMA proposes this aspirational goal with recognition of the dependence on the continuation of these external water sources.

3.3.7 Defining Undesirable Results

In order to better manage groundwater production and projects within the LPVB, the basin has been divided into three management areas (Section 2.5, Management Areas). These management areas are hydrologically separated from each other, and impacts from groundwater production in one management area do not translate to impacts in the other management areas. Therefore, rather than defining basin-wide groundwater conditions that would constitute an undesirable result, these conditions are defined for each management area.

Wells that can be used to monitor representative groundwater conditions were selected in each management area (Table 3-1). One well was selected in the Epworth Gravels Management Area, 14 wells were selected in the ELPMA, and 8 wells were selected in the WLPMA. Of the 14 wells selected in the ELPMA, 2 are screened in the Shallow Alluvial Aquifer, 11 are screened in the FCA, and 1 is screened in the Grimes Canyon Aquifer. The only well selected to monitor conditions in the Epworth Gravels Management Area is screened in the Epworth Gravels Aquifer. All of the wells selected in the WLPMA are screened in the LAS.

West Las Posas Management Area

Five wells were selected as key wells used to monitor representative groundwater conditions in the LAS (Table 3-1). Of these, one is in the western part of the WLPMA, and four are in the eastern part of the WLPMA. Undesirable results are defined in two ways for the LAS in the WLPMA. The first is based on the total number of wells. Under this definition, the WLPMA will be determined to be experiencing undesirable results if, in any single monitoring event, groundwater levels in three of the five key wells are below their respective minimum thresholds.

The second definition of undesirable results for the WLPMA is based on the time over which a well may exceed the minimum threshold. Under this definition, the WLPMA would be determined to be experiencing an undesirable result if the groundwater level in any individual key well were below the minimum threshold for either three consecutive monitoring events or in three of five consecutive monitoring events. Monitoring events are scheduled to occur in the spring and fall of each year.

If conditions in the WLPMA meet either of the definitions of undesirable results listed above, the WLPMA would be considered to be experiencing undesirable results.

East Las Posas Management Area

Fifteen wells were selected as key wells in the ELPMA (Table 3-1). Of these, 2 are screened in the Shallow Alluvial Aquifer, 1 is screened in the Grimes Canyon Aquifer, and 12 are screened in the FCA. Undesirable results are defined in two ways for the ELPMA. The first is based on the total number of wells, independent of aquifer, that have groundwater levels below the minimum threshold. Under this definition, the ELPMA will be determined to be experiencing undesirable results if, in any single monitoring event, groundwater levels in 5 of the 15 key wells are below their respective minimum thresholds.

The second definition of undesirable results for the ELPMA is based on the time over which a well may exceed the minimum threshold. Under this definition, the ELPMA would be determined to be experiencing an undesirable result if the groundwater level in any individual key well were below the minimum threshold for either three consecutive monitoring events or in three of five consecutive monitoring events. Monitoring events are scheduled to occur in the spring and fall of each year.

If conditions in the ELPMA meet any of the definitions of undesirable results listed above, the LAS would be considered to be experiencing undesirable results.

Epworth Gravels Management Area

One well was selected as a key well in the Epworth Gravels Management Area. The definition of undesirable results for the Epworth Gravels Management Area is based on the time over which this well may exceed the minimum threshold. Under this definition, the Epworth Gravels Management Area would be determined to be experiencing an undesirable result if the groundwater level in the key well were below the minimum threshold for either three consecutive monitoring events or in three of five consecutive monitoring events. Monitoring events are scheduled to occur in the spring and fall of each year.

3.4 MINIMUM THRESHOLDS

The following sections and discussion set forth the minimum thresholds for chronic lowering of groundwater levels, reduction of groundwater storage, degraded water quality, land subsidence, and depletions of interconnected surface water. A minimum threshold is not established for seawater intrusion because direct seawater intrusion has not occurred and is unlikely to occur in the future in the LPVB (Section 3.3.3). Additionally, a minimum threshold was not established for depletion of interconnected surface water in the WLPMA or Epworth Gravels Management Area because no GDEs or potential GDEs were established in these areas.

The thresholds discussed below are the minimum groundwater elevations at individual wells that avoid undesirable results, which have been defined as follows:

- Groundwater levels in the LPVB that do not recover to pre-drought levels during multi-year periods of above-average precipitation that follow a drought
- Groundwater levels in the ELPMA and the Epworth Gravels Management Area that allow for more than 20% loss of storage, relative to 2015 storage volumes, in areas that are impacted by declines in groundwater level
- Induced subsidence that substantially interferes with surface land uses
- Groundwater levels in the WLPMA that prevent the Oxnard Subbasin from stopping net landward migration of the saline water impact front after 2040

Of the undesirable results listed above, only the first (declines in groundwater elevation that do not recover to pre-drought levels during multi-year periods of above-average precipitation) has occurred in every management area in the LPVB. Induced subsidence that substantially interferes with surface land uses has not occurred historically in any of the management areas of the LPVB. Groundwater levels that contribute to seawater intrusion in the Oxnard Subbasin have only occurred within the WLPMA.

3.4.1 West Las Posas Management Area

The minimum threshold groundwater levels in the WLPMA are based on a review of the historical groundwater elevation data, incorporation of potential projects, and an analysis of the potential for seawater intrusion in the Oxnard Subbasin under multiple future groundwater production scenarios. Predicted groundwater levels were simulated over a 50-year period from 2020 to 2069 (Section 2.4.5.1, West Las Posas Management Area). The future climate simulated in the model recreated the observed climate from 1930 to 1979 with adjustments to precipitation and streamflow based on climate change factors provided by DWR. The historical period from 1930 to 1979 includes periods of drought and periods of above-average precipitation, but has the average precipitation of the entire climate record for the WLPMA. The 50-year future simulations were used to assess the rate of groundwater production in the WLPMA, Oxnard Subbasin, and Pleasant Valley Basin that results in stable groundwater levels in the WLPMA and avoids net seawater intrusion in either the UAS or the LAS in the Oxnard Subbasin after 2040.

The minimum threshold groundwater elevations in the WLPMA depend on the proximity to the Oxnard Subbasin. For Well 02N21W16J03, in the western part of the WLPMA, the minimum thresholds are based on the lowest simulated groundwater elevation after 2040 for the model scenario in which the 2015 to 2017 average production rate was continued throughout the 50-year model simulation, and projects were implemented. For the remaining wells, the minimum threshold is based on the average low historical groundwater elevations in the early 1990s, before in-lieu surface water deliveries to the WLPMA began (Section 2.3.1, Groundwater Elevation Data). These elevations were selected because the groundwater levels in the eastern part of the WLPMA were able to recover, with the aid of in-lieu surface water deliveries, from the historical low levels in the early 1990s. Additionally, groundwater levels in this area do not exert a measurable influence on groundwater levels in the Oxnard Subbasin.

The minimum thresholds selected for the WLPMA do not impact groundwater elevations in the ELPMA or the Epworth Gravels Management Area because these areas are not in direct hydraulic communication with the ELPMA. Therefore, the exceedance of minimum thresholds selected in the WLPMA will not cause undesirable results in the ELPMA or Epworth Gravels Management Area. The minimum thresholds for each well are presented in Table 3-1 and on Figures 3-8a and 3-8b, Key Well Hydrographs in the West Las Posas Valley Management Area.

3.4.1.1 Chronic Lowering of Groundwater Levels

The selected minimum thresholds for chronic lowering of groundwater levels are presented in Table 3-1. These minimum thresholds are groundwater levels that were selected based on historical groundwater elevations and future groundwater model simulations that show groundwater elevations recover during multi-year cycles of drought and recovery. Numerical groundwater model simulations indicate that, under the conditions modeled, declines in groundwater elevations during periods of future drought will be offset by recoveries during future periods of above-average rainfall throughout the WLPMA (Figures 3-8a and 3-8b).

The minimum threshold selection was guided by historical groundwater elevations and numerical groundwater model simulations that incorporate production throughout the WLPMA, the Oxnard Subbasin, and the Pleasant Valley Basin. These minimum thresholds are anticipated to improve the beneficial uses of the WLPMA by preventing chronic lowering of groundwater levels. This allows for long-term use of groundwater supplies in the WLPMA without ongoing loss of storage that would impair the beneficial uses of groundwater in the WLPMA. These minimum thresholds may impact groundwater users in the WLPMA by requiring an overall reduction in groundwater production relative to historical levels.

The minimum thresholds for chronic lowering of groundwater levels are groundwater levels that will be measured at the monitoring wells listed in Table 3-1. Groundwater levels in these wells, which are referred to as *key wells*, will be reported to DWR in the annual reports that will follow the submittal of this GSP. As funding becomes available, it is recommended that each of these wells be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.1.2 Reduction of Groundwater Storage

The minimum thresholds for reduction in groundwater storage in the WLPMA are groundwater levels that were selected based on historical groundwater elevations and future groundwater model simulations that show groundwater elevations recover during multi-year cycles of drought and recovery (Table 3-1). The minimum thresholds impacts to groundwater users for reduction of groundwater storage are the same as those for chronic lowering of groundwater levels (see Section 3.4.1.1). These minimum thresholds are anticipated to improve the beneficial uses of the WLPMA by allowing for long-term use of groundwater supplies.

The minimum thresholds for reduction of groundwater storage are groundwater levels that will be measured at the key wells. As funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.1.3 Seawater Intrusion

No minimum thresholds are required for seawater intrusion in the WLPMA because the WLPMA is not adjacent to the Pacific Ocean (see Section 3.3.3).

3.4.1.4 Degraded Water Quality

Water quality impacts to the aquifers of the WLPMA are limited to locally high concentrations of TDS, nitrate, sulfate, and boron (Section 2.3 and Section 3.3.4, Degraded Water Quality, under “West Las Posas Management Area”). The sources and mechanisms controlling the concentration of these constituents differs throughout the WLPMA (Section 2.3). Because groundwater quality in the WLPMA is not directly correlated with groundwater production from the WLPMA, specific concentration minimum thresholds have not been selected for the WLPMA. Instead, until a causal relationship between groundwater quality degradation and groundwater production is established, the minimum thresholds for groundwater quality are the same as the groundwater level minimum thresholds for chronic lowering of groundwater levels (Section 3.4.1.1). Groundwater quality will continue to be monitored to evaluate the potential connection between groundwater quality and groundwater production. As the understanding of this connection improves, the minimum thresholds may be revised and direct concentration minimum thresholds may be proposed in the future.

The minimum thresholds impacts to groundwater users for degraded water quality are anticipated to be the same as those for chronic lowering of groundwater levels and reduction of groundwater in storage, which are described in Section 3.4.1.1.

The minimum thresholds for degraded water quality are groundwater levels that will be measured at the key wells. Additionally, as funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.1.5 Land Subsidence

The minimum thresholds for land subsidence in the WLPMA are groundwater levels that were selected based on the historical record of groundwater elevations. Numerical groundwater modeling indicates that the minimum threshold groundwater levels will allow declines in groundwater elevations during periods of future drought to be offset by recoveries during future periods of above-average rainfall (Table 3-1). The minimum thresholds are equal to or higher than historical low groundwater levels. In order to avoid undesirable results, groundwater levels in the WLPMA will remain above historical low groundwater levels after 2040. Therefore, groundwater levels in the WLPMA will reduce the potential for inelastic subsidence.

These minimum thresholds will also limit future subsidence, because currently the thresholds are greater than the historical low groundwater elevation. The minimum thresholds impacts to groundwater users for land subsidence are anticipated to be the same as those for chronic lowering of groundwater levels and depletion of groundwater storage, which are described in Section 3.4.1 (West Las Posas Management Area) and Section 3.4.2 (East Las Posas Management Area).

The minimum thresholds for subsidence are groundwater levels that will be measured at the key wells (Table 3-1). Additionally, as funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.1.6 Depletions of Interconnected Surface Water

No minimum thresholds specific to the depletion of interconnected surface water are proposed at this time because no interconnected surface waters or potential GDEs were identified in the

WLPMA. Therefore, depletion of interconnected surface water in the WLPMA is not currently occurring and is unlikely to occur in the future.

3.4.2 East Las Posas Management Area

The minimum threshold groundwater levels in the ELPMA are based on a review of the historical groundwater elevation data, incorporation of potential projects, and an analysis of the projected future declines in groundwater elevation and storage under multiple future groundwater production scenarios. Predicted groundwater levels were simulated over a 50-year period from 2020 to 2069 (Section 2.4.5.2, Projected Water Budget and Sustainable Yield: East Las Posas Management Area). The future climate simulated in the model recreated the observed climate from 1930 to 1979 with adjustments to precipitation and streamflow based on climate change factors provided by DWR. The historical period from 1930 to 1979 includes periods of drought and periods of above-average precipitation, but has the average precipitation of the entire climate record for the ELPMA. The 50-year future simulations were used to assess the rate of groundwater production in the ELPMA that avoids chronic lowering of groundwater elevation and loss of storage after 2040.

The minimum threshold groundwater elevations in the ELPMA vary geographically within the management area and depend on the historical record of groundwater levels, proximity to both Arroyo Simi–Las Posas and the Moorpark anticline. For wells that are adjacent to Arroyo Simi–Las Posas and are, generally, south and west of the Moorpark anticline, the minimum thresholds are based on the historical low groundwater elevation. For the remaining wells, the minimum threshold is based on the groundwater level that limits reduction in storage to less than 20% relative to the estimated 2015 groundwater storage volume in areas of the ELPMA where the FCA may convert from being confined to unconfined (Section 2.3.1). Limiting the long-term loss of storage to no more than 20% in these areas of the ELPMA was determined to be a reasonable approach by the FCGMA Board to avoid significant and unreasonable loss of supply.

Conversion of the FCA from confined to unconfined conditions is most likely to occur on the flanks of the Moorpark and Long Canyon anticlines, and on the northern and southern margins of the ELPMA where the FCA crops out (Figure 3-9, Fox Canyon Aquifer Zone Map). Continued production at the 2015 to 2017 rates has the potential to cause these areas of the ELPMA to lose greater than 30% of the available groundwater storage. Limiting the long-term loss of storage to 20% will avoid significant and unreasonable loss of supply in these areas of the ELPMA.

The minimum thresholds selected for the ELPMA do not impact groundwater elevations in the PVB, the WLPMA, or the Epworth Gravels Management Area because these areas are not in direct hydraulic communication with the ELPMA. Therefore, the minimum thresholds selected in the ELPMA will not cause undesirable results in the PVB, WLPMA, or Epworth Gravels Management

Area. The minimum thresholds for each well are presented in Table 3-1 and on Figures 3-10a through 3-10e, Key Well Hydrographs in the East Las Posas Valley Management Area.

3.4.2.1 Chronic Lowering of Groundwater Levels

The selected minimum thresholds for chronic lowering of groundwater levels are presented in Table 3-1. These minimum thresholds are groundwater levels that were selected based on historical groundwater elevations and groundwater model simulations of future conditions that limit loss of groundwater storage in the ELPMA. Numerical groundwater model simulations indicate that, under the conditions modeled, declines in groundwater elevations are not offset by recoveries during future periods of above-average rainfall throughout the ELPMA (Figures 3-8a and 3-8b). Therefore, groundwater elevations in the ELPMA must stabilize, and should not reach the minimum thresholds, because it may be difficult for groundwater elevations to recover from long-term declines without finding additional sources of recharge for the management area.

