San Antonio Creek Valley Groundwater Basin Groundwater Sustainability Plan

December 16, 2021

Prepared for:

San Antonio Basin
Groundwater Sustainability Agency

Prepared by:

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San Antonio Basin Groundwater Sustainability Agency

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December 16, 2021

Prepared for:
Board of Directors
San Antonio Basin Groundwater Sustainability Agency
920 East Stowell Rd
Santa Maria, CA 93454

GSI Water Solutions, Inc.

GSI Water Solutions, Inc. is pleased to submit this Groundwater Sustainability Plan (GSP) prepared in accordance with California Code of Regulations, Title 23. Water, Division 2. Department of Water Resources, Chapter 1.5. Groundwater Management, Subchapter 2. Groundwater Sustainability Plans.

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Contents

Tables

Figures

Appendices

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Abbreviations and Acronyms

AB	Assembly Bill
AF	acre-feet
AFY	acre-feet per year
amsl	above mean sea level
Basin Plan	Water Quality Control Plan for the Central Coast Basin
Basin	San Antonio Creek Valley Groundwater Basin
BMP	best management practice
Board	SABGSA Board of Directors
BOD	biochemical oxygen demand
BPA	Base Pumping Allocation
CARB	California Air Resources Board
CASGEM	California Statewide Groundwater Elevation Monitoring
CCI	California Climate Investments
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CGPS	Continuous Global Positioning System
COGG	California Oil, Gas, and Groundwater
CRCD	Cachuma Resource Conservation District
DAC	Disadvantaged Community
DDW	Division of Drinking Water
DEHP	di(2-ethylhexyl)phthalate
DMS	Data Management System
DQO	data quality objective
DSW-MAR	Distributed Storm Water Managed Aquifer Recharge
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
EVI	Enhanced Vegetation Index
ft	foot or feet
ft^2/day	square feet per day
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater-dependent ecosystem
GEC	Groundwater Extraction Credit
GIS	geographic information system
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute

gpm/ft	gallons per minute per foot
GPS	Global Positioning System
Groundwater Report	Santa Barbara County 2019 Groundwater Basins Status Report
GSA	Groundwater Sustainability Agency
GSI	GSI Water Solutions, Inc.
GSP	Groundwater Sustainability Plan
HCM	hydrogeologic conceptual model
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
IRWMP	Integrated Regional Water Management Plan
JPA	Joint Exercise of Powers Agreement
JPL	Jet Propulsion Laboratory
LACSD	Los Alamos Community Services District
LAFD	Los Alamos Fire Department
MAR	Managed Aquifer Recharge
MCL	maximum contaminant level
MO	measurable objective
MT	minimum threshold
NASA	National Aeronautics and Space Administration
NAVD 88	North American Vertical Datum of 1988
NCCAG	Natural Communities Commonly Associated with Groundwater
NHD	National Hydrography Dataset
NWIS	National Water Information System
OSWCR	Online System for Well Completion Reports
QA/QC	quality assurance and quality control
RMS	representative monitoring site
RP	reference point
RWQCB	Regional Water Quality Control Board
SABGSA	San Antonio Basin Groundwater Sustainability Agency
SABWD	San Antonio Basin Water District
SAC	Stakeholder Advisory Committee
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SERS	streambed electrical resistance sensors
SGMA	Sustainable Groundwater Management Act
Slough	Barka Slough
SMC	sustainable management criteria
SMCL	secondary maximum contaminant level
SSURGO	Soil Survey Geographic Database
SWAMP	Surface Water Ambient Monitoring Program

SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UC	University of California
UNAVCO	University NAVSTAR Consortium
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
UTS	unarmored three-spine stickleback
VAFB	Vandenberg Air Force Base
VOC	volatile organic compound
VSFB	Vandenberg Space Force Base
WCR	well completion report
WQO	water quality objective
WWTF	Wastewater Treatment Facility

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Executive Summary

ES-1 Introduction

The Sustainable Groundwater Management Act (SGMA), effective as of January of 2015, created a new statewide framework for managing California's groundwater at the local level through the formation of Groundwater Sustainability Agencies (GSAs). SGMA requires the development and implementation of a Groundwater Sustainability Plan (GSP) for each groundwater basin in the state that has been designated as high or medium priority. A GSP presents strategies for maintaining or bringing a groundwater basin into a sustainable condition within the next 20 years. SGMA exempts de minimus pumpers (e.g., individual domestic well owners who extract up to 2 acre-feet per year [AFY]) from most of the SGMA requirements and does not require metering.

The San Antonio Basin Groundwater Sustainability Agency (SABGSA) was formed in 2017 for the purpose of sustainably managing groundwater and developing this GSP for the San Antonio Creek Valley Groundwater Basin (Basin). The SABGSA member agencies are the San Antonio Basin Water District and Los Alamos Community Services District. The Basin occupies approximately 123 square miles in western Santa Barbara County (see Figure ES-1). It is bounded on the north by the Casmalia Hills and Solomon Hills, on the east by the San Rafael Mountains and a watershed divide separating the adjoining Santa Ynez River Valley groundwater basin, on the south by the Purisima Hills and Burton Mesa, and the west by the approximate western boundary of Barka Slough.

This GSP describes the physical setting of the Basin; quantifies historical, present, and future water budgets; develops quantifiable management objectives that account for the interests of the Basin's beneficial groundwater uses and users and identifies a group of projects and management actions that will allow the Basin to achieve sustainability within 20 years of plan adoption. This document also includes the list of references and technical studies, documentation of the stakeholder engagement process undertaken in the development of this plan, and several supporting appendices.

The SABGSA has provided multiple venues for stakeholder engagement and public comment. A Stakeholder Advisory Committee was formed to represent basin water user groups. Members of the Advisory Committee reviewed draft sections of this GSP, provided feedback, and solicited input from their respective stakeholders as the plan was developed. Opportunities for public comment are provided at all SABGSA Board meetings, Advisory Committee meetings, and two workshops. Comments were also received through a Groundwater Communication Portal, letters, and email.

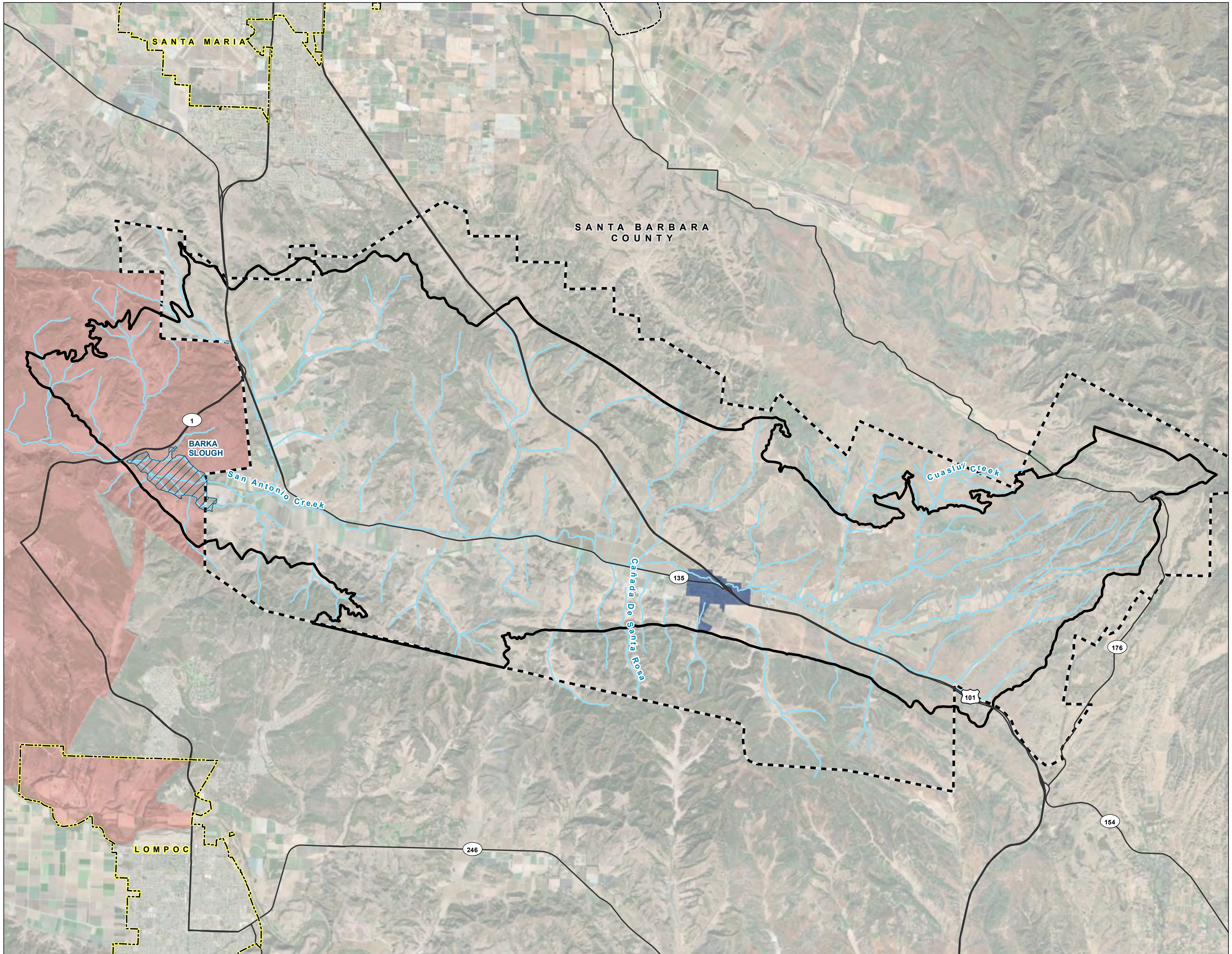

FIGURE ES-1

San Antonio Creek Valley Groundwater Basin Plan Area

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Los Alamos Community Services District
- Vandenberg Space Force Base