The minimum threshold selection was guided by historical groundwater elevations and numerical groundwater model simulations. The model simulations were used to investigate the groundwater elevation that would limit loss of groundwater storage to less than 20% in areas of the ELPMA where the FCA is prone to conversion from confined to unconfined conditions. These minimum thresholds are anticipated to maintain the beneficial uses of the ELPMA by preventing chronic lowering of groundwater levels. This allows for long-term use of groundwater supplies in the ELPMA without ongoing loss of storage that would impair the beneficial uses of groundwater. These minimum thresholds may impact groundwater users in the ELPMA by requiring an overall reduction in groundwater production relative to historical levels.

The minimum thresholds for chronic lowering of groundwater levels are groundwater levels that will be measured at the monitoring wells listed in Table 3-1. Groundwater levels in these key wells will be reported to DWR in the annual reports that will follow the submittal of this GSP. As funding becomes available, it is recommended that each of these wells be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.2.2 Reduction of Groundwater Storage

The minimum thresholds for reduction in groundwater storage in the ELPMA are groundwater levels that were selected based on historical groundwater elevations and future groundwater model simulations that limit loss of groundwater storage in the ELPMA to less than 20% relative to the estimated 2015 groundwater storage volume in areas of the ELPMA where the FCA may convert from being confined to unconfined (Table 3-1; Figure 3-9).

The minimum thresholds impacts to groundwater users for reduction of groundwater storage are the same as those for chronic lowering of groundwater levels (see Section 3.4.2.1). These minimum thresholds are anticipated to maintain the beneficial uses of the ELPMA by allowing for long-term use of groundwater supplies and preserving groundwater storage.

The minimum thresholds for reduction of groundwater storage are groundwater levels that will be measured at the key wells. As funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.2.3 Seawater Intrusion

No minimum thresholds are required for seawater intrusion in the ELPMA because the ELPMA is not adjacent to the Pacific Ocean (see Section 3.3.3).

3.4.2.4 Degraded Water Quality

Water quality impacts to the aquifers of the ELPMA have been observed in areas that receive recharge from Arroyo Simi–Las Posas. In these areas concentrations of TDS in the groundwater have increased, related to the perennial flows of SVWQCP and shallow dewatering well discharge along Arroyo Simi–Las Posas (Sections 2.3 and 3.3.4). Groundwater modeling suggests that groundwater production rates exert little influence over the area of the ELPMA that will eventually be impacted by higher concentrations of TDS (Figures 3-3 through 3-7). Because groundwater quality in the ELPMA is not directly correlated with groundwater production from the ELPMA, specific concentration minimum thresholds have not been selected for the ELPMA. Instead, until a causal relationship between groundwater quality degradation and groundwater production is established, the minimum thresholds for groundwater quality are the same as the groundwater level minimum thresholds for chronic lowering of groundwater levels (Section 3.4.1). Groundwater quality will continue to be monitored to evaluate the potential connection between groundwater quality and groundwater production. As the understanding of this connection improves, the minimum thresholds may be revised and direct concentration minimum thresholds may be proposed in the future.

The minimum thresholds impacts to groundwater users for degraded water quality are anticipated to be the same as those for chronic lowering of groundwater levels and reduction of groundwater in storage, which are described in Section 3.4.2.1.

The minimum thresholds for degraded water quality are groundwater levels that will be measured at the key wells. Additionally, as funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.2.5 Land Subsidence

The minimum thresholds for land subsidence in the ELPMA are groundwater levels that were selected based on the historical record of groundwater elevations. These thresholds vary geographically in the ELPMA (Table 3-1). In the key wells where the minimum thresholds are equal to or higher than historical low groundwater levels, subsidence is not a concern (Figure 3-9). In areas where the minimum threshold is lower than the historical low groundwater level there is potential for land subsidence, however, DWR designated the LPVB as an area with a medium to low potential for future subsidence. Because the ELPMA has a medium to low potential for subsidence, and future declines in groundwater levels are limited by the minimum thresholds for chronic lowering of groundwater levels and declines in groundwater storage, these minimum thresholds are adopted for land subsidence as well. The minimum thresholds for chronic lowering of groundwater levels and declines in groundwater storage are anticipated to reduce the potential for subsidence that substantially interferes with surface land uses (Section 3.3.5, Land Subsidence). The need for specific subsidence monitoring will be explored over the next 5 years.

As discussed previously, the minimum thresholds are anticipated to maintain the beneficial uses of the ELPMA by limiting declines in freshwater storage in the ELPMA. These minimum thresholds will also limit future subsidence. The minimum thresholds impacts to groundwater users for land subsidence are anticipated to be the same as those for chronic lowering of groundwater levels and depletion of groundwater storage, which are described in Sections 3.4.1 and 3.4.2.

The minimum thresholds for land subsidence are groundwater levels that will be measured at the key wells (Table 3-1). Additionally, as funding becomes available, it is recommended that each key well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in each well will be compared to the minimum threshold assigned in Table 3-1 to determine whether groundwater levels in individual wells are above the minimum thresholds.

3.4.2.6 Depletions of Interconnected Surface Water

Arroyo Simi–Las Posas is a losing stream in the ELPMA, and groundwater elevations are below the bottom of the Arroyo (see Section 3.3.6). Therefore, groundwater production from the FCA and underlying aquifers will not impact flow in Arroyo Simi–Las Posas. A potential GDE has been identified in the ELPMA adjacent to Arroyo Simi–Las Posas, however. This potential GDE is described in more detail in Section 2.3.6, Groundwater–Surface Water Connections, and Section 2.3.7, Groundwater-Dependent Ecosystems. Riparian vegetation associated with the potential GDE may have roots that reach groundwater in the Shallow Alluvial Aquifer, or the roots may rely on soil water as surface flows in Arroyo Simi–Las Posas infiltrate into the underlying aquifers. Until the relationship between groundwater elevation and impacts to the potential GDE is better understood, the minimum thresholds for chronic lowering of groundwater levels and depletion of groundwater storage are assumed to be protective of the potential GDE. These minimum thresholds were selected based on groundwater levels that limit future declines in groundwater storage to less than 20% of the 2015 groundwater storage volume in areas of the ELPMA where the FCA is susceptible to conversion from confined to unconfined conditions (Table 3-1).

As discussed previously, the minimum thresholds are anticipated to maintain or improve the beneficial uses of the ELPMA by limiting decreases in the overall amount of groundwater storage in the management area. The minimum thresholds impacts to groundwater users for interconnected groundwater and surface water are anticipated to be the same as those for chronic lowering of groundwater levels and reduction in groundwater storage, which are described in Sections 3.4.2.1 and 3.4.2.2.

Currently there is very little groundwater production from the Shallow Alluvial Aquifer. If future projects investigate producing water from the Shallow Alluvial Aquifer they will have to evaluate the potential impact to the potential GDE as part of the feasibility and permitting process. Additionally, if projects that produce groundwater from the Shallow Alluvial Aquifer are implemented, the need for specific groundwater level minimum thresholds to protect against depletion of interconnected surface water should be reevaluated.

3.4.3 Epworth Gravels Management Area

The minimum threshold groundwater level in the Epworth Gravels Management Area is based on a review of the historical groundwater elevation data, incorporation of potential projects, and an analysis of the potential future declines in groundwater elevation and storage under multiple future groundwater production scenarios. Predicted groundwater levels were simulated over a 50-year period from 2020 to 2069 (Section 2.4.5.2). The future climate simulated in the model recreated the observed climate from 1930 to 1979 with adjustments to precipitation and streamflow based on climate change factors provided by DWR. The historical period from 1930 to 1979 includes periods of drought and periods of above-average precipitation, but has the average precipitation of the entire climate record for the ELPMA. The 50-year future simulations were used to assess the rate of groundwater production in the ELPMA that avoids chronic lowering of groundwater elevation and loss of storage after 2040.

There is only one key well located in the Epworth Gravels Management Area. The minimum threshold groundwater level was selected as the groundwater level that limits reduction in storage to less than 20% relative to the estimated 2015 groundwater storage volume (Section 2.3.1).

Limiting the long-term loss of storage to 20% will avoid significant and unreasonable loss of supply in the Epworth Gravels Management Area.

The minimum threshold selected for Epworth Gravels Management Area does not impact groundwater elevations in the ELPMA because the ELPMA is not in direct hydraulic communication with the Epworth Gravels Aquifer. Therefore the minimum threshold selected in the Epworth Gravels Aquifer will not cause undesirable results in the ELPMA. The minimum threshold is presented in Table 3-1 and in Figure 3-11, Key Well Hydrographs in the Epworth Gravels Management Area – Epworth Gravels Aquifer.

3.4.3.1 Chronic Lowering of Groundwater Levels

The selected minimum threshold for chronic lowering of groundwater levels was selected based on historical groundwater elevations and future groundwater model simulations that limit loss of groundwater storage in the Epworth Gravels Management Area. Numerical groundwater model simulations indicate that, under the conditions modeled, declines in groundwater elevations are not offset by recoveries during future periods of above-average rainfall throughout the ELPMA (Figure 3-11). However, groundwater elevations are sensitive to groundwater production rates (Section 2.4). As groundwater production in the Epworth Gravels Aquifer was reduced, groundwater elevations recovered, while higher rates of groundwater production resulted in chronic lowering of groundwater levels. Therefore, impacts from groundwater production on groundwater levels in the Epworth Gravels Aquifer can be minimized or mitigated through controls on groundwater production.

Consequently the minimum threshold groundwater elevation for chronic lowering of groundwater levels in the Epworth Gravels Management Area is the same as the minimum threshold for groundwater in storage discussed in Section 3.4.3.2, Reduction of Groundwater Storage. This minimum threshold is anticipated to maintain the beneficial uses of the Epworth Gravels Management Area by preventing chronic lowering of groundwater levels. This allows for long-term use of groundwater supplies without ongoing loss of storage that would impair the beneficial uses of groundwater. These minimum thresholds may impact groundwater users in the Epworth Gravels Management Area by requiring an overall reduction in groundwater production relative to historical levels.

The minimum threshold for chronic lowering of groundwater level is a groundwater levels that will be measured at the monitoring well listed in Table 3-1. Groundwater levels in this key well will be reported to DWR in the annual reports that will follow the submittal of this GSP. As funding becomes available, it is recommended that this well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in this well will be compared to the minimum threshold assigned in Table 3-1 to determine whether the groundwater level is above the minimum threshold.

3.4.3.2 Reduction of Groundwater Storage

The minimum threshold for reduction in groundwater storage in the Epworth Gravels Management Area is a groundwater level that was selected to limit loss of groundwater storage in the Epworth Gravels Management Area to less than 20% relative to the estimated 2015 groundwater storage volume (Table 3-1; Figure 3-9).

This minimum threshold is anticipated to maintain the beneficial uses of the Epworth Gravels Management Area by allowing for long-term use of groundwater supplies and preserving groundwater storage. This minimum threshold may impact groundwater users in the Epworth Gravels Management Area by requiring an overall reduction in groundwater production relative to historical levels.

The minimum threshold for reduction of groundwater storage is a groundwater level that will be measured at the key well. As funding becomes available, it is recommended that this well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation in the well will be compared to the minimum threshold assigned in Table 3-1 to determine whether the groundwater level is above the minimum threshold.

3.4.3.3 Seawater Intrusion

No minimum thresholds are required for seawater intrusion in the Epworth Gravels Management Area because it is not adjacent to the Pacific Ocean (see Section 3.3.3).

3.4.3.4 Degraded Water Quality

No minimum thresholds specific to the degraded water quality are proposed at this time because degraded water quality has not been detected in the Epworth Gravels Management Area, despite long-term use of the Epworth Gravels Aquifer for agricultural production and historical groundwater levels that were lower than the minimum threshold groundwater levels for chronic lowering of groundwater elevation. Therefore, degraded water quality in the Epworth Gravels Management Area is not currently occurring and is unlikely to occur in the future.

3.4.3.5 Land Subsidence

The minimum threshold for land subsidence in the Epworth Gravels Management Area is a groundwater level that was selected based on the historical record of groundwater elevations (Table 3-1). The minimum threshold water level for chronic lowering of groundwater levels is higher than the historical low groundwater levels in the management area. Therefore, this minimum threshold will also reduce the potential for subsidence that substantially interferes with surface land uses in the Epworth Gravel Management Area.

As discussed previously, the minimum threshold is anticipated to maintain the beneficial uses of the Epworth Gravels Management Area by limiting declines in groundwater storage and avoiding chronic lowering of groundwater levels. This minimum threshold will also limit future subsidence. The minimum threshold impacts to groundwater users for land subsidence are anticipated to be the same as those for chronic lowering of groundwater levels which are described in Section 3.4.3.1.

The minimum threshold for land subsidence is a groundwater level that will be measured at the key well in the Epworth Gravels Management Area (Table 3-1). Additionally, as funding becomes available, it is recommended that this well be instrumented with a pressure transducer capable of recording hourly groundwater levels. The groundwater elevation will be compared to the minimum threshold assigned in Table 3-1 to determine whether the groundwater level is above the minimum threshold.

3.4.3.6 Depletions of Interconnected Surface Water

No minimum thresholds specific to the depletion of interconnected surface water are proposed at this time because no interconnected surface waters or potential GDEs were identified in the Epworth Gravels Management Area. Therefore, depletion of interconnected surface water in the Epworth Gravels Management Area is not currently occurring and is unlikely to occur in the future.

3.5 MEASURABLE OBJECTIVES

The measurable objectives are quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted GSP to achieve the sustainability goal. The criteria for selecting the measurable objectives vary by management area in the LPVB, therefore, the discussion of the measurable objectives has been broken out by management area in the following subsections.

3.5.1 West Las Posas Management Area

The criteria for selecting the measurable objectives differ geographically within the WLPMA. In the eastern WLPMA, the measurable objective groundwater levels were selected based on the groundwater level recovery observed in wells in the eastern WLPMA between 1995 and 2008. This groundwater level recovery resulted from in-lieu deliveries of surface water that reduced groundwater production from the area (Section 2.2, Hydrogeologic Conceptual Model). The measurable objective groundwater elevation is the elevation that represents half of the total recovery in the historical record. Therefore, historical groundwater elevations were below the measurable objective groundwater elevations between 1995 and 2003, and were above the measurable objective groundwater elevation between 2003 and 2012 (Figures 3-8a and 3-8b). In the western WLPMA the measurable objective at Well 02N21W16J03 is selected based on both the historical groundwater levels and the groundwater modeling results used to assess the potential for seawater intrusion in the Oxnard Subbasin. In this well, the measurable objective is the groundwater level to which the well has recovered historically, and is achievable under the UWCD model simulation that includes projects. The measurable objective groundwater levels in the WLPMA are at least 20 feet higher than the minimum threshold groundwater levels, thereby allowing for operational flexibility in the management area.

3.5.1.1 Chronic Lowering of Groundwater Levels

The measurable objective for chronic lowering of groundwater elevations in the western WLPMA is the groundwater level to which Well 02N21W16J03 has recovered historically, and allows the Oxnard Subbasin to avoid seawater intrusion. In the eastern WLPMA, the measurable objective groundwater elevation is the groundwater elevation that is halfway between the historical low groundwater elevation and the high groundwater elevations measured since 2000 (Table 3-2, Measurable Objectives and Interim Milestones). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the WLPMA.