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- San Antonio Basin Water District
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

N

0 5,000 10,000 15,000
Feet

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

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The organization of this plan is as follows:

- **Section 1 – Introduction to Plan Contents:** An introduction to the GSP, including a description of its purpose and a brief description of the Basin.
- **Section 2 – Administrative Information:** Includes the following:
  - Information on the SABGSA as an organization and a brief description of the agencies participating in the GSA, including information on the legal authority of the GSA to plan and coordinate groundwater sustainability for the Basin.
  - An overview description of the Basin, including land use and agencies with jurisdiction, a description of the existing groundwater management plans and regulatory programs, and land use programs that might have an effect on, or be affected by, this GSP.
  - The SABGSA's communications and engagement planning and implementation, public feedback and stakeholder comments on the plan, how feedback was incorporated into the GSP, and responses to comments received.
- **Section 3 – Basin Setting:** Includes the following:
  - An explanation of the hydrogeologic conceptual model developed for the Basin that includes descriptions of the regional hydrology and geology, principal aquifers and aquitards, and a description of the data gaps in the current model.
  - A detailed description of the groundwater conditions, including groundwater elevations and changes in storage, groundwater quality distribution and trends over time, an evaluation of land subsidence, locations where surface water and groundwater are interconnected, and the identification and distribution of groundwater-dependent ecosystems (GDEs).
  - A presentation of the historical, current, and projected future water budget for the Basin; how the water budgets were developed; and the effects of climate change (using DWR climate change factors).
- **Section 4 – Sustainable Management Criteria:** Defines the sustainability goal for the Basin; describes the process through which sustainable management criteria (SMCs) were established; describes significant and unreasonable effects that could lead to undesirable results as a result of groundwater use; describes and defines SMCs regarding chronic lowering of groundwater levels, reduction of groundwater in storage, seawater intrusion, degraded groundwater quality, land subsidence, and depletion of interconnected surface water; and describes the minimum thresholds, measurable objectives, and interim milestones to avoid undesirable results.
- **Section 5 – Monitoring Networks:** A detailed description of the monitoring network objectives and monitoring protocols in the Basin for groundwater levels, groundwater storage, water quality, land subsidence, interconnected surface water, representative monitoring sites, and a description of how monitoring data will be reported.
- **Section 6 – Projects and Management Actions:** Provides a description of the tiered implementation plan and a description of each project and management action that is planned to be implemented by the SABGSA to avoid undesirable results and ensure sustainability within 20 years of GSP adoption.
- **Section 7 – Groundwater Sustainability Plan Implementation:** Describes the implementation approach and timing for projects and management actions, overall schedule, estimated implementation costs, and sources of funding.

Summaries of the key technical sections of this GSP are presented below.

ES-2 Basin Setting (GSP Section 3)

Section 3 of the GSP describes the hydrogeologic conceptual model (HCM) of the Basin, including the basin boundaries, geologic formations and structures, and principal aquifer units. The section also summarizes general basin water quality, the conceptual interaction between groundwater and surface water, and generalized groundwater recharge and discharge areas. The HCM is a summary of aspects of the basin hydrogeology that influence groundwater sustainability. The HCM is based on the available body of data and prior studies of regional geology, hydrology, and water quality. In this GSP, the HCM provides a framework for subsequent sections describing the basin setting, including groundwater conditions and water budgets. Ongoing studies of the Basin will help the SABGSA better understand the Basin’s hydrogeology in the future. The USGS is in the process of conducting a hydrogeological study and developing a calibrated groundwater model of the Basin. This study was not complete at the time this GSP was prepared; however, some preliminary information developed by the USGS was used in the development of the GSP. Once the USGS study is completed, the GSA expects to update the basin setting information and utilize the groundwater flow model for basin management purposes.

ES-2.1 Principal Aquifers

The Basin consists of an elongated bowl-shaped structure that is oriented east-west and was formed by compressional forces. Two relatively thick geologic units fill the Basin; the Paso Robles Formation and the Careaga Sand. Both have been identified as principal aquifers (see Figure ES-2). The alluvium in the Basin may be water bearing, particularly in the lower reaches of San Antonio Creek, because it receives recharge from San Antonio Creek; however, it is not considered a principal aquifer because there are no known wells completed in this unit and it does not produce sufficient quantities of water to support agricultural operations.

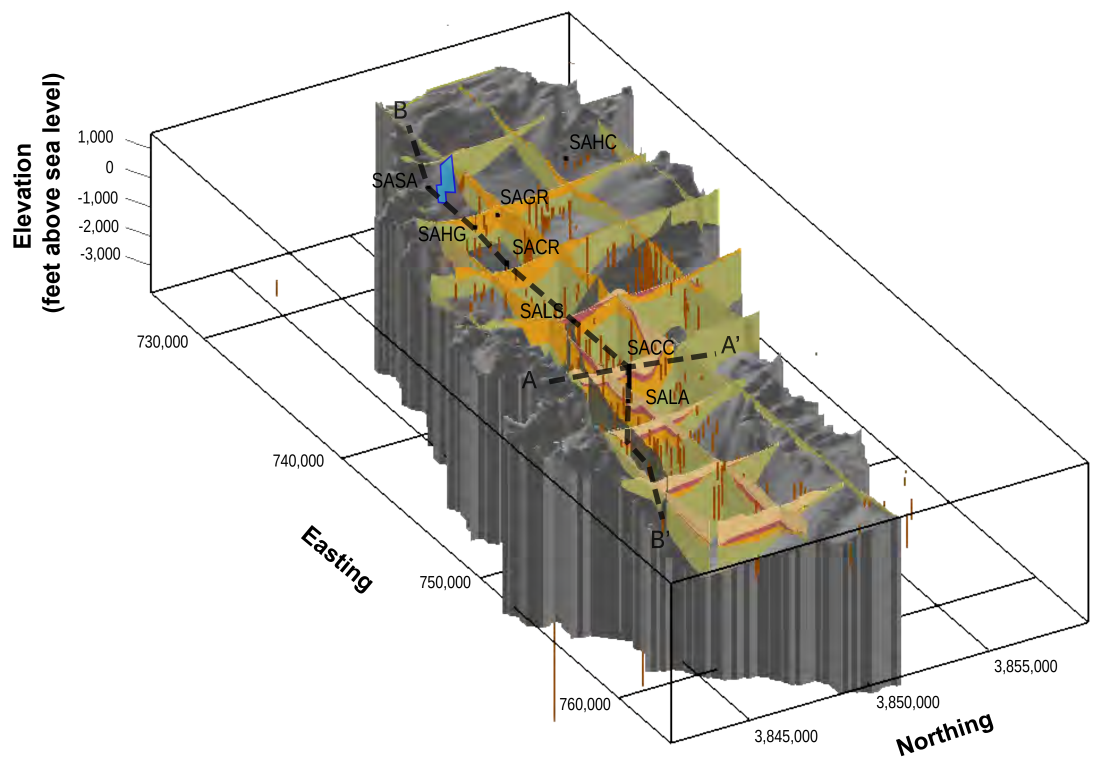
The Paso Robles Formation is approximately 2,000 feet (ft) thick, and much of it is saturated. It underlies the San Antonio Creek Valley and outcrops in large areas along the valley flanks and in the adjacent Solomon Hills, Casmalia Hills, and Zaca Canyon. The Paso Robles Formation consists of stream-deposited lenticular beds of gravel, sand, silt, and clay. Generally, the sand is silty and includes stringers of coarse sand and small pebbles. Coarse-grained beds in the formation yield water freely to wells, while fine-grained zones act as confining beds and are the cause of the artesian conditions that were historically reported in some wells screened within the Paso Robles Formation. The lower part of the Paso Robles Formation contains occasional beds of limestone, ranging in thickness from approximately 1 to 30 ft, that may restrict the vertical movement of groundwater.