Interim Milestones for Chronic Lowering of Groundwater Levels

Interim milestones, which are target groundwater levels in 2025, 2030, and 2035 at key wells, will be used to assess progress toward sustainable groundwater management in the WLPMA between 2020 and 2040. These milestones have only been selected for key wells in which the fall 2015 groundwater level was below the measurable objective groundwater level (Table 3-2). The interim milestones for chronic lowering of groundwater levels are the same as the interim milestones for the other sustainability indicators, because the interim milestones measure progress toward the groundwater elevations in the WLPMA that will prevent undesirable results. In these wells, the interim milestones were calculated using linear interpolation between the fall 2015 low groundwater elevation and the measurable objective.

3.5.1.2 Reduction of Groundwater in Storage

The measurable objective for reduction of groundwater in storage in the western WLPMA is the groundwater level to which Well 02N21W16J03 has recovered historically, and allows the Oxnard Subbasin to avoid seawater intrusion. In the eastern WLPMA, the measurable objective groundwater elevation is the groundwater elevation that is half way between the historical low groundwater elevation and the high groundwater elevations measured since 2000 (Table 3-2).

At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the WLPMA.

Interim Milestones for Reduction of Groundwater in Storage

Interim milestones for reduction of groundwater in storage are presented in Table 3-2 for wells in which the measurable objective is above the fall 2015 groundwater level. The interim milestones were calculated from a linear interpolation between the fall 2015 low groundwater elevation and the measurable objective at the well. These interim milestones will be used to assess progress toward sustainable groundwater management in the WLPMA between 2020 and 2040. The interim milestones for reduction of groundwater in storage are the same as the interim milestones for chronic lowering of groundwater levels.

3.5.1.3 Seawater Intrusion

No measurable objectives are required for seawater intrusion in the WLPMA because the WLPMA is not adjacent to the Pacific Ocean (Section 3.3.3).

3.5.1.4 Degraded Water Quality

The measurable objective for degraded water quality in the western WLPMA is the groundwater level to which Well 02N21W16J03 has recovered historically, and allows the Oxnard Subbasin to avoid seawater intrusion. In the eastern WLPMA, the measurable objective groundwater elevation is the groundwater elevation that is half way between the historical low groundwater elevation and the high groundwater elevations measured since 2000 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the WLPMA.

Interim Milestones for Degraded Water Quality

Interim milestones for degraded water quality are the same as those for chronic lowering of groundwater levels and reduction of groundwater in storage. These interim milestones are presented in Table 3-2 for wells in which the measurable objective is above the fall 2015 groundwater level. The interim milestones were calculated from a linear interpolation between the fall 2015 low groundwater elevation and the measurable objective at the well. These interim milestones will be used to assess progress toward sustainable groundwater management in the WLPMA between 2020 and 2040.

3.5.1.5 Land Subsidence

The measurable objective for land subsidence in the western WLPMA is the groundwater level to which Well 02N21W16J03 has recovered historically, and allows the Oxnard Subbasin to avoid seawater intrusion. In the eastern WLPMA, the measurable objective groundwater elevation is the groundwater elevation that is half way between the historical low groundwater elevation and the high groundwater elevations measured since 2000 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the WLPMA.

Interim Milestones for Land Subsidence

Interim milestones for land subsidence are the same as those for chronic lowering of groundwater levels and reduction of groundwater in storage. These interim milestones are presented in Table 3-2 for wells in which the measurable objective is above the fall 2015 groundwater level. The interim milestones were calculated from a linear interpolation between the fall 2015 low groundwater elevation and the measurable objective at the well. These interim milestones will be used to assess progress toward sustainable groundwater management in the WLPMA between 2020 and 2040.

3.5.1.6 Depletions of Interconnected Surface and Groundwater

No measurable objectives specific to the depletion of interconnected surface water are proposed in the WLPMA because no interconnected surface waters or potential GDEs were identified in the WLPMA. Therefore, depletion of interconnected surface water in the WLPMA is not currently occurring and is unlikely to occur in the future.

3.5.2 East Las Posas Management Area

In the ELPMA, the measurable objective groundwater elevations were selected based on the historical groundwater level record and the groundwater model simulations that result in stable groundwater elevations after 2040. The measurable objective groundwater elevation is lower than the 2015 groundwater elevation in each of the key wells in the ELPMA (Figures 3-10a through 3-10e). South of the Moorpark anticline, in the areas of the ELPMA that received recharge from Arroyo Simi–Las Posas, groundwater elevations have been above the measurable objective since the late 1980s or early 1990s (Figures 3-10a through 3-10e). As SVWQCP discharge to Arroyo Simi–Las Posas decreased upstream of the ELPMA, groundwater levels have been declining in these areas, and were within 20 feet of the measurable objective groundwater level in 2015. North of the Moorpark anticline the historical groundwater level has always been above the measurable objective groundwater level. However, groundwater production from this area has caused long-term declines in groundwater elevations. Because groundwater elevations do not respond to climate cycles in this management area, numerical groundwater simulations indicate that reductions in groundwater production will be necessary to avoid further chronic lowering of groundwater levels. As groundwater production in the simulations is reduced between 2020 and 2040, groundwater elevations continue to decline. Consequently, measurable objective groundwater levels, which are the stable groundwater levels in the model simulations, are below the current groundwater level. The measurable objective groundwater levels in the ELPMA are at least 20 feet higher than the minimum threshold groundwater levels, thereby allowing for operational flexibility in the management area.

3.5.2.1 Chronic Lowering of Groundwater Levels

The measurable objective for chronic lowering of groundwater elevations in the ELPMA is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the ELPMA.

Interim Milestones for Chronic Lowering of Groundwater Levels

Interim milestones, which are target groundwater levels in 2025, 2030, and 2035 at key wells, can be used to assess progress toward sustainable groundwater management between 2020 and 2040. However, groundwater elevations in the ELPMA are currently higher than the measurable objective groundwater elevation. Therefore, interim milestone targets have not been selected for wells in the ELPMA.

3.5.2.2 Reduction of Groundwater in Storage

The measurable objective for reduction of groundwater storage in the ELPMA is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). This measurable objective is the same as the measurable objective for chronic lowering of groundwater levels. At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the ELPMA.

Interim Milestones for Reduction of Groundwater in Storage

Interim milestones target groundwater levels have not been selected for wells in the ELPMA because the groundwater elevations in the ELPMA are currently higher than the measurable objective groundwater levels.

3.5.2.3 Seawater Intrusion

No measurable objectives are required for seawater intrusion in the ELPMA because the ELPMA is not adjacent to the Pacific Ocean (Section 3.3.3).

3.5.2.4 Degraded Water Quality

The measurable objective for degraded water quality is the same as the measurable objective for chronic lowering of groundwater levels and reduction in groundwater storage. In the ELPMA, the measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the ELPMA.

Interim Milestones for Degraded Water Quality

Interim milestones target groundwater levels have not been selected for wells in the ELPMA because the groundwater elevations in the ELPMA are currently higher than the measurable objective groundwater levels.

3.5.2.5 Land Subsidence

The measurable objective for land subsidence is the same as the measurable objective for chronic lowering of groundwater levels and reduction in groundwater storage. In the ELPMA, the measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the ELPMA.

Interim Milestones for Land Subsidence

Interim milestones target groundwater levels have not been selected for wells in the ELPMA because the groundwater elevations in the ELPMA are currently higher than the measurable objective groundwater levels.

3.5.2.6 Depletions of Interconnected Surface and Groundwater

The measurable objective for interconnected surface and groundwater is the same as the measurable objective for chronic lowering of groundwater levels and reduction in groundwater storage in all wells except those in the Shallow Alluvial Aquifer. For wells not screened in the

Shallow Alluvial Aquifer, the measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the ELPMA.

In addition to the primary sustainability goal, the measurable objectives selected for the Shallow Alluvial Aquifer in the ELPMA (see Section 3.5.2, East Las Posas Management Area) recognize an aspirational sustainability goal of maintaining groundwater elevations in the Shallow Alluvial Aquifer at 2015 levels by continued surface flows in Arroyo Simi–Las Posas. This goal stems from the FCGMA Board planning goal that seeks to promote water levels that mitigate or minimize undesirable results including surface water connectivity (see Section 3.1, Introduction to Sustainable Management Criteria), and acknowledges the environmental benefit of the vegetation that composes the Arroyo Simi–Las Posas potential GDE.

For wells screened in the Shallow Alluvial Aquifer, the measurable objectives were selected to maintain groundwater elevations at or near 2015 levels. These objectives exceed the reasonable margin of operational flexibility in the ELPMA, but were selected for the purpose of improving the environmental beneficial use of water along Arroyo Simi–Las Posas (in accordance with 23 CCR 354.30[g]).

Interim Milestones for Depletions of Interconnected Surface and Groundwater

Interim milestones target groundwater levels have not been selected for wells in the ELPMA because the groundwater elevations in the ELPMA are currently higher than or equal to the measurable objective groundwater levels.

3.5.3 Epworth Gravels Management Area

In the Epworth Gravels Management Area, the measurable objective groundwater elevation was selected based on the historical groundwater level record and the groundwater model simulations that result in stable groundwater elevations after 2040. Groundwater elevations have been below the measurable objective groundwater elevation historically (Figure 3-11). However, as groundwater production from the Epworth Gravels Aquifer was reduced, groundwater elevations recovered. Between 2005 and 2015, groundwater elevations in the Epworth Gravels Aquifer remained above the measurable objective. The measurable objective groundwater level in the Epworth Gravels Management Area is 30 feet higher than the minimum threshold groundwater levels, thereby allowing for operational flexibility.

3.5.3.1 Chronic Lowering of Groundwater Levels

The measurable objective for chronic lowering of groundwater elevations in the Epworth Gravels Management Area is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). The difference between the measurable objective and the minimum threshold is 30 feet, which provides a margin of safety for operational flexibility in the Epworth Gravels Management Area.

Interim Milestones for Chronic Lowering of Groundwater Levels

Interim milestones, which are target groundwater levels in 2025, 2030, and 2035 at key wells, can be used to assess progress toward sustainable groundwater management between 2020 and 2040. However, groundwater elevations in the Epworth Gravels Management Area are currently higher than the measurable objective groundwater elevation. Therefore, interim milestone targets have not been selected for wells in the Epworth Gravels Management Area.

3.5.3.2 Reduction of Groundwater in Storage

The measurable objective for reduction of groundwater storage in the Epworth Gravels Management Area is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). The difference between the measurable objective and the minimum threshold is 30 feet, which provides a margin of safety for operational flexibility in the Epworth Gravels Management Area.

Interim Milestones for Reduction of Groundwater in Storage

Interim milestones target groundwater levels have not been selected for wells in the ELPMA because the groundwater elevations in the ELPMA are currently higher than the measurable objective groundwater levels. 3.5.3.3 Seawater Intrusion

No measurable objectives are required for seawater intrusion in the Epworth Gravels Management Area because the Epworth Gravels Management Area is not adjacent to the Pacific Ocean (Section 3.3.3).

3.5.3.4 Degraded Water Quality

The measurable objective for degraded water quality is the same as the measurable objective for chronic lowering of groundwater levels and reduction in groundwater storage. In the Epworth Gravels Management Area, the measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the Epworth Gravels Management Area.

Interim Milestones for Degraded Water Quality

Interim milestones target groundwater levels have not been selected for wells in the Epworth Gravels Management Area because the groundwater elevations in the Epworth Gravels Management Area are currently higher than the measurable objective groundwater levels.

3.5.3.5 Land Subsidence

The measurable objective for land subsidence is the same as the measurable objective for chronic lowering of groundwater levels and reduction in groundwater storage. In the Epworth Gravels Management Area, the measurable objective is the groundwater level at which observed declines in groundwater elevation would cease if gradual reductions in groundwater production are implemented between 2020 and 2040 (Table 3-2). At each of the wells, the difference between the measurable objective and the minimum threshold is greater than or equal to 20 feet, which provides a margin of safety for operational flexibility in the Epworth Gravels Management Area.

Interim Milestones for Land Subsidence

Interim milestones target groundwater levels have not been selected for wells in the Epworth Gravels Management Area because the groundwater elevations in the Epworth Gravels Management Area are currently higher than the measurable objective groundwater levels.

3.5.3.6 Depletions of Interconnected Surface and Groundwater

No measurable objectives specific to the depletion of interconnected surface water are proposed in the Epworth Gravels Management Area because no interconnected surface waters or potential GDEs were identified in the Epworth Gravels Management Area. Therefore, depletion of interconnected surface water in the Epworth Gravels Management Area is not currently occurring and is unlikely to occur in the future.

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Table 3-1
Minimum Threshold Groundwater Elevations by Well, Management Area, and Aquifer for Key Wells in the Las Posas Valley Basin

State Well Number	Management Area	Aquifer	Perforations	Top Perforations	Bottom Perforations	Historical Groundwater Level Low		2015 Spring Groundwater Level		GSP Undesirable Result	Proposed Minimum Threshold
			(ft bgs)	*(ft msl)*	*(ft msl)*	*(ft msl)*	*Date Measured*	*(ft msl)*	*Date Measured*		*(ft msl)*
03N19W29F06	Epworth Gravels	Epworth Gravels	222–505	633	350	529.91	8/17/1984	601.5	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	555
02N20W09Q08	ELPMA	Shallow Alluvial	35–85	267	217	271	6/16/2016	273	3/15/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	170
02N20W12MMW1	ELPMA	Shallow Alluvial		—	—	358.17	11/8/1999	372.18	2/23/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	300
02N20W01B02	ELPMA	FCA	532–765	13	−220	53.79	6/17/2010	N/A	—	Chronic lowering of groundwater levels, reduction in groundwater storage	80
02N20W03H01	ELPMA	FCA	900–1,260	−374	−734	143	7/1/2012	N/A	—	Chronic lowering of groundwater levels, reduction in groundwater storage	100
02N20W04F02	ELPMA	FCA	680–1,000	−221	−541	157	9/18/2013	N/A	—	Chronic lowering of groundwater levels, reduction in groundwater storage	100
02N20W10D02	ELPMA	FCA	872–1,032	−404	−564	77.23	10/7/1977	165.52	3/10/15	Chronic lowering of groundwater levels, reduction in groundwater storage	80
02N20W10G01	ELPMA	FCA	635–890	−197	−452	66.5	10/4/1972	259.57	3/10/15	Chronic lowering of groundwater levels, reduction in groundwater storage	100
02N20W10J01	ELPMA	FCA	500–540	−94	−134	86.87	10/5/1971	285.76	3/10/15	Chronic lowering of groundwater levels, reduction in groundwater storage	110
03N19W19J01	ELPMA	FCA	858–1,050	180	−12	171.1	9/14/2016	179.69	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	130
03N19W28N03	ELPMA	FCA	598–900	204	98	175	6/15/2015	182	3/15/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	130
03N19W31B01	ELPMA	FCA	880–1,420	−102	−642	93.5	7/14/2014	155.5	3/15/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	105
03N20W34G01	ELPMA	FCA	580–1,011	104	−327	70.68	10/22/1974	145.07	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	75
03N20W35R03	ELPMA	FCA	800–900	−213	−313	83.16	6/3/2010	155.56	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	105
03N20W26R03	ELPMA	FCA	803–1,180	−92	−469	98.51	9/22/2009	146.51	3/10/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	100
03N20W35R02	ELPMA	FCA/GCA	1050–1,110	−463	−523	85.27	6/3/2010	156.56	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	105
02N20W06R01S	WLPMA	LAS	1,090–1,512	−631	−1053	−232.91	1/1/2016	−124.21	3/9/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	−170
02N20W08F01S	WLPMA	LAS	752–1,405	−315	−969	−230.83	10/14/1993	NA	—	Chronic lowering of groundwater levels, reduction in groundwater storage	−195
02N21W16J03S	WLPMA	LAS	560–1,120	−297	−857	−115.49	6/17/2004	−74	3/17/2015	Seawater intrusion (in Oxnard Subbasin), chronic lowering of groundwater levels, reduction in groundwater storage	−73
02N21W11J03S	WLPMA	LAS	1,020–1,080	−640	−700	−83.64	10/24/1994	−51.01	3/16/2015	Chronic lowering of groundwater levels, reduction in groundwater storage	−70
02N21W12H01S	WLPMA	LAS	928–1,765	−510	−1,347	−83.91	12/5/1991	N/A	—	Chronic lowering of groundwater levels, reduction in groundwater storage	−70

Notes: ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; ft bgs = feet below ground surface; ft msl = feet above mean sea level; GCA = Grimes Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; N/A = not applicable; UAS = Upper Aquifer System; WLPMA = West Las Posas Management Area.

Table 3-2
Measurable Objectives and Interim Milestones

Well Number	Management Area	Aquifer	Minimum Threshold	Measurable Objective	Fall 2015 Water Level Low		Interim Milestone (ft msl)			
			(ft msl)	*(ft msl)*	*(ft msl)*	*Date Measured*	*2025*	*2030*[a]	*2035*[a]	*2040*[a]
03N19W29F06	Epworth Gravels	Epworth Gravels	555	585	580	10/21/2015	581	583	584	585
02N20W09Q08	ELPMA	Shallow Alluvial	170	255	271	10/15/−2015	—	—	—	—
02N20W12MMW1	ELPMA	Shallow Alluvial	300	345	369	9/15/2015	—	—	—	—
02N20W01B02	ELPMA	FCA	80	120	129.8	9/23/2012	—	—	—	—
02N20W03H01	ELPMA	FCA	100	135	157	10/19/2015	—	—	—	—
02N20W04F02	ELPMA	FCA	100	145	157	9/18/2013	—	—	—	—
02N20W10D02	ELPMA	FCA	80	130	150.5	10/27/2015	—	—	—	—
02N20W10G01	ELPMA	FCA	100	230	244.8	10/27/2015	—	—	—	—
02N20W10J01	ELPMA	FCA	110	250	279.3	10/27/2015	—	—	—	—
03N19W19J01	ELPMA	FCA	130	160	176.2	10/21/2015	—	—	—	—
03N19W28N03	ELPMA	FCA	130	170	180.9	10/15/2015	—	—	—	—
03N19W31B01	ELPMA	FCA	105	145	146.5	10/15/2015	—	—	—	—
03N20W34G01	ELPMA	FCA	75	130	141.9	10/29/2015	—	—	—	—
03N20W35R03	ELPMA	FCA	105	145	136.6	10/29/2015	139	141	143	145
03N20W26R03	ELPMA	FCA	100	120	131.9	11/2/2015	—	—	—	—
03N20W35R02	ELPMA	GCA	105	145	128.7	10/15/2015	133	137	141	145
02N20W06R01S	WLPMA	LAS	−170	−125	−154	10/15/2015	−147	−140	−132	−125
02N20W08F01S	WLPMA	LAS	−195	−150	−121	7/1/2014	—	—	—	—
02N21W16J03S	WLPMA	LAS	−75	−45	−79.8	12/14/2015	−71	−62	−54	−45
02N21W11J03S	WLPMA	LAS	−70	−50	−69	10/22/2015	−64	−60	−55	−50
02N21W12H01S	WLPMA	LAS	−70	−45	−41.9	3/10/2014	—	—	—	—

Notes: ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; ft msl = feet above mean sea level; GCA = Grimes Canyon Aquifer; LAS = Lower Aquifer System; WLPMA = West Las Posas Management Area.

[a] Interim milestones for 2030, 2035, and 2040 will depend on basin water level recoveries between 2020 and 2025. These thresholds are proposed for the current GSP but will be reviewed and revised with each 5-year evaluation.

Figure 3-1 Key Wells Screened in the Fox Canyon Aquifer for the Las Posas Valley Basin

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Figure 3-2 Key Wells Screened in the Shallow Alluvial Aquifer and Epworth Gravels Aquifer for the Las Posas Valley Basin

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Figure 3-3 Scenario 3 Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS (mg/L) Measured 2011–2015

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Figure 3-4 Scenario 5 Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS (mg/L) Measured 2011–2015

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Figure 3-5 Scenario 6 Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS (mg/L) Measured 2011–2015

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Figure 3-6 Scenario 7 Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS (mg/L) Measured 2011–2015

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Figure 3-7 Scenario 8 Predicted Particle Tracks for 2020–2070 from CMWD Model and Most Recent TDS (mg/L) Measured 2011–2015

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Figure 3-8a Key Well Hydrographs in the West Las Posas Valley Management Area

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Figure 3-8b Key Well Hydrographs in the West Las Posas Valley Management Area

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Figure 3-9 Fox Canyon Aquifer Zone Map

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Figure 3-10a Key Well Hydrographs in the East Las Posas Valley Management Area – Shallow Alluvial Aquifer

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Figure 3-10b Key Well Hydrographs in the East Las Posas Valley Management Area – Fox Canyon Aquifer

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Figure 3-10c Key Well Hydrographs in the East Las Posas Valley Management Area – Fox Canyon Aquifer

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Figure 3-10d Key Well Hydrographs in the East Las Posas Valley Management Area – Fox Canyon Aquifer

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Figure 3-10e Key Well Hydrographs in the East Las Posas Valley Management Area – Fox Canyon Aquifer

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Figure 3-11 Key Well Hydrographs in the Epworth Gravels Management Area – Epworth Gravels Aquifer

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CHAPTER 4
MONITORING NETWORKS

4.1 MONITORING NETWORK OBJECTIVES

The overall objective of the monitoring network in the Las Posas Valley Basin (LPVB) is to track and monitor parameters that demonstrate conditions in the LPVB related to the sustainability goals. In order to accomplish this objective, the monitoring network in the LPVB must be capable of:

- Monitoring changes in groundwater conditions (in six 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 LPVB 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 LPVB.

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.

4.2 DESCRIPTION OF EXISTING MONITORING NETWORK

The existing monitoring network for groundwater and related surface conditions in the LPVB includes groundwater production wells, dedicated groundwater monitoring wells, stream gauges, and weather stations. The components of the monitoring network are discussed in Section 4.2.1, Network for Monitoring Groundwater; Section 4.2.2, Surface Conditions Monitoring; and Section 4.2.3, Network for Monitoring Precipitation, in the context of their ability to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, as well as the ability of the network to provide representative conditions in the LPVB. A discussion of how the monitoring network relates to each of the sustainability criteria follows this discussion in Section 4.3, Monitoring Network Relationship to Stability Indicators.

4.2.1 Network for Monitoring Groundwater

Data collected from more than 200 wells in the LPVB have been used to demonstrate historical groundwater elevation conditions (Appendix C, CMWD Model Report). The current groundwater well monitoring network is smaller, but still encompasses approximately 40 wells in the West Las Posas Management Area (WLPMA) and approximately 90 wells in the East Las Posas Management Area (ELPMA) (Figures 4-1 through 4-3). The groundwater well monitoring network contains wells that are screened in every primary aquifer in the LPVB. The network of groundwater wells includes agricultural, municipal, industrial, and domestic production wells and these are the primary wells used to assess groundwater conditions in the LPVB. In addition to the groundwater production wells used in the monitoring network the U.S. Geological Survey installed one dedicated nested monitoring well cluster (02N21W11J03S-06S) in the WLPMA and one dedicated nested monitoring well cluster (03N20W35R02S-04S) in the ELPMA. The only other dedicated monitoring wells in the LPVB are screened in the shallow alluvial aquifer.

West Las Posas Management Area

The majority of the groundwater elevation data in the WLPMA are collected by the Ventura County Watershed Protection District (VCWPD). VCWPD conducts manual groundwater sampling in 16 wells. The United Water Conservation District (UWCD) collects manual groundwater elevation measurements from three additional wells in the WLPMA. Two of these are municipal wells and one is an agricultural well.

Manual groundwater elevation measurements are used to assess seasonal and long-term trends in groundwater elevation in the WLPMA, where groundwater elevations were first measured in the 1940s (Appendix C). Seasonal and long-term groundwater elevation trends have been assessed based on the data collected from the existing and historical network of groundwater monitoring wells, and are discussed in Section 2.3, Groundwater Conditions, of this Groundwater Sustainability Plan (GSP).

The spatial and temporal coverage of the existing groundwater monitoring network is sufficient to provide an understanding of representative conditions in the Upper San Pedro Formation (USP), the Fox Canyon Aquifer (FCA), and the Grimes Canyon Aquifer (GCA) in the WLPMA. Therefore, this network will be used to demonstrate progress toward the sustainability goals for the LPVB. Although evaluation of the current network suggests that the network is sufficient to document groundwater conditions in the LPVB areas for future improvement of the network are identified in Section 4.6, Potential Monitoring Network Improvements.

East Las Posas Management Area

In the ELPMA groundwater elevations are monitored by Calleguas Municipal Water District (CMWD) and VCWPD. CMWD monitors 30 wells in the ELPMA, 15 of which are agricultural wells, 10 of which are dedicated monitoring wells, and 5 of which are municipal wells. VCWPD monitors an additional 18 wells in the ELPMA and the Epworth Gravels Management Area. Manual groundwater elevation measurements are collected by VCWPD, while CMWD records water levels both manually and with pressure transducers. Pressure transducers record the pressure of water (or height of the water column) above the transducer in the well. The CMWD transducers record the height of the water column in the well every 30 minutes, thereby providing high-temporal-resolution data on groundwater conditions in the aquifers.

Manual groundwater elevation measurements are used to assess seasonal and long-term trends in groundwater elevation in the ELPMA, where groundwater elevations were first measured in the 1920s. Seasonal and long-term groundwater elevation trends have been assessed based on the data collected from the existing and historical network of groundwater monitoring wells, and are discussed in Section 2.3.

The spatial and temporal coverage of the existing groundwater monitoring network is sufficient to provide an understanding of representative conditions in the Shallow Alluvial Aquifer or shallow alluvium, the USP, the FCA, and the GCA in the ELPMA. Therefore, this network will be used to demonstrate progress toward the sustainability goals for the LPVB. Although evaluation of the current network suggests that the network is sufficient to document groundwater conditions in the LPVB, areas for future improvement of the network are identified in Section 4.6.

Groundwater Quality

VCWPD collects groundwater quality samples from 14 wells in the WLPMA and 13 wells in the ELPMA. In the WLPMA, eight of the wells from which groundwater quality samples are collected are screened in the FCA, one well is screened in the USP, and the remaining five wells are screened in multiple aquifers, or the aquifer designation is not known. All of the wells used for groundwater quality sampling in the WLPMA are agricultural production wells. In the ELPMA, six of the wells from which groundwater quality samples are collected are screened only in the FCA, and the remaining wells are screened in multiple aquifers, or the aquifer designation is not known. One well is a municipal production well and the remaining wells are agricultural production wells.

Groundwater quality samples are generally collected annually (Appendix E, UWCD Model Report). Annual monitoring of groundwater quality is sufficient to demonstrate long-term trends in groundwater quality. Water quality does not change as rapidly as groundwater elevation because the physical processes that drive changes in groundwater quality operate on a longer time scale. Currently, groundwater elevations are the primary metric by which progress toward sustainability will be measured. However, groundwater quality data will continue to be collected and analyzed in order to assess whether groundwater elevation thresholds are sufficiently protective of groundwater conditions in the LPVB. Recommendations for improvement of the groundwater quality monitoring network are identified in Section 4.6.

Groundwater Extraction

The Fox Canyon Groundwater Management Agency (FCGMA) has required reporting of groundwater extraction from the LPVB since 1983. Historically, groundwater extraction data from wells within the FCGMA jurisdictional boundary have been self-reported by the well owner semi-annually (Figure 2-5, Groundwater Extraction [acre-feet] in 2015 in the Las Posas Valley Basin). In 2018, FCGMA adopted an ordinance that required installation of advanced metering infrastructure (AMI) telemetry on wells that were equipped with flowmeters (FCGMA 2018). All agricultural wells were required to install AMI by December 31, 2018, municipal and industrial wells are required to install AMI by October 1, 2019, and all other metered wells are required to install AMI by October 1, 2020. Requiring AMI on all metered wells within FCGMA jurisdiction will provide for broader simultaneous reporting of groundwater extractions, improve FCGMA's ability to monitor and manage groundwater use, and facilitate implementation of this GSP.

4.2.2 Surface Conditions Monitoring

The primary surface conditions that impact groundwater conditions in the LPVB are surface water flows and precipitation. Additionally, evapotranspiration from riparian vegetation lining Arroyo Simi–Las Posas impacts surface conditions by using surface water in the Arroyo. The monitoring networks for surface water flows and precipitation are discussed in this section. There is no specific monitoring network for evapotranspiration.

Surface flows in the LPVB are monitored by a network of gauges that are maintained by the VCWPD (Table 4-1, Network of Stations Monitoring Surface Flows in the Vicinity of the Las Posas Valley Basin; Figure 4-4, Active Surface Water Monitoring Network for the Las Posas Valley Basin). The network includes two types of gauges:

1. Recording Stream Gauges (also known as Daily and Peak Stations). These stream gauges record daily average flowrates as well as "peak" flowrates during rain events.
2. Peak Only (Event) Gauges. This type of stream gauge records only "peak" flowrates during rain events (the threshold over which a flowrate is considered to be part of a rain event is site-specific).

Both of the surface water gauges in the LPVB are located in the ELPMA, because there are no major surface water bodies in the WLPMA. The recording station on Arroyo Simi above Hitch Boulevard provides the primary data on surface flows. This gauge collects daily data, while the Gabber–Walnut Canyon Drain gauge only record flows during precipitation events.

Surface water flows have been recorded in the LPVB since the 1930s (Figure 1-4, Monthly Minimum, Average, and Maximum Average Daily Flows in Arroyo Simi–Las Posas). The historical and existing spatial and temporal coverage from the surface water flow gauge network provides adequate coverage for the short-term, seasonal, and long-term surface flow conditions in the LPVB. Although the current network is sufficient to document surface flow conditions in the LPVB, areas for improvement are identified in Section 4.6.

4.2.3 Network for Monitoring Precipitation

Seven precipitation gauges currently monitor precipitation in the LPVB (Table 4-2, Network of Stations Monitoring Precipitation in the Vicinity of the Las Posas Valley Basin; Figure 4-5, Active Precipitation Monitoring Network for the Las Posas Valley Basin). The precipitation gauges are maintained, and data are collected, by VCWPD and the National Weather Service.