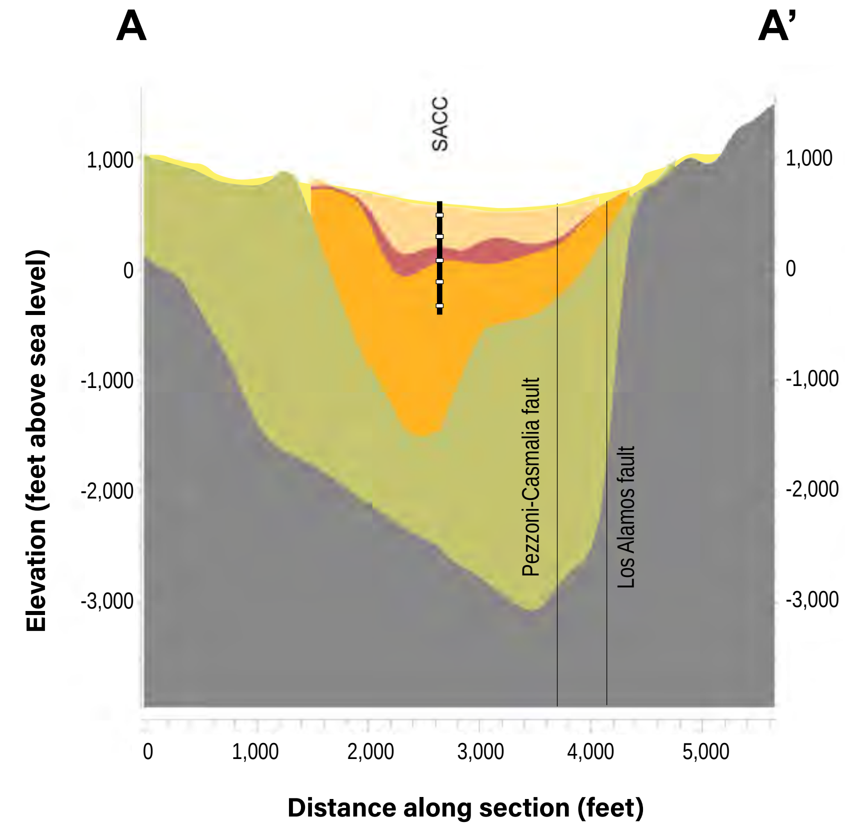
The Careaga Sand outcrops extensively in the Purisima Hills and in large areas in the Solomon and Casmalia Hills and underlies the Paso Robles Formation in the Basin. The exposed Careaga Sand dips northward in the Purisima Hills and passes under the San Antonio Creek Valley at a depth of several thousand feet. The Careaga Sand is approximately 1,500 ft thick, and much of the formation is saturated. It consists of fine- to medium-grained sand with some silt and abundant pebbles. The upper member of the Careaga Sand is coarse-grained and uniformly graded. The Careaga Sand has a large storage capacity and transmits water readily to wells and to the overlying younger formations.

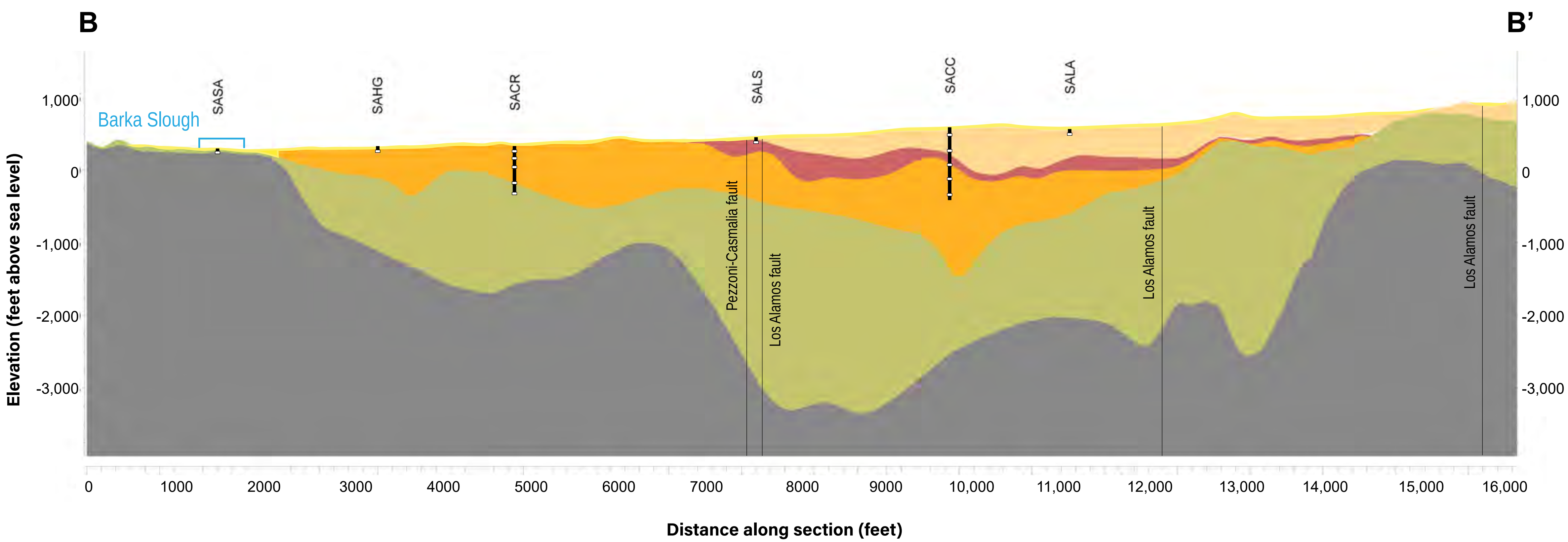
FIGURE ES-2

Geologic Cross Sections, San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin







LEGEND

- Channel Alluvium
- Upper member - Paso Robles Formation
- Middle member - Paso Robles Formation
- Lower member - Paso Robles Formation
- Careaga Sand
- Consolidated bedrock

WELL LEGEND

Screen

NOTE
Geologic cross section locations shown on Figure 3-4.

Date: September 16, 2021
Data Sources: USGS (2020c)

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ES-2.2 Recharge and Discharge in the Basin

Natural areal recharge in the Basin occurs through distributed areal infiltration of precipitation and through infiltration of surface water from San Antonio Creek and tributary drainages. Recharge to the Paso Robles Formation and Careaga Sand also occurs through direct infiltration of precipitation and infiltration in creek beds in the higher elevations where these units crop out at the surface.

Natural groundwater discharge areas in the Basin include springs and seeps, groundwater discharge to the lower end of San Antonio Creek and Barka Slough, and evapotranspiration (ET) by phreatophytes. Phreatophytes are plants whose roots tap into groundwater present in the alluvium along creeks and streams. Springs tend to be located in the uplands of the Solomon Hills and San Rafael Mountains ranges. Groundwater discharge also likely occurs in the vicinity of Barka Slough on the west end of the Basin.

ES-2.3 Groundwater Conditions

This section of the GSP describes the current and historical groundwater conditions in the Paso Robles Formation and Careaga Sand in the Basin. Groundwater flow direction is generally to the west across most of the Basin, except in the northwest area of the Basin, where groundwater flow is to the south in the Paso Robles Formation and to the south-southwest in the Careaga Sand. In general, groundwater flow in the Basin tends to converge toward the lower groundwater levels in the San Antonio Creek and Barka Slough.

Long-term groundwater elevation declines are evident on the hydrographs of wells completed in the Paso Robles Formation, shown in Appendix D. The magnitude of measured declines for Paso Robles Formation wells with a period of record of at least 10 years ranges from approximately 26 to 143 ft. The most significant water level declines occurred during the current drought (2012 to the present). Since 2017, observed water levels in some Paso Robles Formation wells indicate stabilization, while the trend is unclear in others. Long-term groundwater elevation declines are evident in virtually all of the hydrographs for wells completed in the Careaga Sand, also shown in Appendix D. The magnitude of measured declines for Careaga Sand wells with a period of record of at least 10 years ranges from approximately 1 to 70 ft. Although some recovery has occurred in groundwater levels in Careaga Sand wells during periods of above-average rainfall, the overall trend shows sharply declining water levels.