Precipitation in the LPVB has been recorded for over a century (Figure 1-5, Las Posas Valley Precipitation). Although the locations of individual precipitation gauges have changed through time with some gauges being removed from service and others added, there is overlap between the records collected from the various gauges. Therefore a continuous precipitation record can be constructed for the LPVB to demonstrate long-term trends. More recent data collected at higher frequencies can be used to demonstrate short term and seasonal trends in precipitation.

In addition to providing adequate temporal coverage of the LPVB, the current network of precipitation gauges includes sites in both the ELPMA and WLPMA. This is sufficient spatial coverage to document precipitation in the LPVB and to connect the precipitation measurements to both streamflow and groundwater conditions. Additional precipitation monitoring locations are not currently recommended for characterizing surface conditions in the LPVB.

4.3 MONITORING NETWORK RELATIONSHIP TO SUSTAINABILITY INDICATORS

To document changes in groundwater conditions related to each of the six sustainability indicators, monitoring will be conducted, using the existing network of groundwater wells (Figures 4-1 through 4-3). This network includes a greater number of wells than the list of key wells provided in Chapter 3, Sustainable Management Criteria, of this GSP (see Tables 4-3 through 4-5 for monitoring schedules for wells in the LPVB). Minimum thresholds and measurable objectives have been selected for the set of key wells, but have not been selected for every well used to monitor groundwater conditions in the LPVB. Conditions measured in the key wells will be used to document progress toward the sustainability goals. Groundwater conditions measured in the broader network of wells, which includes the key wells, will be used to document conditions in the LPVB at a greater spatial coverage than is provided by the key wells. Recommendations and findings based on the key well data will be supported by the data collected by the broader well network.

4.3.1 Chronic Lowering of Groundwater Levels

To monitor conditions related to chronic lowering of groundwater levels, the groundwater monitoring network must be structured to accomplish the following:

- Track short-term, seasonal, and long-term trends in water elevation.
- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the LPVB.

Spatial Coverage by Aquifer

The LPVB monitoring well density for groundwater elevations varies by aquifer and by management area (Tables 4-3 through 4-5). In the WLPMA, nine wells are screened in the USP, which is not a principal aquifer but supplies water to the FCA (Figure 4-2, Monitoring Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin). The density of wells in the USP in the WLPMA is approximately one well per 3 square miles (the WLPMA is approximately 27 square miles in area). In the FCA, there are 25 wells in the monitoring network. The density of wells in the FCA is approximately one well per square mile. There are five wells in the monitoring network screened within the GCA, for a density of approximately one well per 5 square miles.

Although there is no definitive rule for the density of groundwater monitoring points needed in a basin, for comparison the monitoring well density recommended by CASGEM Groundwater Elevation Monitoring Guidelines ranges from 1 to 10 wells per 100 square miles (DWR 2010). Additional DWR guidelines recommend a well network with a density of 1 observation per 16 square miles (DWR 2010, 2016b). Therefore, the density of wells in the monitoring network for the WLPMA the meets the criteria for adequate coverage and is sufficient to accomplish the objectives of the monitoring well network for determining chronic lowering of groundwater levels.

In the ELPMA, six wells are screened within the Shallow Alluvial Aquifer (Figure 4-1, Monitoring Wells Screened in the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, and Grimes Canyon Aquifer in the Las Posas Valley Basin). The area of the entire ELPMA is approximately 42 square miles, but the Shallow Alluvial Aquifer is limited to the area adjacent to Arroyo Las Posas and is approximately 20 square miles. Thus the density of wells in the Shallow Alluvial Aquifer is approximately one well per 3 square miles. The density of wells in the FCA in the ELPMA is less than one well per square mile, with over 50 wells in the monitoring network screened in the FCA (Figure 4-3, Monitoring Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin). No wells in the monitoring network are screened in the GCA in the ELPMA. Although the lack of wells screened in the GCA is a data gap, the overall density of wells in the monitoring well network is sufficient to document groundwater conditions in the FCA, which is the principal aquifer from which groundwater is produced in the ELPMA. Additionally, the density of wells in the Shallow Alluvial Aquifer and the USP also meets the general guidelines for adequate coverage (DWR 2010, 2016b). Therefore, the network of monitoring wells in the ELPMA is sufficient to document groundwater conditions and meet the objectives for determining chronic declines in groundwater elevation.

In the Epworth Gravels Management Area, there are five wells screened within the Epworth Gravels Aquifer. This aquifer is limited to an area of approximately 2.5 square miles. The density of wells in the Epworth Gravels Aquifer is approximately one well per 0.5 square miles. This density meets the DWR and CASGEM criteria for documenting groundwater elevations in the Epworth Gravels Aquifer.

Although the active network of wells used to document chronic lowering of groundwater levels in the management areas of the LPVB has sufficient spatial density on the scale of each management area, in some aquifers there are local areas in which coverage can be improved. Potential improvements in local coverage are discussed in Section 4.6.

Temporal Coverage by Aquifer

Groundwater elevation data will be collected from the network of groundwater wells to provide groundwater elevation conditions in the spring and fall of each year. Further discussion of the monitoring schedule is provided in Section 4.4, Monitoring Network Implementation.

4.3.2 Reduction of Groundwater Storage

To monitor conditions related to reduction of groundwater storage, the groundwater monitoring network must be structured to accomplish the following:

- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Calculate year-over-year (mid-March to mid-March) change in storage by aquifer.
- Provide data from which lateral and vertical hydraulic gradients within and between aquifers can be calculated.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

The requirements for documenting reduction in groundwater storage are similar to those for chronic lowering of groundwater levels (see Section 4.3.1), because these two sustainability indicators are interrelated. The primary difference between the two sets of requirements is the need to document potential gradients between aquifers. These gradients influence the movement of water between aquifers, which in turn influences storage in the aquifer.

Historically, the change in stored groundwater in the WLPMA has been modeled by UWCD, and the change in stored groundwater in the ELPMA has been modeled by CMWD. After GSP adoption, modeled volumes of annual change in storage will be reported by aquifer and by year in annual reports. A standardized method to calculate the change in storage that relies solely on water elevations within each aquifer, rather than a numerical model, may also be developed as a check on the model predictions.

The spatial and temporal density of groundwater elevation data necessary to document groundwater storage changes in the aquifers of the LPVB is the same as that necessary to document groundwater elevation changes. The current network of wells is capable of documenting changes to both sustainability indicators. Specific recommendations for potential improvements to local coverage are discussed in Section 4.6.

4.3.3 Seawater Intrusion

Direct seawater intrusion does not impact the LPVB. To monitor groundwater conditions related to seawater intrusion in the Oxnard Subbasin, groundwater elevations will be measured in the WLPMA in such a way as to accomplish the following:

- Track short-term, seasonal, and long-term trends in water elevation.
- Demonstrate groundwater elevations in mid-March and mid-October for each primary aquifer or aquifer system.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

These goals are the same as those for chronic lowering of groundwater levels and the spatial density of monitoring network wells required to meet these goals is also the same as the density requirement for documenting chronic lowering of groundwater levels. The current monitoring network provides adequate spatial coverage to accomplish these goals (see Section 4.3.1).

4.3.4 Degraded Water Quality

To monitor conditions related to degraded water quality, water quality samples will be collected in such a way as to track long-term trends in water quality that may impact beneficial uses and users of groundwater in the LPVB. Specifically, these water quality samples should be targeted to constituents of concern and areas of the LPVB that have documented, or potential for degradation related to groundwater production from the LPVB.

Spatial Coverage by Aquifer

The network of wells currently used to monitor groundwater elevation conditions in each aquifer is sufficient to determine trends in groundwater quality as well. The primary area of concern for groundwater quality degradation is in the ELPMA, where infiltration of surface water in Arroyo Simi–Las Posas has resulted in increasing concentrations of total dissolved solids (TDS) in the groundwater adjacent to Arroyo Simi–Las Posas. The spatial density of groundwater elevation monitoring wells is discussed in Section 4.3.1. The spatial coverage provided by the existing monitoring network is sufficient to document changes in groundwater quality.

Water Quality Constituents

Monitoring and annual reporting has occurred for constituents that are associated with a water quality threshold adopted by the FCGMA Board of Directors or by the Los Angeles Regional Water Quality Control Board. These constituents are TDS, chloride, nitrate, sulfate, and boron. The network of existing wells is capable of providing an adequate assessment of groundwater quality trends for these constituents.

Temporal Resolution

Degradation of groundwater quality occurs on a longer timescale than changes in groundwater elevation. Historically, groundwater samples have been collected annually in many, but not all, wells in the monitoring network (Appendix E). More frequent sampling has occurred in some wells, while others have not been sampled as frequently. The temporal resolution of the data collection has been adequate to document trends in groundwater concentration for the constituents identified by the FCGMA Board of Directors and the Los Angeles Regional Water Quality Control Board.

4.3.5 Land Subsidence

To monitor conditions related to land subsidence, groundwater elevations will be measured to determine if water levels fall below historical lows until such time as a subsidence monitoring program can be established. Groundwater elevations are being used as a proxy for land subsidence in the

LPVB. The subsidence monitoring program will only be necessary in the northern part of the ELPMA, where minimum thresholds for chronic lowering of groundwater levels are lower than historical low groundwater elevations. In the southern part of the ELPMA and throughout the WLPMA and Epworth Gravels Management Area, the minimum thresholds identified at the key wells are above the historical low groundwater elevation. Therefore, in these areas it is not anticipated that specific land subsidence monitoring will be required. Instead, the network of groundwater monitoring wells discussed in Sections 4.2.1 and 4.3.1 will be used to determine if land subsidence related to groundwater production may occur.

4.3.6 Depletions of Interconnected Surface Water

To monitor conditions related to depletions of interconnected surface water, surface water flows and shallow groundwater will be measured in such a way as to accomplish the following:

- Track short-term, seasonal, and long-term trends in groundwater elevation in the semi-perched aquifer.
- Demonstrate groundwater elevations in mid-March and mid-October for the semi-perched aquifer.
- Record groundwater elevations in key wells in which minimum thresholds and measurable objectives have been identified to track progress toward the sustainability goals for the Subbasin.

Surface water flows in Arroyo Simi–Las Posas are a source of recharge to the ELPMA, and groundwater elevations in the underlying Shallow Alluvial Aquifer are generally below the bottom of the Arroyo. Portions of Arroyo Simi–Las Posas have been identified as potential groundwater-dependent ecosystems (GDEs) because riparian communities have developed adjacent to the stream bed. However, the Arroyo is a losing stream and the degree to which the vegetation adjacent to the Arroyo is reliant on groundwater versus unsaturated soil water is unknown (see Section 2.3.7, Groundwater-Dependent Ecosystems). To better characterize the relationship between the riparian vegetation and water levels in the Shallow Alluvial Aquifer (or shallow alluvium), an additional shallow monitoring well could be installed within the boundaries of the potential GDE. This potential improvement to the monitoring well network is discussed further in Section 4.6.

4.4 MONITORING NETWORK IMPLEMENTATION

4.4.1 Groundwater Elevation Monitoring Schedule

To reduce uncertainty associated with hydraulic gradients and to follow guidance documents produced by DWR (DWR 2016b), water level measurements used in the evaluation of seasonal high and seasonal low groundwater conditions should collected in a 2-week window in mid-March and mid-October (specifically, March 9–22 and October 9–22 of any given calendar year).

Short-term trends in groundwater elevation are currently, and will continue to be, monitored using transducers that are operated and maintained by UWCD and CMWD. Data from these transducers is downloaded quarterly and are stored in a central database.

Seasonal and long-term trends in groundwater elevation are monitored using the transducer data and manual measurements made by UWCD on a monthly or bimonthly basis, and manual measurements made by VCWPD on a quarterly basis. Other entities that generate water level and water quality data in the LPVB include the Ventura County Water Works Districts No. 1 and No. 19, the Moorpark Wastewater Treatment Plant, and small mutual water companies. Relevant data collected by these entities and UWCD is regularly sent to the VCWPD for inclusion in annual reporting data products such as water elevation contour maps (i.e., FCGMA 2014).

4.4.2 Groundwater Storage Monitoring Schedule

Groundwater storage is directly related to, and calculated from, groundwater elevations. Consequently, the schedule for monitoring groundwater storage is the same as that for monitoring groundwater elevations.

4.4.3 Seawater Intrusion Monitoring Schedule

No monitoring schedule is required for seawater intrusion because the LPVB does not experience direct seawater intrusion.

4.4.4 Water Quality Monitoring Schedule

UWCD, VCWPD, and CMWD conduct annual monitoring of groundwater quality in the LPVB. Groundwater quality monitoring should continue on the same schedule in order to document groundwater quality trends in the LPVB. Annual reviews of the groundwater quality trends will be used to assess whether sampling frequency needs to be adjusted.

4.4.5 Groundwater Extraction Monitoring Schedule

Monitoring of groundwater extraction rates will take place continuously, using flow meters and telemetry equipment installed on individual wellheads, and monthly totals of pumped water will be transmitted to a central database maintained by FCGMA.

4.5 PROTOCOLS FOR DATA COLLECTION AND MONITORING

Protocols for collecting groundwater level measurements and water quality samples, as well as downloading transducers and logging the borehole of newly drilled wells, are included in the Monitoring Protocols Best Management Practices (BMPs) produced by DWR (DWR 2016a). FCGMA plans to work with agency partners to ensure that future data collection is conducted according to relevant protocols in the BMP. Current practices used by VCWPD, UWCD, and CMWD are described in this section.

VCWPD Protocols

VCWPD technicians collect water levels using steel tapes. For a well that is too deep for the tape, an acoustical sounder or an air pressure gauge is used, and the measurement is stored in the database with a Questionable Measurement Code, indicating that alternate equipment was used.

VCWPD technicians collect water quality samples from production wells using the installed pump equipment. A three-volume purge, or a testing of groundwater parameters including pH, temperature, and electrical conductivity, is conducted to determine whether the water at the wellhead is representative of groundwater in the aquifer. Water quality samples are then sent to an analytical laboratory, where they are filtered and preserved.

UWCD Protocols

UWCD technicians collect water levels using a variety of equipment, including dual wire and single wire sounders, and metal tapes. In the event that the well contains a pump, the technician manually tests the approximate temperature of the pump housing. If the pump housing is warm, the water level that is entered into the database is qualified with a Questionable Measurement Code, indicating recent pumping.

UWCD technicians collect water quality samples using the three-volume purge method, and follow U.S. Geological Survey guidelines for groundwater quality sampling. For shallow wells, a Grundfos Redi-Flo pump is used to purge and sample the groundwater. For deeper wells, a compressor is used to airlift the groundwater for purging and sampling. On rare occasions, a bailer is used to purge and sample.

CMWD Protocols

CMWD monitors water level data using pressure transducers.

4.6 POTENTIAL MONITORING NETWORK IMPROVEMENTS

The existing monitoring network in the LPVB is sufficient to document groundwater and can be used to document progress toward the sustainability goals for the WLPMA, the ELPMA, and the Epworth Gravels Management Area. However, analysis of the monitoring network also indicates that there are areas in which data coverage and monitoring efforts can be improved in the future. Areas for improvement of the existing monitoring network and data infrastructure system are described in the following sections.

4.6.1 Water Level Measurements: Spatial Data Gaps

Additional monitoring wells could be used to improve spatial coverage for groundwater elevation measurements in the WLPMA and the ELPMA. Wells that are added to the network should be dedicated monitoring well clusters, with individual wells in the cluster screened in a single aquifer. The potential improvements to the monitoring network in each aquifer are shown on Figures 4-6 through 4-9.

In the WLPMA, the groundwater monitoring network could be improved by adding a monitoring well or wells near the boundary between the WLPMA and the Oxnard Subbasin to the west (Figure 4-6, Existing and Proposed New Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin). Groundwater elevation measurements in this area would help constrain groundwater gradients across the boundary between the WLPMA and the Oxnard Subbasin.

In the ELPMA, the groundwater monitoring network could be improved by adding a monitoring well or wells adjacent to Arroyo Simi–Las Posas and a well or wells screened in the GCA. A new monitoring well adjacent to Arroyo Simi–Las Posas should be located within the boundaries of the potential GDE and would be used to characterize depth to groundwater and changes in groundwater elevation adjacent to the Arroyo. This well would provide data on whether the vegetation in the riparian corridor relies on groundwater or soil moisture from infiltrating surface water.

Currently, there are no dedicated monitoring wells screened in the GCA in the ELPMA. Adding a monitoring well would provide for aquifer specific water levels that would improve the understanding of groundwater gradients between the FCA and the GCA. The location of the new nested monitoring well should consider the areas of the ELPMA that are likely to experience groundwater elevation declines in the future, as well as the complexity of the underlying geology.

New wells will be constructed to applicable well installation standards set in California DWR Bulletin 74-81 and 74-90, or as updated (DWR 2016b). It is recommended that, where feasible, new wells be subjected to pumping tests in order to collect additional information about aquifer properties in the vicinity of new monitoring locations.

Proposed locations are approximate and subject to feasibility review (accounting for infrastructure, site acquisition, and site access among other factors), after GSP submittal. The schedule for new well installation will be developed in conjunction with feasibility review.

4.6.2 Water Level Measurements: Temporal Data Gap

The DWR Monitoring Protocols BMP (DWR 2016a) states the following:

> Groundwater elevation data … should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1 to 2 week period.

The DWR Monitoring Networks BMP (DWR 2016b) states the following:

> Groundwater levels will be collected during the middle of October and March for comparative reporting purposes.

Currently, groundwater elevation measurements are not scheduled according to these criteria. To minimize the effects of this type of temporal data gap in the future, it will be necessary to coordinate the collection of groundwater elevation data so it occurs within a 2-week window during the key reporting periods of mid-March and mid-October. The recommended collection windows are October 9–22 in the fall and March 9–22 in the spring (see Section 4.4).

Additionally, 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.

4.6.3 Groundwater Quality Monitoring

Improvements to the groundwater quality monitoring network include increasing the spatial density of samples by collecting water quality samples from a larger subset of wells in the monitoring network, and ensuring that water quality samples are collected at least annually from each well in the groundwater quality monitoring network. Annual groundwater quality samples should also be collected from wells that are added to the groundwater elevation monitoring network in the future.

Additionally, the proposed analyte list could be expanded to include a full general minerals suite so that Stiff or Piper diagrams can be created to fully characterize the geochemical characteristics of the groundwater and track changes over time.

4.6.4 Subsidence Monitoring

Currently, neither FCGMA nor its partner agencies in the region monitor land subsidence. Two monuments are used for measuring subsidence in the LPVB: monument MPWD, located in the foothills north of Moorpark in the ELPMA, and monument P729, located near Los Angeles Avenue in the WLPMA (Figure 2-37, Subsidence Monuments in the Las Posas Valley Basin). UNAVCO maintains and collects data from these monuments. Future subsidence related to groundwater production is not anticipated to occur in the WLPMA, where minimum threshold groundwater elevations are equal to or higher than historical low groundwater elevations. This is also true in the southern part of the ELPMA. In the area of the ELPMA north of the Moorpark Anticline, however, minimum threshold groundwater elevations are lower than the historical low groundwater elevations. Although subsidence risk related to groundwater withdrawal in this area is not high, a subsidence monitoring program should be established. Preexisting GPS-based benchmarks are not well suited for monitoring land subsidence.

A feasibility study is recommended to determine the following:

- The likelihood of subsidence related to groundwater withdrawal that could substantially interfere with surface land uses based on the measurable objective and minimum threshold groundwater elevations
- The appropriate location or locations for establishing a new subsidence monument in the ELPMA
- Recommended monitoring protocols and schedules

This study should consider the tectonic activity in the ELPMA and the location of faults that may influence ground movement. If the study indicates that subsidence related to groundwater withdrawal that substantially interferes with surface land uses may occur in the ELPMA, the findings of the feasibility study should be used to establish a subsidence monitoring monument and a subsidence monitoring plan with protocols for data measurement and reporting should be established before the monument is installed.

4.6.5 Shallow Groundwater Monitoring near Surface Water Bodies and GDEs

As discussed in Section 4.6.1 (Water Level Measurements: Spatial Data Gaps), there are no dedicated monitoring wells that can be used to monitor shallow groundwater within the boundaries of the potential GDE adjacent to Arroyo Simi–Las Posas in the ELPMA. To fill the existing data gap, and to assist with understanding the potential connectivity between groundwater and the potential GDEs, a shallow dedicated monitoring well or wells can be added within the boundaries of the potential GDE.

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Table 4-1
Network of Stations Monitoring Surface Flows in the Vicinity of the Las Posas Valley Basin

Station Number	Station Name	Latitude	Longitude	Elevation (ft msl)	Station Type	USGS ID
839	Gabbert–Walnut Canyon Drain	34.271667	−118.915750	421	Peak Only (Event) Gauge	—
841A	Arroyo Simi above Hitch Blvd	34.271778	−118.923444	400	Recording Stream Gauge	—

Notes: ft msl = feet above mean sea level; USGS = U.S. Geological Survey.
This table shows results from active gauges only (as of August 2016).

Table 4-2
Network of Stations Monitoring Precipitation in the Vicinity of the Las Posas Valley Basin

Station Number	Station Name	Latitude	Longitude	Elevation (ft msl)	Station Type	USGS ID
126A	Moorpark–Ventura County Yard	34.295509	−118.877971	725	Recording Precipitation Gauge	—
189	Somis–Deboni	34.285250	−119.073250	520	Recording Precipitation Gauge	—
190	Somis–Bard	34.282413	−119.008178	460	Recording Precipitation Gauge	—
206B	Somis–Fuller	34.310926	−118.979983	733	Recording Precipitation Gauge	—
238	South Mountain–Shell Oil	34.331765	−119.008998	2240	Recording Precipitation Gauge	—
250[a]	Moorpark–Happy Camp Canyon	34.346494	−118.850524	1410	Recording Precipitation Gauge	—
507	South Mountain East (Type B)	34.301542	−119.045036	1020	Non-Standard Recorder	—
508	Moorpark–Home Acres ALERT (Type B)	34.271288	−118.924846	400	Non-Standard Recorder	—

Notes: ft msl = feet above mean sea level; USGS = U.S. Geological Survey.
This table shows results from active gauges only (as of August 2016).

[a] The Moorpark–Happy Camp Canyon precipitation gauge is located within the FCGMA jurisdictional boundary but is outside of the DWR basin boundary for the LPVB.

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N19W29F06S	ELPMA	Epworth Gravels	Agricultural	Yes		Unassigned	Yes
02N19W07B02S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
02N19W08H02S	ELPMA	FCA	Municipal	Yes	Yes	LAS	
02N20W01B02	ELPMA	Multiple	Municipal			LAS	Yes
02N20W04F02	ELPMA	FCA	Agricultural			LAS	Yes
02N20W09Q07S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
02N20W10D02S	ELPMA	FCA	Domestic	Yes		LAS	Yes
02N20W10G01S	ELPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N20W10J01S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
02N20W16B06S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
03N19W19J01S	ELPMA	FCA	Agricultural	Yes		LAS	Yes
03N19W30E06S	ELPMA	FCA	Agricultural		Yes	LAS	Yes
03N20W25H01S	ELPMA	FCA	Agricultural	Yes		LAS	
03N20W26R03S	ELPMA	FCA	Agricultural	Yes		LAS	Yes
03N20W27H03S	ELPMA	FCA	Agricultural	Yes		LAS	
03N20W35R02S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
03N20W35R03S	ELPMA	FCA	Monitoring	Yes		LAS	Yes
03N19W19P02S	ELPMA	GCA	Industrial	Yes		LAS	
02N20W01Q02S	ELPMA	Multiple	Agricultural		Yes	Unassigned	Yes
03N20W34G01S	ELPMA	Multiple/FCA	Agricultural	Yes	Yes	Unassigned	Yes
02N19W07D02S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N20W01Q01S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N19W29K06S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N19W29K08S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N20W28J04S	ELPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
03N20W35R04S	ELPMA	USP	Monitoring	Yes		Unassigned	
02N20W06R01S	WLPMA	FCA	Agricultural	Yes		LAS	Yes
02N20W07R03S	WLPMA	FCA	Agriculture			LAS	Yes
02N21W08H03S	WLPMA	FCA	Agricultural	Yes		LAS	Yes
02N21W11A02S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
02N21W11A03S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
02N21W11J03S	WLPMA	FCA	Monitoring	Yes		LAS	Yes
02N21W12H01S	WLPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N21W13A01S	WLPMA	FCA	Agricultural	Yes	Yes	LAS	Yes
02N21W17F05S	WLPMA	FCA	Agricultural		Yes	LAS	Yes
03N20W32H03S	WLPMA	FCA	Agricultural	Yes		LAS	
03N21W35P02S	WLPMA	FCA	Agricultural	Yes		LAS	
02N20W08F01S	WLPMA	Multiple	Domestic	Yes		Unassigned	Yes
02N20W17L01S	WLPMA	Multiple	Agricultural		Yes	LAS	Yes
02N21W10G03S	WLPMA	Multiple	Agricultural	Yes		LAS	
02N21W18H12S	WLPMA	Multiple	Agricultural	Yes		LAS	
02N21W18H03S	WLPMA	Oxnard	Agricultural	Yes		UAS	
02N20W06J01S	WLPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N21W15M04S	WLPMA	Unassigned	Agricultural		Yes	Unassigned	Yes
02N21W20Q05S	WLPMA	Unassigned	Agricultural		Yes	LAS	Yes
02N21W11J04S	WLPMA	USP	Monitoring	Yes		Unassigned	
02N21W11J05S	WLPMA	USP	Monitoring	Yes		Unassigned	

Table 4-3
Current VCWPD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Screened Aquifer	Main Use	Manual Water Levels Monitored by VCWPD?[a]	Water Quality Samples Collected by VCWPD?[a]	Screened Aquifer System	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N21W11J06S	WLPMA	USP	Monitoring	Yes		Unassigned	
02N21W15M03S	WLPMA	USP	Agricultural	Yes		Unassigned	
02N21W16J01S	WLPMA	USP	Agricultural	Yes		UAS	

Notes: ELPMA = East Las Posas Management Area; FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; UAS = Upper Aquifer System; USP = Upper San Pedro Formation; VCWPD = Ventura County Watershed Protection District; WLPMA = West Las Posas Management Area.
This table shows the monitoring schedule and status as of October 2017.
[a] As of October 2017.

Table 4-4
Current UWCD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Las Posas Management Area	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by UWCD?[a]	Transducer Maintained by UWCD?[a]	Water Quality Samples Collected Monthly or Quarterly?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N21W16J03S	WLPMA	Agricultural	Multiple	LAS	Yes			Yes
02N21W17F05S	WLPMA	Agricultural	FCA	LAS	Yes			Yes
02N21W20A02S	WLPMA	Agricultural	Unassigned	Unassigned	Yes			Yes
02N21W22G01S	WLPMA	Municipal	FCA	LAS	Yes			Yes
02N21W28A02S	WLPMA	Municipal	FCA	LAS	Yes			Yes

Notes: FCA = Fox Canyon Aquifer; GCA = Grimes Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; UWCD = United Water Conservation District; WLPMA = West Las Posas Management Area.
This table shows the monitoring schedule and status as of October 2017.
[a] As of October 2017.

Table 4-5
Current CMWD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by CMWD?[a]	Transducer Maintained by CMWD?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
02N20W06R01S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
03N20W32H02S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
02N19W06F01S	Monitoring	USP	Unassigned	Yes	Yes	Yes
02N19W07G01S	Monitoring	Alluvium	Unassigned	Yes	Yes	Yes
02N19W07K02S	Monitoring	FCA	Unassigned	Yes	Yes	Yes
02N19W07K03S	Monitoring	USP	Unassigned	Yes	Yes	Yes
02N19W07K04S	Agricultural	Alluvium	Unassigned	Yes	Yes	
02N19W09E01S	Agricultural	Alluvium	Unassigned	Yes	Yes	
02N20W02D02S	Monitoring	FCA	LAS	Yes	Yes	
02N20W02J01S	Agricultural	USP	LAS	Yes	Yes	
02N20W03H01S	Agricultural	FCA	LAS	Yes	Yes	Yes
02N20W03J01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W04B01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W09Q08S	Municipal	Alluvium	LAS	Yes	Yes	Yes
02N20W10K02S	Agricultural	Alluvium	LAS	Yes	Yes	
02N20W17J06S	Municipal	Alluvium	LAS	Yes	Yes	
03N19W28N03S	Agricultural	FCA	LAS	Yes	Yes	Yes
03N19W30D01S	Municipal	FCA	LAS	Yes	Yes	
03N19W30M02S	Agricultural	Epworth	LAS	Yes	Yes	
03N19W31B01S	Municipal	FCA	LAS	Yes	Yes	Yes
03N19W31H01S	Monitoring	FCA	LAS	Yes	Yes	
03N20W25R04S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35J01S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35R02S	Agricultural	FCA	LAS	Yes	Yes	
03N20W35R04S	Agricultural	USP	LAS	Yes	Yes	
03N20W36A02S	Agricultural	USP	Unassigned	Yes	Yes	

Table 4-5
Current CMWD Monitoring Schedule for Wells in the Las Posas Valley Basin

State Well Number	Main Use	Screened Aquifer	Screened Aquifer System	Manual Water Levels Monitored by CMWD?[a]	Transducer Maintained by CMWD?[a]	Twice-Yearly Water Quality Sampling Required after GSP Adoption?
03N20W36A04S	Monitoring	USP	Unassigned	Yes	Yes	
03N20W36G01S	Agricultural	USP	Unassigned	Yes	Yes	
03N20W36P01S	Monitoring	USP	Unassigned	Yes	Yes	
02N20W01A01S	Agricultural	FCA	LAS	Yes	Yes	
02N20W01E03S	Agricultural	FCA	LAS	Yes	Yes	

Notes: CMWD = Calleguas Municipal Water District; FCA = Fox Canyon Aquifer; GSP = Groundwater Sustainability Plan; LAS = Lower Aquifer System; USP = Upper San Pedro Formation.
This table shows the monitoring schedule and status as of October 2017.
[a] As of October 2017.