Groundwater in the Basin is of widely varying quality and generally decreases in quality from east to west coincident with the groundwater flow direction. Overall, groundwater in the Basin is of sufficient quality to be suitable for drinking water and agricultural purposes. Concentrations of total dissolved solids (TDS) generally increase from east to west along San Antonio Creek and are greatest near the Barka Slough, along western San Antonio Creek, and in Harris Canyon. Concentrations of boron, sodium, nitrate, and chloride are also elevated in the Barka Slough area, along western San Antonio Creek and in Harris Canyon. While there are some wells that have concentrations of TDS, sodium, chloride, and boron that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated concentrations of TDS, sodium, and chloride are often associated with the rocks of marine origin that are present in the Basin, and elevated boron concentrations are naturally occurring in many central coast basins.

ES-2.4 Interconnected Groundwater and Surface Water

All the streams in the Basin are classified as intermittent and are likely to be losing streams, meaning that surface water flows down through the streambed into the groundwater. The stream channels located in Barka Slough are classified as perennial and likely to be gaining streams, meaning that groundwater flowing in through the streambed feeds the surface water system. Ephemeral surface water flows in the Basin make it difficult to assess the interconnectivity of surface water and groundwater and to quantify the degree to which surface water depletion has occurred. Interconnected surface water and groundwater within the Paso Robles Formation and Careaga Sand is present in Barka Slough and contributes to the classification of perennial streams in that area.

ES-2.5 Groundwater-Dependent Ecosystems

GDEs are defined under SGMA as “ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.” GDE types include terrestrial vegetation that is supported by shallow groundwater that discharges to seeps, springs, wetlands, streams, and estuaries. The locations of potential GDEs in the Basin were identified through screening methods developed by The Nature Conservancy and with local hydrologic data. A complete biological survey of Barka Slough has not been completed. The presence of potential GDEs associated with springs and seeps will be verified during GSP implementation.

Several wetland features, three mapped springs, and four types of groundwater dependent vegetation communities are present in the Basin. The four Natural Communities vegetation types are the following:

- Coast Live Oak
- Valley Oak
- Riparian Mixed Harwood
- Willow

Wetland classifications present in the Basin include the following:

- Palustrine, Emergent, Persistent, Seasonally Flooded
- Palustrine, Emergent, Persistent, Semipermanently Flooded
- Palustrine, Forested, Seasonally Flooded
- Palustrine, Scrub-Shrub, Seasonally Flooded
- Palustrine, Unconsolidated Bottom, Permanently Flooded
- Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded
- Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded

Generally, wetlands were recorded along the San Antonio Creek tributary channels as well as Barka Slough. There are a few small areas outside of these locations that may be associated with springs. The locations of the groundwater dependent vegetation classifications and wetland classifications are presented in Figure ES-3.

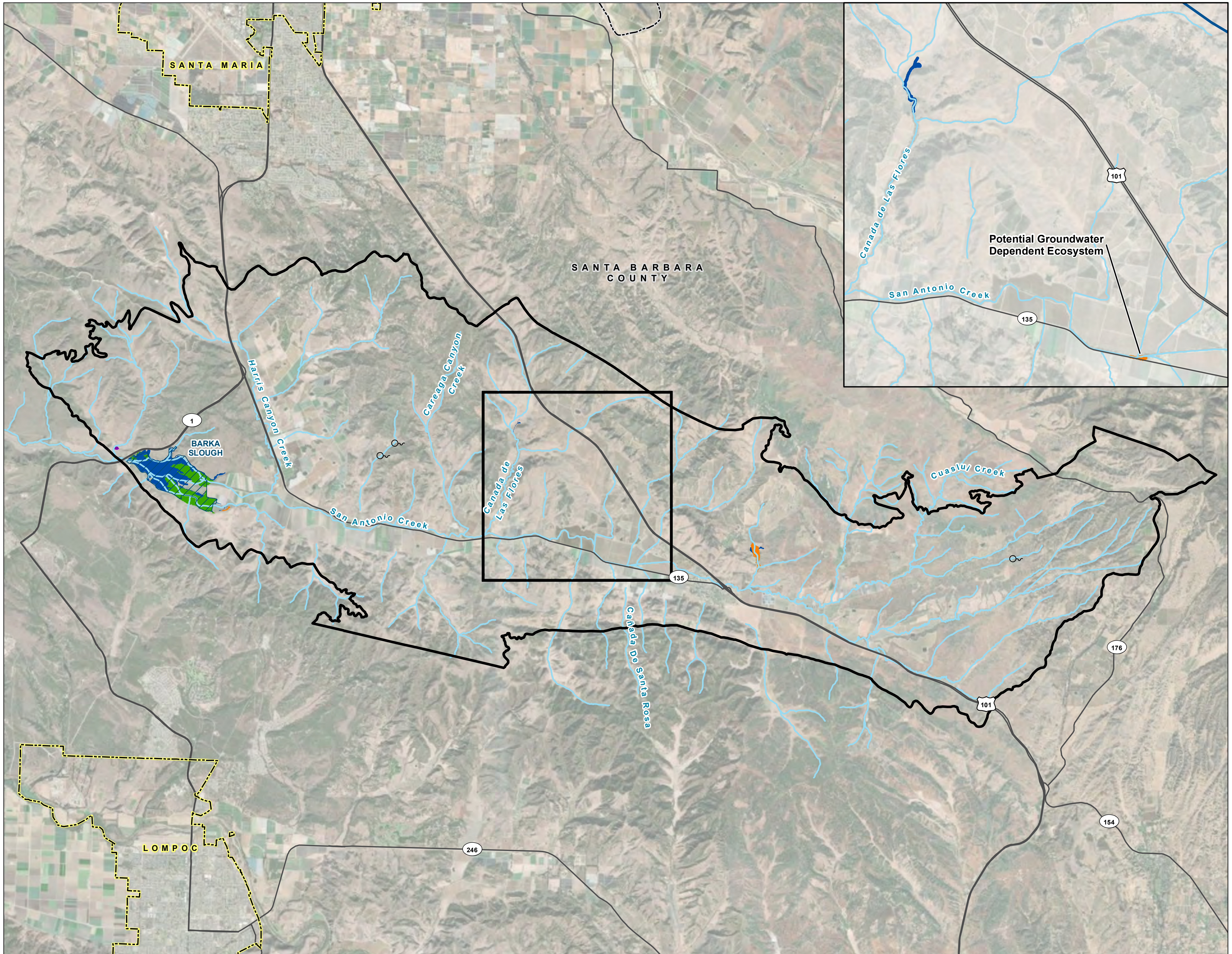

FIGURE ES-3

Groundwater-Dependent Ecosystems

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Natural Communities Commonly Associated with Groundwater (NCCAG)

- Wetland Area

VEGETATION

- Coast Live Oak
- Riparian Mixed Hardwood
- Willow

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- Major Road
- City Boundary
- USGS Spring

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 17, 2021
Data Sources: USGS (2020b, 2020h), ESRI, DWR (2018a, 2020b), Maxar imagery (2020)

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ES-2.6 Water Budget Development

The water budgets presented in the GSP provide an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Basin, including historical, current, and projected water budget conditions, and the change in the volume of groundwater in storage.

The water budget includes the following elements:

Surface Water Inflows:

- Runoff of precipitation into streams and rivers within the watershed

Surface Water Outflows:

- Streamflow exiting the Basin from Barka Slough
- Percolation of streamflow to the groundwater system

Groundwater Inflows:

- Recharge from precipitation, including mountain front recharge
- Irrigation return flow (water not consumed by crops/landscaping)
- Percolation of streamflow to groundwater
- Percolation of treated wastewater from septic systems and Los Alamos Community Services District Wastewater Treatment Plant spray irrigation

Groundwater Outflows:

- ET from crops, unirrigated land, and riparian areas
- Groundwater pumping
- Groundwater discharge to surface water

The difference between inflows and outflows is equal to the change of groundwater in storage.

Groundwater from the Basin's two identified principal aquifers, the Paso Robles Formation and the Careaga Sand, supplied all the groundwater pumped and used in the Basin over the historical water budget period (water years [WYs] 1981–2018) or historical period. The historical groundwater budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage. The results of the water budget indicate that average annual outflows from the Basin (28,100 AFY) has exceeded average annual inflows to the Basin (17,500 AFY) throughout the historical period, resulting in a deficit of groundwater in storage of approximately 10,600 AFY from year to year. Figure ES-4 depicts the Basin's average groundwater inflows and outflows during the historical period by groundwater budget component.

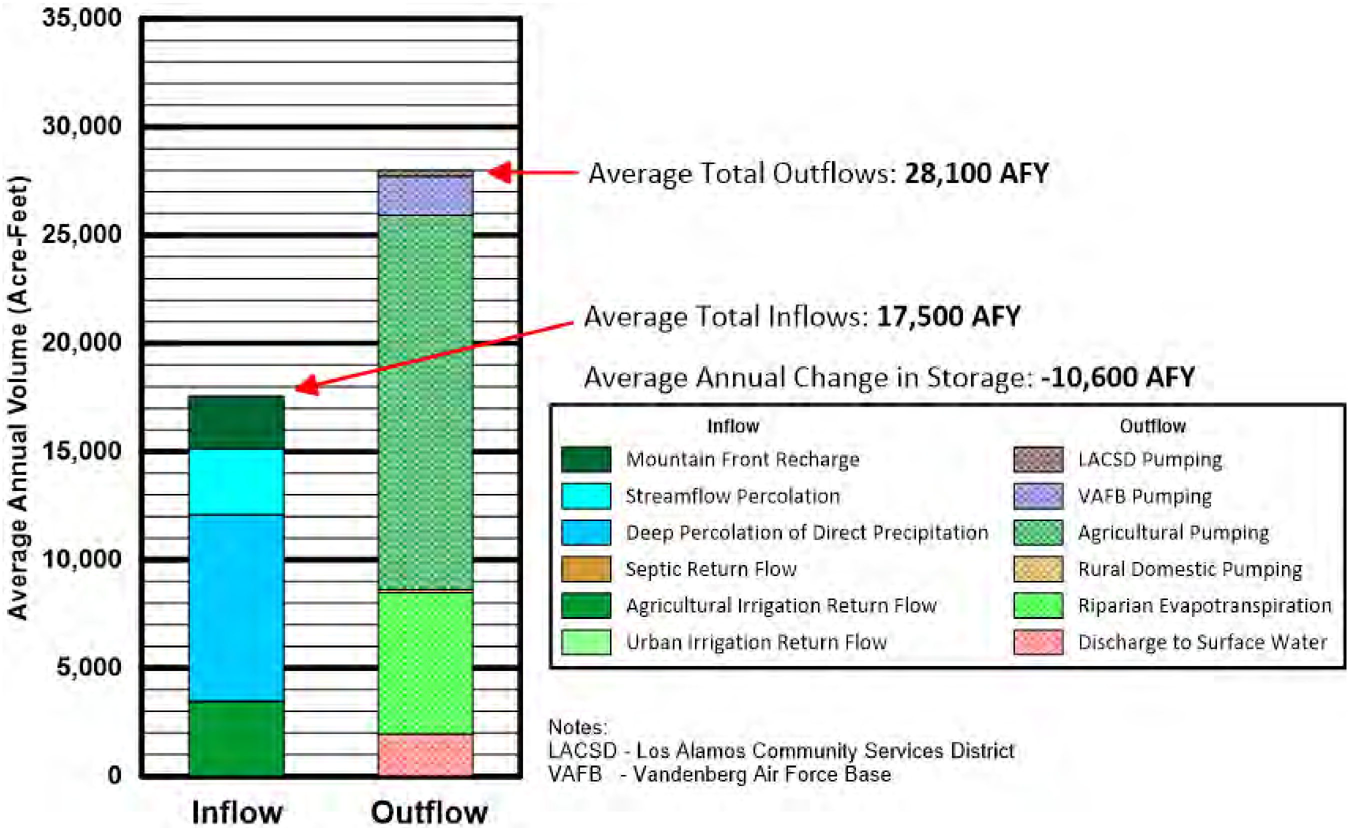


Figure ES-4. Average Groundwater Budget Volumes, Historical Period

Basin yield, or safe yield, of a groundwater basin is defined by SGMA as the maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect (e.g., chronic and continued lowering of groundwater levels and the volume of groundwater in storage). Basin yield is not a fixed constant value but a dynamic value that fluctuates over time as the balance of the groundwater inputs and outputs change; thus, the calculated basin yield of the Basin will be estimated and likely modified with each future update of this GSP. Basin yield is not the same as sustainable yield. Sustainable yield is defined in SGMA as "the maximum quantity of water, calculated over a period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply *without causing an undesirable result*" (emphasis added). Calculating the basin yield (see Section 3.3) provides a starting point for later establishing sustainable yield by considering the sustainability indicators described in greater detail in Section 4 of the GSP.

The historical basin yield was calculated by summing the average annual groundwater in storage decrease of 10,600 AFY with the estimated total average annual amount of groundwater pumping, of 19,500 AFY, for the historical period. This results in a historical basin yield for the Basin of about 8,900 AFY. This estimated value reflects historical climate, hydrologic, and pumping conditions and provides insight into the amount of groundwater pumping that could be sustained in the Basin to maintain a balance between groundwater inflows and outflows. It is anticipated that this value may fluctuate in the future as conditions change or as more data are obtained.

ES-2.7 Projected Water Budget

The surface water and groundwater inflow and outflow components of the projected water budget (WYs 2018–2072) in the Basin were estimated using estimated future land uses, cropping patterns, related pumping volumes, and repeating factors associated with the observed historical climatic conditions forward in time through 2042 and 2072. The effects of climate change were also evaluated using DWR-provided climate change factors.

The DWR-provided climate change data are based on the California Water Commission's Water Storage Investment Program climate change analysis results, which used global climate models and radiative forcing scenarios recommended for hydrologic studies in California by the Climate Change Technical Advisory Group. Climate data from the recommended General Circulation Model models and scenarios have also been downscaled and aggregated to generate an ensemble time series of change factors that describe the projected change in precipitation and ET values for climate conditions that are expected to prevail at midcentury and late century, centered around 2030 and 2070, respectively.

The seasonal timing and amount of precipitation in the Basin is projected to change. Decreases are projected in the summer, mid-fall, and late winter. Increases are projected in mid-winter, early spring, and late summer to early fall. The Basin is projected to experience minimal changes in total annual precipitation. In a warmer climate such as may occur in the Basin, crops require more water to sustain growth, and this increased water requirement is characterized in climate models using the rate of ET. Under 2030 conditions, the Basin is projected to experience average annual ET increases of approximately 3.6 percent relative to the baseline period (see Section 3.3.5), while under 2070 conditions, annual ET is projected to increase by approximately 8 percent relative to the baseline period. The Basin is projected to experience average annual increases in streamflow of approximately 2 percent and 6 percent under 2030 and 2070 conditions, respectively.

Consistent with the historical period, the projected water budget is dominated by groundwater pumping for agricultural irrigation. Consequently, on the inflow side of the water budget, there is an increase in agricultural irrigation return flow due to the increase in the volume of groundwater used for irrigation. The other inflow component, streamflow percolation, shows a notable increase even though a decrease in mountain front recharge and deep percolation of direct precipitation is projected. The average annual groundwater inflow for the Basin is projected to increase by approximately 13 percent and 11 percent during the 2042 and 2072 projected periods, respectively, compared to the historical period. The average annual groundwater outflow is projected to increase by approximately 25 percent and 27 percent during the 2042 and 2072 projected periods, respectively, compared to the historical period. The average annual change in storage for the Basin is projected to decrease by approximately 44 percent and 53 percent during the 2042 and 2072 project periods, respectively, compared to the historical period.

The projected water budget for year 2042 conditions is presented in Figure ES-5, which breaks out the inflow and outflow components of the water budget. Table ES-1 summarizes the Basin's historical, current (WYs 2011–2018), and projected water budgets.