Figure 4-1 Monitoring Wells Screened in the Shallow Alluvial Aquifer, Epworth Gravels Aquifer, and Grimes Canyon Aquifer in the Las Posas Valley Basin

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Figure 4-2 Monitoring Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin

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Figure 4-3 Monitoring Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin

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Figure 4-4 Active Surface Water Monitoring Network for the Las Posas Valley Basin

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Figure 4-5 Active Precipitation Monitoring Network for the Las Posas Valley Basin

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Figure 4-6 Existing and Proposed New Wells Screened in the Upper San Pedro Formation in the Las Posas Valley Basin

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Figure 4-7 Existing and Proposed New Wells Screened in the Fox Canyon Aquifer in the Las Posas Valley Basin

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Figure 4-8 Existing and Proposed New Wells Screened in the Grimes Canyon Aquifer in the Las Posas Valley Basin

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Figure 4-9 Existing and Proposed New Wells Screened in the Shallow Alluvial Aquifer in the Las Posas Valley Basin

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CHAPTER 5
PROJECTS AND MANAGEMENT ACTIONS

5.1 INTRODUCTION TO PROJECTS AND MANAGEMENT ACTIONS

Projects and management actions have been developed to meet the sustainability goal, measurable objectives, and undesirable results identified for the Las Posas Valley Basin (LPVB) in Chapter 3, Sustainable Management Criteria, of this Groundwater Sustainability Plan (GSP). In the West Las Posas Management Area (WLPMA), chronic declines in groundwater elevation and associated loss of storage, along with the potential for low groundwater elevations to adversely impact seawater intrusion in the aquifers of the Upper Aquifer System and Lower Aquifer System in the Oxnard Subbasin, have been identified as the undesirable results that will have the greatest impact on beneficial uses of groundwater. In the East Las Posas Management Area (ELPMA), chronic declines in groundwater elevation, loss of storage, and the potential for subsidence related to groundwater withdrawal are the undesirable results that were identified as having the potential to impact beneficial uses of groundwater.

Projects ~~that~~ were developed in the WLPMA and the ELPMA to address the potential undesirable results in these management areas. The projects listed in this chapter were proposed by stakeholders, selected for inclusion in the GSP through a process by the Operations Committee of the Fox Canyon Groundwater Management Agency (FCGMA) Board of Directors (Board), and approved for inclusion in the GSP by the FCGMA Board. The criteria for including a project in the GSP included the following:

- Sufficient project information is available for evaluation and modeling.
- Project increases sustainable yield, or reduces groundwater demand.
- Project implementation is planned within 20 years.
- Project meets GSP Emergency Regulations Section 354.44 criteria.
- There is an agency proponent for the project.
- Funding for the project is identified.

The Operations Committee determined that one project in the WLPMA and two projects in the ELPMA met these criteria. The WLPMA project incorporated the purchase of 1,762 acre-feet per year (AFY) of imported water from Calleguas Municipal Water District (CMWD). This water would be delivered to the eastern part of the WLPMA in lieu of groundwater production. In the ELPMA, one project involves removing giant reed (*Arundo donax*; also called Arundo) in the Arroyo Simi–Las Posas watershed, and the other project involves purchasing wastewater discharges and de-watering well discharges from the City of Simi Valley to maintain flow in

Arroyo Simi–Las Posas. These three projects were incorporated into the future model scenarios to the extent possible (see Section 2.4.5, Projected Future Water Budget and Sustainable Yield). The inclusion of these projects does not constitute a commitment by the FCGMA Board to construct or fund the projects, but rather signals that these projects were 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 Las Posas Valley Basin (LPVB). As currently envisioned, the projects in this GSP would be implemented by the project proponent or sponsoring agency. However, FCGMA may opt to implement projects in the future as necessary to achieve sustainability in the LPVB. Additionally, all projects undertaken in the LPVB will need to be approved and permitted by all relevant regulatory agencies. These agencies may include, but are not limited to, the Regional Water Quality Control Board and the State Water Resources Control Board.

As discussed in Chapter 2, Basin Setting, of this GSP, groundwater modeling was used to evaluate projected water budget conditions and potential impacts to beneficial uses and users of groundwater in the basin.– Without the type of projects described below, substantially greater reductions in groundwater production will be needed to meet the sustainability goal for the basin, which would lead to significant economic disruption and prevent groundwater in the basin from being put to beneficial use to the fullest extent possible. In addition to the projects discussed in this chapter, the FCGMA Board has the authority to implement management actions to ensure that the LPVB does not experience undesirable results. The primary management action that can be implemented by the FCGMA Board is restrictions on groundwater production. This authority was granted to the FCGMA Board in the enabling legislation that formed the FCGMA, and this action has been undertaken in the past to eliminate overdraft.

It is anticipated, and recommended, that FCGMA will evaluate, model, and conduct feasibility studies of other projects for achieving sustainable groundwater management for the 5-year update to this GSP to optimize basin management and minimize extraction restrictions.

5.2 PROJECT NO. 1 – PURCHASE OF IMPORTED WATER FROM CMWD FOR BASIN REPLENISHMENT

5.2.1 Description of Project No. 1

The Purchase of Imported Water from CMWD for Basin Replenishment Project (Purchase of Imported Water from CMWD Project) would supply imported water to the eastern part of the WLPMA in lieu of groundwater production (FCGMA 2018). This project would directly result in decreased groundwater production from discrete wells in the WLPMA. This project is limited to water purveyors with ability to receive water from CMWD (FCGMA 2018).

5.2.2 Relationship of Project No. 1 to Sustainability Criteria

Supply of purchased imported water in lieu of groundwater production was included in future groundwater modeling scenarios to examine the impact that the project will have on the sustainability criteria (see Section 2.4.5). The future model scenarios also incorporated projects in the Oxnard Subbasin and the Pleasant Valley Basin, both of which are in the same model domain as the WLPMA. Because the future scenarios incorporated multiple projects, the impact of this project independent of the others was not quantified. Rather, the potential effect of this project in the context of all of the projects is presented in this discussion.

Relationship to Minimum Thresholds

As modeled, the Purchase of Imported Water from CMWD Project reduced production from the WLPMA by 1,762 AFY (see Section 2.4.5). The numerical groundwater model simulation of the Future Baseline With Projects Scenario, which incorporates potential future projects including the Purchase of Imported Water from CMWD Project, results in higher groundwater elevations than the Future Baseline Scenario, which does not incorporate projects (see Section 2.4, Water Budget). This suggests that the project will assist with water level recovery in the WLPMA. Furthermore, historical deliveries of imported water in lieu of groundwater production have resulted in groundwater elevation recoveries in the eastern WLPMA (see Section 2.3, Groundwater Conditions). Therefore, this project is anticipated to have a direct impact on groundwater elevations and could be used to help maintain elevations above the minimum thresholds defined in Chapter 3.

Relationship to Measurable Objectives

The relationship of the Purchase of Imported Water from CMWD Project to the measurable objectives is similar to its relationship with the minimum thresholds. By reducing groundwater production and increasing groundwater elevations, the Purchase of Imported Water from CMWD Project could be used to help the WLPMA meet the measurable objective water levels defined in Chapter 3.

5.2.3 Expected Benefits of Project No. 1

The Purchase of Imported Water from CMWD Project will benefit the WLPMA by reducing the groundwater production from the WLPMA without limiting the total quantity of water available to beneficial uses and users of the WLPMA (FCGMA 2018).

5.2.4 Timetable for Project No. 1

The project does not require construction of new facilities, and CMWD has completed its California Environmental Quality Act (CEQA) compliance review (FCGMA 2018). No additional permits would be needed to implement this project. Therefore, the project could be implemented after agreements have been completed for the purchase and delivery of the water from CMWD.

5.2.5 Metrics for Evaluation of Project No. 1

The metric for evaluation of the Purchase of Imported Water from CMWD Project will be the volume of groundwater that is not produced from wells that would have been pumped if the in-lieu water had not been delivered. FCGMA has required groundwater production reporting since 1983. Historical groundwater production rates will be compared to groundwater production rates during participation in the in-lieu delivery program to ensure compliance and reduction in groundwater production. If the project is implemented, the base period for the historical groundwater production rates will need to be determined.

5.2.6 Economic Factors and Funding Sources for Project No. 1

The funding source for this project is anticipated to be replenishment fees collected by FCGMA. A pumper would buy water from CMWD and FCGMA would reimburse the pumper for the net cost to purchase imported water. The cost of this project would depend on the amount of water purchased from CMWD. It is anticipated that water would be purchased at the Tier 1 rate, which is currently $1,423 per acre-foot of water.

Any action taken by the FCGMA Board, acting as the Groundwater Sustainability Agency for the portion of the LPVB in its jurisdiction, to impose or increase a fee shall be taken by ordinance or resolution. Should the FCGMA Board decide to fund a project through imposition of a replenishment fee, FCGMA will hold at least one public meeting, at which oral or written presentations may be made. Notice of the meeting will include an explanation of the fee to be considered and the notice shall be published pursuant to Section 6066 of the Government Code.[1] At least 20 days prior to the meeting, the Groundwater Sustainability Agency will make the data on which the proposed fee is based available to the public.

[1] Publication of notice pursuant to Section 6066 of the Government Code: "shall be once a week for two successive weeks. Two publications in a newspaper, published once a week or oftener, with at least five days intervening between the respective publication dates not counting such publication dates are sufficient."

5.3 PROJECT NO. 2 – ARROYO SIMI–LAS POSAS ARUNDO REMOVAL

5.3.1 Description of Project No. 2

The Arroyo Simi–Las Posas Arundo Removal Project involves removing the invasive plant species Arundo from approximately 324 acres of land along the Arroyo Simi–Las Posas corridor (FCGMA 2018). Arundo would be replaced with native riparian plant species, which are estimated to consume approximately 6 to 25 AFY per acre less water than Arundo. If all of the Arundo within the 324-acre area is removed, this project could result in up to an additional 2,680 AFY of recharge to the ELPMA (FCGMA 2018). This project is anticipated to have a positive impact on groundwater recharge, as well as a positive impact on the health of riparian habitat along Arroyo Simi–Las Posas.

5.3.2 Relationship of Project No. 2 to Sustainability Criteria

Surface water infiltration through the bottom of Arroyo Simi–Las Posas is a primary recharge mechanism for the ELPMA. Arundo that lines the banks of Arroyo Simi–Las Posas consumes more water than native riparian vegetation would. Therefore, removing Arundo will make additional water available to recharge the groundwater aquifers of the ELPMA. The effect of this additional recharge was investigated in the numerical groundwater model simulation of the ELPMA that included projects (see Section 2.4.5). Two projects were incorporated in these simulations: Arroyo Simi–Las Posas Arundo Removal and acquisition of wastewater and shallow dewatering well discharge to maintain perennial flow in Arroyo Simi–Las Posas (see Section 5.4, Project No. 3 – Arroyo Simi–Las Posas Water Acquisition). Because both of these projects were incorporated in the same model simulation, the impact of the Arroyo Simi–Las Posas Arundo Removal Project alone was not quantified. Therefore, the results and impacts on the minimum thresholds and measurable objectives discussed in this section are presented in the context of the cumulative project impacts from both of the projects modeled.

Relationship to Minimum Thresholds

As modeled, the Arroyo Simi–Las Posas Arundo Removal Project eliminated approximately 1,900 AFY of evapotranspiration (ET) losses within the model domain and incorporated the additional reduction of ET upstream of the model domain as increased surface water flow into the ELPMA along Arroyo Simi–Las Posas (see Section 2.4.5). The numerical groundwater model simulation of the Future Baseline With Projects Scenario, which incorporates the Arroyo Simi–Las Posas Arundo Removal Project, resulted in higher simulated groundwater elevations than the Future Baseline Scenario, which did not incorporate projects (see Section 2.4). The higher elevations were simulated in all aquifers of the ELPMA except the Epworth Gravels Aquifer, which does not receive recharge from Arroyo Simi–Las Posas. Additionally, the impact of this project on groundwater elevations was greater in the southern part of the ELPMA, adjacent to Arroyo Simi–Las Posas. In wells in the northern part of the ELPMA, the combined effects of the Arroyo Simi–Las Posas Arundo Removal Project and the Arroyo Simi–Las Posas Water Acquisition Project were not sufficient to maintain groundwater elevations above the minimum threshold after 2040. In the southern part of the ELPMA, the combined projects maintained groundwater elevations above the minimum thresholds throughout the 50-year model run. Therefore, this project is anticipated to have a direct impact on groundwater elevations and could be used to help maintain elevations above the minimum thresholds defined in Chapter 3 throughout much, but not all, of the ELPMA.

Relationship to Measurable Objectives

The relationship of the Arroyo Simi–Las Posas Arundo Removal Project to the measurable objectives is similar to its relationship with the minimum thresholds. By increasing surface water flow in Arroyo Simi–Las Posas and decreasing ET losses from invasive species that currently line the Arroyo Simi–Las Posas, the ELPMA is anticipated to receive more recharge along Arroyo Simi–Las Posas. Although this recharge alone is insufficient to maintain groundwater elevations above the measurable objectives throughout the ELPMA at the 2015–2017 average groundwater production rate, it will lessen groundwater pumping reductions necessary to maintain groundwater elevations close to the measurable objectives water levels defined in Chapter 3.

5.3.3 Expected Benefits of Project No. 2

The Arroyo Simi–Las Posas Arundo Removal Project has multiple benefits for the ELPMA. Fundamentally, this project would help maintain groundwater elevations in Arroyo Simi—Las Posas and directly addresses the aspirational measurable objectives selected for improving conditions in the ELPMA (see Section 3.5.2, East Las Posas Management Area). Additionally, ~~A~~agricultural users of groundwater in the ELPMA will benefit from this project because it increases the sustainable yield of the management area. ~~Additionally, t~~This project also provides benefits to environmental users of groundwater. Arundo has been characterized as one of the greatest threats to riparian resources of coastal Southern California (Bell 1997). Removal of Arundo from riparian reaches of Southern California streams has provided downstream benefits for native species habitat, water quantity, water quality, and wildfire protection (Bell 1997).

5.3.4 Timetable for Project No. 2

CEQA compliance has already been completed for this project, but permits are likely to be required from the Ventura County Watershed Protection District, Los Angeles Regional Water Quality Control Board, California Department of Fish and Wildlife, and U.S. Army Corps of Engineers

(FCGMA 2018). Limitations on implementing the project include securing funding, although this project is a good candidate for securing outside funding and would not necessarily rely solely on replenishment fees. Additionally, the project implementation will be limited to seasons during which Arundo may be removed, and time periods during which use of mechanical equipment is allowed. Depending on whether the project is implemented in phases and when it receives the necessary permits, the project is anticipated to take approximately 1 to 2 years to complete (FCGMA 2018).

5.3.5 Metrics for Evaluation of Project No. 2

The metric for evaluation of the Arroyo Simi–Las Posas Arundo Removal Project will be the flow in Arroyo Simi–Las Posas downstream of the Arundo removal sites and the health of the native riparian habitat. If a suitable stream gauge is not in place to quantify flow in the Arroyo Simi–Las Posas, one should be installed as part of this project so the benefits can be measured and monitored.