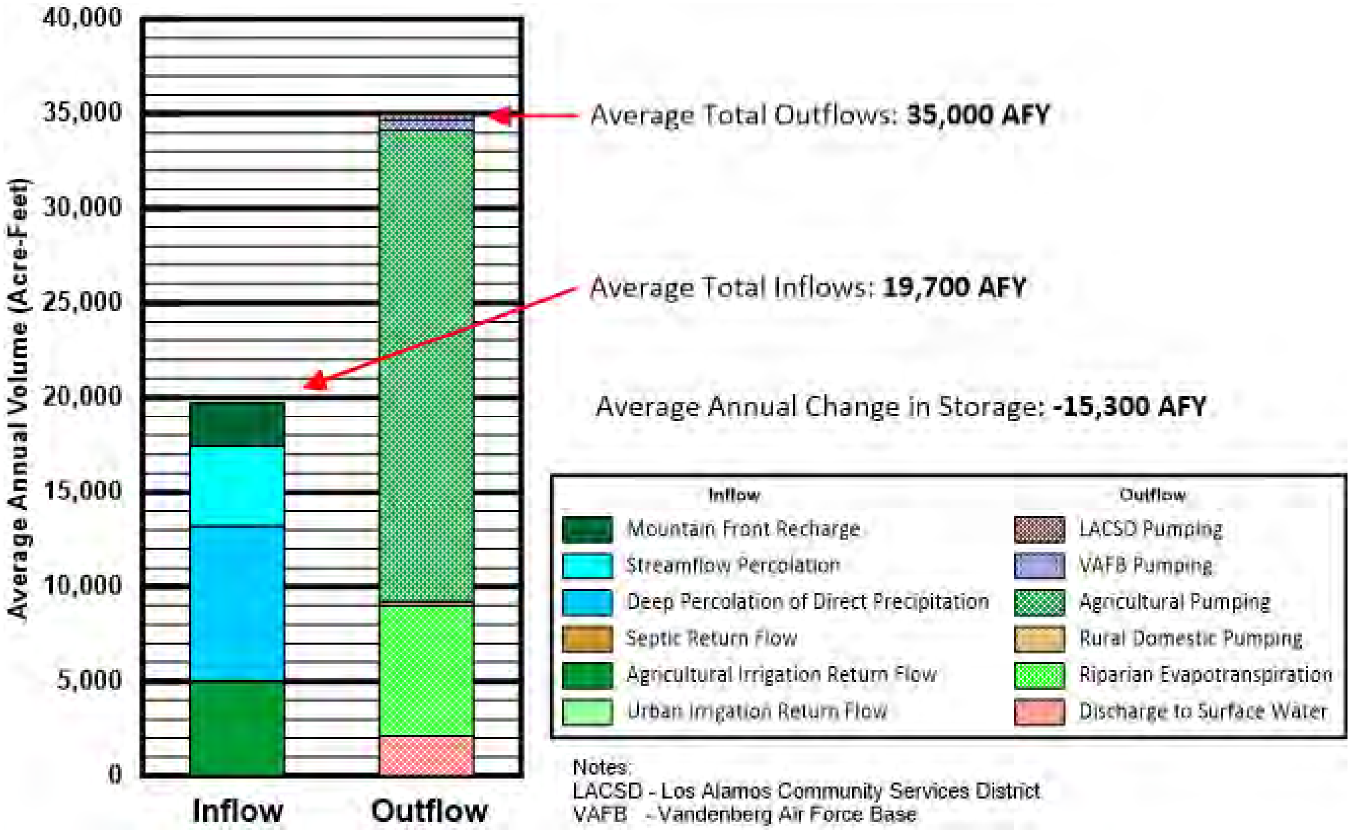


Table ES-1. Summarized Historical, Current, and Projected Water Budgets

Water Budget Period	Annual Average					
	Total Inflows	Total Pumping	Total Outflows	Change of Groundwater in Storage	Cumulative Change of Groundwater in Storage	Basin Yield[1]
Historical Period	17,500	19,500	28,100	-10,600	-400,100	8,900
Current Period	13,500	23,200	30,500	-17,000	-135.500	6,200
Projected Period (2042)[2]	19,700	26,000	35,000	-15,300	—	10,700
Projected Period (2072)[2]	19,500	26,600	35,700	-16,200	—	10,400

Notes

All values are in units of acre-feet.

[1] Basin yield is calculated by subtracting average annual total groundwater pumping from the sum of the average annual total inflows and average annual change in storage.

[2] 2042 and 2072 volumes are annual averages calculated using the 50-year base period described in Section 3.3.5.1.

— = Not applicable

ES-3 Sustainable Management Criteria (GSP Section 4)

Section 4 of the GSP defines the conditions that constitute sustainable groundwater management and discusses the process by which the SABGSA will characterize undesirable results and establish minimum thresholds and measurable objectives for each sustainability indicator in the Basin. Section 4 presents the data and methods used to develop SMCs and demonstrates how these criteria influence beneficial uses and users. The SMCs are considered initial criteria and will be reevaluated and potentially modified in the future as new data become available.

Sustainability indicators are defined in SGMA to mean the conditions in a basin that, when significant, unreasonable, and caused by groundwater use, become undesirable results and impact sustainability of the basin. The following five sustainability indicators are applicable in the Basin:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded groundwater quality
- Land subsidence
- Depletion of interconnected surface water

The sixth SMC designated in SGMA, seawater intrusion, is not applicable in the Basin because of the distance from the Pacific Ocean and the presence of a bedrock high on the west end of the Basin that creates a barrier to groundwater flow.

A wide variety of information was used to define minimum thresholds and measurable objectives for each sustainability indicator, which are measured at representative wells. Minimum thresholds and measurable objectives are generally defined as follows:

- **Minimum Threshold** - A minimum threshold is the numeric value for each sustainability indicator that is used to define undesirable results. For example, a particular groundwater level might be a minimum threshold if lower groundwater levels would result in a significant and unreasonable reduction of groundwater in storage or depletion of supply.
- **Measurable Objective** - Measurable objectives are specific, quantifiable goals or targets that reflect the SABGSA's desired groundwater conditions and allow the SABGSA to achieve the sustainability goal within 20 years.

ES-3.1 Sustainability Goal

The goal of this GSP is to sustainably manage the groundwater resources of the Basin for current and future beneficial uses of groundwater, including Barka Slough (Slough), through an adaptive management approach that builds on best available science and monitoring and considers economic, social, and other objectives of Basin stakeholders. This goal was developed with input from Basin stakeholders. It takes into consideration the need to maintain a vibrant agricultural community while ensuring that domestic and environmental water uses are protected. As discussed in Section 3 of the GSP, the GSA recognizes that the observed water level declines and chronic storage deficit are undesirable. The GSA is committed to implementing a number of projects and management actions, including a pumping allocation program, after the GSP is adopted (see Section 6) that will result in basin pumping within the sustainable yield and avoidance of undesirable results within the next 20 years. The GSP includes plans to fill critical data gaps and an extensive monitoring program (see Section 5) that addresses each of the applicable sustainability indicators. Minimum thresholds, measurable objectives, and interim milestones have been established to measure sustainability and to assess progress toward meeting the sustainability goal over the next 20 years.

This GSP is intended to be an adaptive plan that allows for consideration of observed basin conditions and adaptive management actions through the planning horizon.

ES-3.2 Qualitative Objectives for Meeting Sustainability Goals

Qualitative objectives are designed to help stakeholders understand the overall purpose for sustainably managing groundwater resources (e.g., avoid chronic lowering of groundwater levels) and reflect the local economic, social, and environmental values within the Basin. A qualitative objective is often compared to a mission statement. The qualitative objectives for the Basin are the following:

- **Avoid Chronic Lowering of Groundwater Levels**
  - Maintain groundwater levels that continue to support current and future groundwater uses and sustain the health of Barka Slough in the Basin.
- **Avoid Chronic Reduction of Groundwater in Storage**
  - Maintain sufficient groundwater volumes in storage to sustain current and planned groundwater use in prolonged drought conditions while avoiding impacts to Barka Slough resulting from groundwater pumping.
- **Avoid Degraded Groundwater Quality**
  - Maintain access to drinking water supplies.
  - Maintain access to agricultural water supplies.
  - Maintain quality consistent with current ecosystem uses.
- **Avoid Land Subsidence**
  - Prevent land subsidence that causes significant and unreasonable effects to groundwater supply, land uses, infrastructure, and property interests.
- **Avoid Depletion of Interconnected Surface Water**
  - Avoid significant and unreasonable effects to beneficial uses, including GDEs, caused by groundwater extraction.
  - Maintain sufficient groundwater levels to maintain areas of interconnected surface water as of January 2015 when SGMA became effective.

ES-3.3 Process for Establishing Sustainable Management Criteria

This section presents the process that was used to develop the SMCs for the Basin, including input obtained from Basin stakeholders, the criteria used to define undesirable results, and the information used to establish minimum thresholds and measurable objectives.

ES-3.3.1 Public Input

The public input process was developed in conjunction with the SABGSA member agency's continued engagement of local stakeholders and interested parties on water issues. This included the formation of the Stakeholder Advisory Committee, whose members were selected by the SABGSA Board because members have an interest in maintaining a healthy agricultural and business community, good water quality, and a healthy environment. The SMCs and beneficial uses presented in this section were developed using a combination of information from public input, public meetings, comment forms, hydrogeologic analysis, and meetings with Advisory Committee members.

ES-3.3.2 Define Undesirable Results

Defining what is considered undesirable is one of the first steps in the SMC development process. The qualitative objectives for meeting sustainability goals are presented as ways of avoiding undesirable results for each of the sustainability indicators. The absence of undesirable results defines sustainability. The following are the general criteria used to define undesirable results in the Basin:

- There must be significant and unreasonable effects caused by pumping
- A minimum threshold is exceeded in a specified number of representative wells over a prescribed period
- Impacts to beneficial uses—including to GDEs and/or threatened or endangered species— occur

These criteria may be refined periodically during the 20-year GSP implementation period based on monitoring data and analysis.

ES-3.4 Summary of Sustainable Management Criteria

Table ES-2 summarizes the SMCs for the six groundwater sustainability indicators. The table first describes the type(s) of potential undesirable results associated with each sustainability indicator, then describes the minimum thresholds and measurable objectives for each indicator. Detailed discussions of the SMCs for each groundwater sustainability indicator are provided in Sections 4.5 through 4.10 of this GSP.

Table ES-2. Summary of Sustainable Management Criteria

Potential Undesirable Results	Minimum Threshold	Measurable Objective	Other Notes
Chronic Lowering of Groundwater Levels			
Groundwater levels in the Paso Robles Formation or Careaga Sand drop below the minimum threshold after periods of average and above-average precipitation in 50 percent of representative wells for 2 consecutive years An acute or chronic measurable impact to GDEs associated with interconnected surface water, specifically Barka Slough, caused by groundwater pumping in the Basin (during periods of average or above-average precipitation measured at the Los Alamos Fire Station gage) Reduction of groundwater in storage results in an inability to produce the estimated annual volume of groundwater equal to the sustainable yield for the Basin determined using the water budget method described in this GSP.	Paso Robles Formation and Careaga Sand groundwater levels: 25 feet below the fall 2018 groundwater levels measured at representative monitoring sites.	Groundwater levels measured at each representative monitoring site in spring 2015	Extended drought or high rates of pumping (exceeding the long-term rate of recharge) in the Paso Robles Formation or Careaga Sand could lead to significant and unreasonable effects on groundwater levels.
Reduction of Groundwater in Storage			
Groundwater levels in the Paso Robles Formation or Careaga Sand drop below the minimum threshold after periods of average and above-average precipitation in 50 percent of representative wells for 2 consecutive years. Reduction of groundwater in storage results in an inability to produce the estimated annual volume of groundwater equal to the sustainable yield for the Basin determined using the water budget method described in this GSP.	Same as for chronic lowering of groundwater levels.	Same as for chronic lowering of groundwater levels.	Extended drought or high rates of pumping (exceeding the long-term rate of recharge) in the Paso Robles Formation or Careaga Sand could lead to significant and unreasonable effects on groundwater levels.
Seawater Intrusion			
Not applicable to this Basin	N/A	N/A	N/A
Degraded Groundwater Quality			
Concentrations of regulated contaminants in untreated groundwater from private domestic wells, agricultural wells, or municipal wells exceed regulatory thresholds as a result of pumping or GSA activities. Groundwater pumping or GSA activities cause concentrations of TDS, chloride, sulfate, boron, sodium, and nitrate to increase and exceed WQOs since SGMA was enacted in January 2015.	Minimum thresholds presented in Table 4-3 for TDS, chloride, sulfate, boron, sodium, and nitrate as measured by SWRCB ILRP and Division of Drinking Water programs in 20 percent of wells monitored. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the minimum threshold concentration is 110 percent of the ambient water quality in 20 percent of the wells.	Maintain groundwater quality related to contaminants equal to, or below, regulatory standards or, equal to or below concentrations present in groundwater in January 2015. Maintain groundwater quality related to salts and nutrients equal to or below WQOs in the Basin Plan, or equal to or below concentrations in January 2015.	SABGSA has no responsibility to manage groundwater quality unless it can be shown that water quality degradation is caused by pumping in the Basin, or the SABGSA implements a project that degrades water quality.

Potential Undesirable Results	Minimum Threshold	Measurable Objective	Other Notes
Significant and Unreasonable Land Subsidence that Substantially Interferes with Surface Land Uses			
Groundwater extraction results in subsidence that substantially interferes with surface land uses (including agricultural, residential, rural residential, and town buildings) and property interests. Groundwater extraction results in subsidence that causes land surface deformation that impacts the use of critical infrastructure (including LACSD wells, WWTP, and associated infrastructure) and roads. Groundwater extraction results in land subsidence greater than minimum thresholds at the UNAVCO CGPS Station ORES.	The rate of subsidence does not exceed 0.05 feet (0.6 inches) per year for 3 consecutive years measured at the UNAVCO CGPS Station ORES.	Maintenance of current conditions and average rate of subsidence from 2000 to 2020 (0.5 inches per year).	Based on measured subsidence at UNAVCO CGPS stations.
Depletion of Interconnected Surface Water that Causes Significant and Unreasonable Results to Beneficial Uses of Surface Water			
Groundwater level declines caused by groundwater pumping in the Basin could reduce the amount of groundwater discharging to interconnected surface water and Barka Slough, resulting in an impact to GDEs. Severe drought that reduces mountain front recharge, streamflow percolation, percolation of direction precipitation, and recharge to the Paso Robles Formation and Careaga Sand; thus, lowering groundwater levels and reducing surface water flow into the Slough, resulting in an impact to GDEs. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods. Permanent loss or significant degradation of existing native riparian or aquatic habitat due to lowered groundwater levels and reduced surface water flow into Barka Slough caused by groundwater pumping.	0.15 cfs of surface water flow measured at the Casmalia stream gage west of Barka Slough.	Surface water flow measured at the Casmalia stream gage equal to the geometric mean flow (0.5 cfs) between 2015 and 2018.	Groundwater and surface water exit the Basin as surface water flow from Barka Slough. Consequently, if surface water flow can be measured exiting the Basin, it is inferred that there is sufficient water available to GDEs in the Slough. If surface flow exiting Barka Slough ceased, there is a potential that there is no longer enough water, whether entering the Slough as groundwater or surface water, available to GDEs located in the Slough.

Notes

Basin Plan = Water Quality Control Plan for the Central Coast Basin
cfs = cubic feet per second
CGPS = Continuous Global Positioning System
GDE = groundwater-dependent ecosystem
GSA = groundwater sustainability agency
GSP = Groundwater Sustainability Plan
ILRP = Irrigated Lands Regulatory Program
N/A = not applicable
SABGSA = San Antonio Basin Groundwater Sustainability Agency
SGMA = Sustainable Groundwater Management Act
Slough = Barka Slough
SWRCB = State Water Resources Control Board
TDS = total dissolved solids
UNAVCO = University NAVSTAR Consortium
WQO = water quality objective

ES-4 Monitoring Networks (GSP Section 5)

This section of the GSP describes existing monitoring networks and improvements to the monitoring networks that will be developed for the Basin. The monitoring networks presented in this section are based on existing monitoring sites. During the 20-year GSP implementation period, it may be necessary to expand the existing monitoring networks and identify or install more monitoring sites to fully demonstrate sustainability and improve the GSP model.

The groundwater monitoring network section of this GSP is largely based on historical groundwater data compiled by the United States Geological Survey (USGS) National Water Information System (NWIS) program, the USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program, the California Statewide Groundwater Elevation Monitoring (CASGEM), and quarterly groundwater monitoring completed by the SABGSA beginning the fourth quarter of 2019 to the present.

ES-4.1 Monitoring Plan for Water Levels, Change in Storage, Water Quality

The 50 wells included in the groundwater level monitoring network are listed in Table 5-1 and shown on Figure 3-11. The groundwater level monitoring network will be used as a proxy for the groundwater storage monitoring network. All but six wells in the groundwater level monitoring network are monitored by the GSA. Four of the six wells are monitored by the Los Alamos Community Services District (LACSD). Static water levels are provided to the GSA on a quarterly basis in association with the GSA's quarterly monitoring events. The remaining two wells are monitored by Santa Barbara County, and data are provided semiannually. A subset of wells from the monitoring network has been selected as representative monitoring sites (RMSs). RMSs are defined in the SGMA regulations as a subset of monitoring sites that are representative of conditions in the Basin. The monitoring network will enable the collection of data to assess sustainability indicators, evaluate the effectiveness of management actions and projects that are designed to achieve sustainability, and evaluate adherence to minimum thresholds and measurable objectives for each applicable sustainability indicator. There may be opportunities to optimize the groundwater level monitoring network in the Basin. The number of wells included in the groundwater level monitoring network will be evaluated during each 5-year GSP interim period.

The 89 wells included in the groundwater quality monitoring network are listed in Table 5-3 and shown on Figure 5-4. All the wells from the GSP groundwater water quality monitoring network are RMS wells. The groundwater quality monitoring network includes eight municipal drinking water supply wells and 81 wells monitored as part of the state Irrigated Lands Regulatory Program (ILRP). Of the ILRP wells, 21 were determined to be domestic supply wells, and 60 wells were determined to be agricultural supply wells. Groundwater quality data do not indicate a need for additional monitoring locations. Current programs provide adequate spatial and temporal coverage for the purposes for the GSP. There is adequate spatial coverage in the groundwater quality monitoring network to assess impacts, if any, to beneficial uses and users.