5.3.6 Economic Factors and Funding Sources for Project No. 2

The funding source for this project is anticipated to be grant funds from outside agencies that support restoration of native plant habitat and flood control benefits, replenishment fees collected by FCGMA, or a combination of grant funding and replenishment fees. The cost of this project would depend on the acreage of Arundo removed. The estimated capital cost is approximately $7,400,000, with an annual operations and maintenance cost of $200 per acre-foot of water.

Any action taken by the FCGMA Board to impose or increase a fee shall be taken by ordinance or resolution, and notice shall be provided of any meeting at which imposition of the ordinance or resolution will be discussed (see Section 5.2.6, Economic Factors and Funding Sources for Project No. 1).

5.4 PROJECT NO. 3 – ARROYO SIMI–LAS POSAS WATER ACQUISITION

5.4.1 Description of Project No. 3

The Arroyo Simi–Las Posas Water Acquisition Project would involve the purchase of recycled water from the City of Simi Valley (Simi Valley) (FCGMA 2018). In return, Simi Valley would commit to continuing to discharge the purchased or leased water from its shallow dewatering wells or the Simi Valley Water Quality Control Plant to Arroyo Simi–Las Posas for downstream recharge to the LPVB. Simi Valley has indicated that 3,000 AFY of recycled water from the Simi Valley Water Quality Control Plant would be available and 1,700 AFY would be available from the dewatering wells (FCGMA 2018). However, due to the riparian use of the water along the Arroyo Simi–Las Posas, an estimated 1,000 to 2,500 AFY of the water may be lost due to plant uptake and evaporation, leaving 2,200 to 3,700 AFY available as surface flow and recharge to the ELPMA.

5.4.2 Relationship of Project No. 3 to Sustainability Criteria

Acquisition of water for ongoing discharge to Arroyo Simi–Las Posas would help sustain groundwater elevations in the ELPMA by continuing to provide recharge to the groundwater aquifers. The sustainability criteria in the ELPMA are primarily based on limiting storage loss throughout the management area. This project would assist with maintaining storage in the management area, as well as maintaining a sustainable yield that is closer to the recent groundwater production rate than it is to the long-term historical average.

The effect of the Arroyo Simi–Las Posas Water Acquisition Project was investigated in the numerical groundwater model simulation of the ELPMA that included projects (see Section 2.4.5). The Arundo removal project was included in the same model scenario (see Section 5.3, Project No. 2 – Arroyo Simi–Las Posas Arundo Removal). Because both of these projects were incorporated in the same model simulation, the impact of the Arroyo Simi–Las Posas Water Acquisition Project alone was not quantified. Therefore, the results and impacts on the minimum thresholds and measurable objectives discussed in this sections are presented in the context of the cumulative project impacts from both of the projects modeled.

Relationship to Minimum Thresholds

As modeled, the Arroyo Simi–Las Posas Water Acquisition Project maintained approximately 4,700 AFY of surface water flow into the ELPMA along Arroyo Simi–Las Posas (see Section 2.4.5). The numerical groundwater model simulation of the Future Baseline With Projects Scenario, which incorporates the Arroyo Simi–Las Posas Water Acquisition Project, resulted in higher simulated groundwater elevations than the Future Baseline Scenario, which does not incorporate projects (see Section 2.4). The higher elevations were simulated in all aquifers of the ELPMA except the Epworth Gravels Aquifer, which does not receive recharge from Arroyo Simi–Las Posas. Additionally, the impact of this project on groundwater elevations was greater in the southern part of the ELPMA, adjacent to Arroyo Simi–Las Posas. In wells in the northern part of the ELPMA, the combined effects of the Arroyo Simi–Las Posas Water Acquisition Project and the Arroyo Simi–Las Posas Arundo Removal Project were not sufficient to maintain groundwater elevations above the minimum threshold after 2040. In the southern part of the ELPMA, the combined projects maintained groundwater elevations above the minimum thresholds throughout the 50-year model run. Therefore, this project is anticipated to have a direct impact on groundwater elevations and could be used to help maintain elevations above the minimum thresholds defined in Chapter 3 throughout much, but not all, of the ELPMA.

Relationship to Measurable Objectives

The relationship of the Arroyo Simi–Las Posas Water Acquisition Project to the measurable objectives is similar to its relationship with the minimum thresholds. By maintaining surface water flow in Arroyo Simi–Las Posas, the ELPMA is anticipated to continue to receive recharge along Arroyo Simi–Las Posas that might otherwise be sold or leased to water users outside of the ELPMA. Although this recharge alone is insufficient to maintain groundwater elevations above the measurable objectives throughout the ELPMA if groundwater production continues at the 2015–2017 average production rate, it will lessen groundwater pumping reductions necessary to maintain groundwater elevations close to the measurable objectives water levels defined in Chapter 3.

5.4.3 Expected Benefits of Project No. 3

Surface water infiltration through the bottom of Arroyo Simi–Las Posas is a primary recharge mechanism for the ELPMA. Perennial flow in Arroyo Simi–Las Posas did not begin until the 1970s, when discharges of treated wastewater effluent, and eventually discharge from shallow dewatering wells, began upstream of the ELPMA boundary. These perennial flows resulted in rising groundwater levels throughout the southern part of the ELPMA between 1974 and 2015. The beneficial users of surface water and groundwater in the ELPMA do not have control over the upstream discharges of water to Arroyo Simi–Las Posas, and recharge to the ELPMA would be reduced if those discharges are reduced. Therefore, purchase of this discharge would provide a measure of security for the users of groundwater and surface water in the ELPMA. Fundamentally, this project would help maintain groundwater elevations in Arroyo Simi—Las Posas and directly addresses the aspirational measurable objectives selected for improving conditions in the ELPMA (see Section 3.5.2~~, East Las Posas Management Area~~). Additionally, ~~In addition to maintaining a source of recharge in the ELPMA,~~ this project would maintain native habitat and provide flood control benefit.

Although perennial surface water flow has provided recharge to the ELPMA, this flow is also thought to be the primary source of rising total dissolved solids (TDS) concentrations observed in the groundwater adjacent to Arroyo Simi–Las Posas since the 1990s (see Section 2.3). Consequently, if this project is pursued further, the water quality of the surface water flows will have to be investigated further and addressed in the feasibility study.

5.4.4 Timetable for Project No. 3

As proposed, the project does not require construction of new facilities. Because of this, the project proponent suggests that the project is ready to start and could be completed within 1 to 2 years (FCGMA 2018). Permitting of this project without addressing the water quality of the surface water flows may prove challenging. If the water quality of the surface water flows is an impediment to implementing the project, then a treatment facility may need to be constructed, which would delay implementation of the project.

5.4.5 Metrics for Evaluation of Project No. 3

The metric for evaluation of the Arroyo Simi–Las Posas Water Acquisition Project will be the volume of surface water that flows into the ELPMA as a result of the project. Depending on the eventual project details a stream gauge may need to be installed in Arroyo Simi–Las Posas at an appropriate location to measure these flows.

5.4.6 Economic Factors and Funding Sources for Project No. 3

The funding source for this project is anticipated to be replenishment fees collected by FCGMA. These fees may be augmented by grant funding to maintain habitat along Arroyo Simi–Las Posas. The cost of this project depends on a negotiated purchase price for the recycled water from Simi Valley.

Any action taken by the FCGMA Board to impose or increase a fee shall be taken by ordinance or resolution, and notice shall be provided of any meeting at which imposition of the ordinance or resolution will be discussed (see Section 5.2.6).

5.4.7 Project No. 3 Uncertainty

The primary uncertainty associated with the Arroyo Simi–Las Posas Water Acquisition Project is the quality of the water that will be purchased. The concentration of TDS and other constituents in the discharge water may be a hindrance to project permitting, which would necessitate a feasibility study to investigate the cost and benefit of constructing a facility to treat the water before it is used to supply groundwater users with surface water in lieu of groundwater production or used for direct recharge to the management area.

5.5 MANAGEMENT ACTION NO. 1 – REDUCTION IN GROUNDWATER PRODUCTION

5.5.1 Description of Management Action No. 1

The primary management action proposed under this GSP is Reduction in Groundwater Production from the LPVB. FCGMA has had the authority to monitor and regulate groundwater production in the LPVB since 1983. The FCGMA Board has used its authority to reduce groundwater production from the LPVB in the past, and will continue to exert its authority over groundwater production as a Groundwater Sustainability Agency for the LPVB.

In the WLPMA, the estimated long-term rate of groundwater production that will prevent chronic declines in groundwater levels, loss of storage, and subsidence due to groundwater withdrawal and will also allow the prevention of seawater intrusion in the Oxnard Subbasin, is approximately 11,500 AFY with an estimated uncertainty of approximately ±1,200 AFY (see Section 2.4.5). In the ELPMA the estimated long-term rate of groundwater production that will prevent chronic declines in groundwater levels, loss of storage, and subsidence due to groundwater withdrawal is approximately 17,800 AFY ±2,300 AFY ~~17,000 to 20,000 AFY~~ (see Section 2.4.5).

Reductions in groundwater production were modeled for both the ELPMA and the WLPMA in order to investigate their impact on the sustainability indicators in the LPVB. Reductions were modeled as a linear decrease from the 2015–2017 production rates. In the WLPMA, the modeled groundwater production rates were lower than the estimated sustainable yield calculated based on all of the model scenarios (see Section 2.4.5). In the ELPMA, a range of reductions was modeled to estimate the safe yield of the management area. The exact reductions that will be implemented in the LPVB over the next 5 years will be determined by the FCGMA Board based on the data collected and analyzed for this GSP. These reductions will be evaluated based on the potential paths to reaching sustainability discussed in Chapter 3.

5.5.2 Relationship of Management Action No. 1 to Sustainability Criteria

Reducing groundwater production in the LPVB has a measurable impact on groundwater elevations in both the ELPMA and the WLPMA. Groundwater elevations, in turn, are a measure of groundwater in storage in the LPVB; in the WLPMA, they are a measure of influence on seawater intrusion in the Oxnard Subbasin. The effect of reduced groundwater production on groundwater level elevations was simulated using a numerical groundwater model for each management area of the LPVB (see Section 2.4.5). The United Water Conservation District model was used to simulate groundwater elevations in the WLPMA and the adjacent Oxnard Subbasin. The CMWD model was used to simulate groundwater elevations in the ELPMA. The results of the model simulations and the relationship between reduced groundwater production and the sustainability criteria are discussed in this section.

Relationship to Minimum Thresholds

When groundwater production in the WLPMA was reduced from the 2015–2017 average production rates, simulated future groundwater elevations in the management area recovered to elevations that remained above the minimum threshold after 2040 (see Section 2.4.5). The long-term production rate necessary to maintain groundwater elevations above the minimum threshold depended on several factors, including the simulated future climate, the quantity of surface water available to recharge the WLPMA, and implementation of the Purchase of Imported Water from CMWD Project (see Section 5.2, Project No. 1 – Purchase of Imported Water from CMWD for Basin Replenishment). Therefore, the numerical groundwater simulation results suggest a range of potential reductions in groundwater production that will maintain groundwater elevations above the minimum thresholds in the WLPMA. The range is anticipated to change as additional data are collected and additional projects are implemented over the next 5 years. Therefore, any reductions implemented by the FCGMA Board over the initial 5-year period after the GSP is adopted will be evaluated and may be changed as warranted by future conditions in the WLPMA and the adjacent Oxnard Subbasin.

When groundwater production in the ELPMA was reduced from the 2015–2017 average production rates, simulated future groundwater elevations in the management area remained above the minimum threshold after 2040 (see Section 2.4.5). The long-term production rate necessary to maintain groundwater elevations above the minimum threshold depended on several factors, including the simulated future climate. However, the primary factors influencing groundwater elevations in the ELPMA are groundwater production and the quantity of surface water available to recharge the ELPMA via Arroyo Simi–Las Posas. Therefore, the numerical groundwater simulation results suggest a range of potential reductions in groundwater production that will maintain groundwater elevations above the minimum thresholds in the ELPMA, depending on which projects are undertaken. The range is anticipated to change as additional data are collected and project details are further evaluated over the next 5 years. Therefore, any reductions implemented by the FCGMA Board over the initial 5-year period after the GSP is adopted will be evaluated and may be changed as warranted by future conditions in the ELPMA.

Relationship to Measurable Objectives

The relationship between Reduction in Groundwater Production and the measurable objectives is similar to the relationship between Reduction in Groundwater Production and the minimum thresholds in both the WLPMA and the ELPMA. Numerical groundwater model simulations suggest a range of potential groundwater production rates that would result in groundwater elevations that are higher than the measurable objective half of the time and lower than the measurable objective half of the time in the WLPMA, and can be maintained close to the measurable objective water levels in the ELPMA (see Section 3.5, Measurable Objectives). As discussed above, this range is anticipated to change as additional data are collected, additional projects are implemented, and project details are further evaluated over the next 5 years. Therefore, any reductions implemented by the FCGMA Board over the initial 5-year period after the GSP is adopted will be evaluated and may be changed as warranted by future conditions in the LPVB and adjacent basins.

5.5.3 Expected Benefits of Management Action No. 1

The primary benefit related to Reduction in Groundwater Production is maintaining groundwater elevations at levels that prevent chronic declines in groundwater elevation, loss of storage, and land subsidence due to groundwater withdrawal. 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 goal for the LPVB.

5.5.4 Timetable for Implementation of Management Action No. 1

The FCGMA Board already has the authority to reduce groundwater production in the LPVB. Therefore, reductions can be implemented within months of GSP adoption, once the proposed reductions have gone through the FCGMA Board approval process.

5.5.5 Metrics for Evaluation of Management Action No. 1

The metric for evaluation of reduced groundwater production will be groundwater elevations in the aquifers of the WLPMA and the ELPMA. As groundwater elevations recover or stabilize, additional projects are developed, and basin management is optimized, groundwater production rates will continue to be evaluated and adjusted accordingly.

5.5.6 Economic Factors and Funding Sources for Management Action No. 1

Program administration, investigations, inspections, compliance assistance, and enforcement of the Reduction in Groundwater Production management action will rely on funding from pumping fees imposed by FCGMA. Economic factors that will affect Reduction in Groundwater Production include impacts to users of groundwater in the LPVB. Potential economic impacts to stakeholders will be considered in the decision process for selecting future groundwater production rates and reductions necessary to meet the sustainability goal for the LPVB.

5.5.7 Management Action No. 1 Uncertainty

There is uncertainty in the exact reductions in groundwater production required to achieve the sustainability goals for the WLPMA and ELPMA. Uncertainty in the hydrogeologic conceptual model and the numerical groundwater model is discussed in Chapter 2~~, Basin Setting, of this GSP~~. Uncertainty in the minimum thresholds and measurable objectives is discussed in Chapter 3. Chapters 2 and 3 also discuss uncertainty associated with the future location of groundwater production and impacts of projects that will optimize management of the LPVB and adjacent basins.

Because of the existing uncertainty associated with future conditions in the LPVB, a plan for exact reductions and groundwater elevation triggers for those reductions has not been developed as part of this GSP. Instead, FCGMA will work to develop and refine this plan over next 20 years as the level of uncertainty is reduced. FCGMA recognizes that a specific long-term plan that incorporates stakeholder feedback and the need for flexibility in groundwater management will have to be adopted by 2040 to provide users of groundwater in the LPVB with the tools necessary to plan for sustainable groundwater production into the future.

5.6 REFERENCES CITED

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