ES-4.2 Monitoring Plan for Land Subsidence

Locally defined significant and unreasonable conditions for land subsidence are (1) land subsidence rates exceeding rates observed from 2000 through 2020 at the University NAVSTAR Consortium (UNAVCO) Continuous Global Positioning System (CGPS) Station ORES in the town of Los Alamos, near Los Alamos Park; and (2) land subsidence that causes damage to groundwater supply, land uses, infrastructure, and property interests. Since the beginning of data collection in 2000, the land surface elevation has by 0.82 ft. The Basin is located near the intersection of the Coastal Ranges and Transverse Ranges California Geomorphic Provinces. Consequently, the Basin is in a very tectonically active region. The 0.82 ft of vertical displacement measured at the UNAVCO station could be due to tectonic activity, groundwater extraction, oil and gas extraction, or a combination of the three. In addition, Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR shows that significant land subsidence did not occur during the period between June 2015 and June 2019 (the available InSAR data period of record) in the Basin. If subsidence is observed, approaches the minimum threshold, causes undesirable results, and appears to be related to groundwater pumping, the SABGSA will undertake a program to install land surface elevation benchmarks at critical infrastructure locations, and monitor subsidence with measured land surface elevations on an annual basis.

ES-4.3 Monitoring Plan for Depletion of Interconnected Surface Water

The SABGSA plans to install two surface water gages on San Antonio Creek; one upstream and one downstream of Barka Slough to measure surface water inflow and outflow to the Slough and assess surface water depletion and potential for impacts to Barka Slough. Until those gages are installed, the Casmalia stream gage, located 2.5 miles downstream of Barka Slough, will be used to assess surface water depletion and impacts to Barka Slough. Monitoring of groundwater levels in monitoring wells completed in the Careaga Sand surrounding the Barka Slough area will also continue to be conducted by the SABGSA as part of the groundwater level monitoring network. The SABGSA plans to assess the feasibility of installing shallow piezometers within the sediments underlying Barka Slough if access can be achieved and maintained through the dense vegetation and if the California Department of Fish and Wildlife will permit the piezometer installation and monitoring within the Slough. If achievable, the piezometers would provide important data regarding the elevation of the water table relative to the plant rooting depths in the Slough. It is anticipated that these data will be used to better define the water budget at the Slough and to determine whether the SMC for this indicator should be adjusted.

ES-5 Projects and Management Actions (GSP Section 6)

Section 6 of the GSP describes the projects and management actions that will allow the Basin to attain sustainability in a phased manner. In this GSP, groundwater management actions generally refer to activities that support groundwater sustainability through policy and regulations without infrastructure; projects are defined as activities supporting groundwater sustainability that require infrastructure.[1] The identified management actions and potential future projects are classified using a tiered system, with the implementation of Tier 1 management actions to be initiated within 1 year of GSP adoption by the SABGSA. Because the SABGSA desires to begin addressing the observed water level declines and the storage deficit soon after adoption of the GSP, Tier 2 management actions will also be initiated. Tier 3 and 4 management actions and priority projects will be considered for implementation in the future as conditions in the Basin dictate, and as the effectiveness of the lower-tiered initiatives are assessed.

[1] Per SGMA, de minimis groundwater extractors are exempt, and not anticipated to be adversely impacted, from certain projects and management actions managed by the local GSA. Domestic well users generally fall within the SGMA definition of a de minimis extractor. SGMA defines a de minimis extractor as “a person who extracts, for domestic purposes, two acre-feet or less (of groundwater) per year.”

Management Actions

- Address Data Gaps
- Groundwater Pumping Fee Program
- Well Registration Program and Well Meter Installation Program
- Water Use Efficiency Programs
- Groundwater Base Pumping Allocation (BPA) Program
- Groundwater Extraction Credit (GEC) Marketing and Trading Program
- Voluntary Agricultural Crop Fallowing Programs

Projects

- Non-Native/Invasive Species Eradication
- Barka Slough Augmentation Project with Groundwater Supplies
- Watershed Management Projects, Including Controlled Burns
- Distributed Storm Water Managed Aquifer Recharge (DSW-MAR) Basins (In-Channel and Off-Stream Basins)
- LACSD Wastewater Treatment Facility Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse
- SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program
- Vandenberg Space Force Base, previously Vandenberg Air Force Base, Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)
- Barka Slough Augmentation Project with State Water Project or Banked Supplemental Water Supplies
- In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers
- SABGSA to provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses") Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge
- Additional Projects for Potential Future Consideration by SABGSA
  - Development of Water Supply Wells in Bedrock Formations
  - Use of Treated Oilfield Produced Water for Irrigation
  - Water Exchanges to Secure Other Agency State Water Project Allocations

The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. These management actions are focused primarily on filling identified data gaps, developing funding for SABGSA operations and future Basin monitoring, registering and metering wells, and developing new and expanding existing water use efficiency programs for implementation within the Basin. As a critical element of GSP implementation, the Groundwater Pumping Fee Program is included as a Tier 1 management action to provide the SABGSA with a source of funding for operation and the continued monitoring of conditions in the Basin.

Tier 2 management actions are planned to be initiated within approximately 3 years of GSP adoption because accurate flow monitoring is necessary, and time is needed for the Tier 1 well metering program to be fully implemented. Activities in Tier 3 include priority projects on which the SABGSA member agencies may initiate work within 3 to 5 years of GSP adoption. All non-priority projects that were identified and evaluated are classified as Tier 4. The SABGSA does not plan to initiate the construction of any Tier 4 project infrastructure, for the specific goal of achieving Basin sustainability, until evidence exists that the effects of the implemented management actions are proving insufficient. However, the GSA may choose to implement a Tier 3 or 4 project if funding becomes available and the SABGSA determines that there would be substantial benefit to the Basin.

The effect of the management actions will be reviewed annually, and additional higher-tiered management actions and priority projects will be implemented as necessary to avoid undesirable results. A graphical depiction of the implementation sequence is presented in Figure ES-6.

Management actions included in the GSP are summarized below and are described in more detail in Sections 6.3 through 6.11.

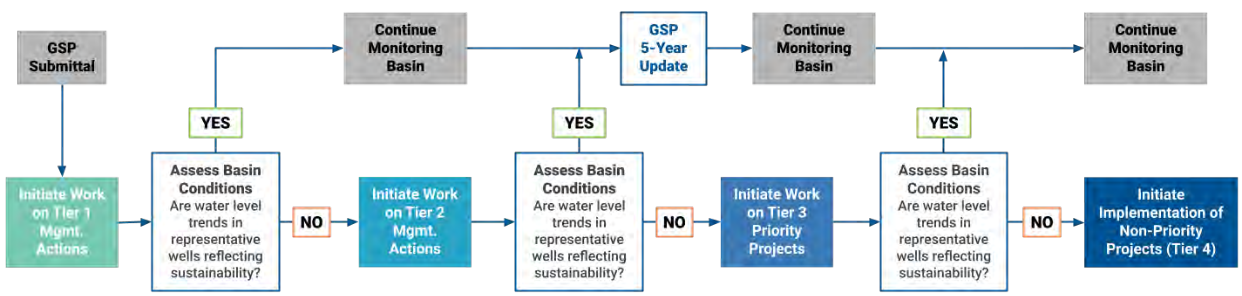


Figure ES-6. Adaptive Implementation Strategy for Projects and Management Actions

ES-5.1 Tier 1 Management Action 1 – Address Data Gaps

Data gaps have been identified that require additional information because they are important for management of the Basin in the future. The following management actions will help fill these data gaps:

- Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density
- Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction
- Install Stream Gages at Barka Slough
- Implement LACSD Wellfield Pumping Coordination/Offsite Well Impact Mitigation
- Review/Update Water Usage Factors and Crop Acreages and Update Water Budget
- Survey and Investigate Potential GDEs in the Basin and Further Characterize Barka Slough
- Review USGS Groundwater Model/Update HCM and Develop Water Budget for Barka Slough

ES-5.1.1 Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density

The areas where additional monitoring well data is needed are depicted in Figure 5-3. Two low-density areas in both principal aquifers were identified in the Basin: the eastern uplands and the central-to-northwestern uplands. The proposed strategy for adding monitoring wells to the monitoring network will be to first incorporate existing wells to the extent possible. If an existing well in a particular area cannot be identified or permission to use data from an existing well cannot be secured to fill a data gap, then a new monitoring well may be considered.

ES-5.1.2 Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction

There are wells in the GSP Monitoring Well Network that do not have adequate documentation regarding the reference point elevation, depth, geologic formations intersected, casing characteristics, screened intervals, pump setting, and/or well construction details. To address this data gap, the SABGSA will identify the wells lacking this information, obtain permission from well owners, and perform reference point surveys and video logging to ascertain well construction details and the location of well production zones.

ES-5.1.3 Install Stream Gages at Barka Slough

Two locations have been identified for installation of stream gages to supplement characterization of spatial and temporal exchanges between surface water and groundwater relative to Barka Slough. A stream gage downstream of the confluence of San Antonio Creek and Harris Canyon Creek and upstream of the Slough would enable direct quantification of surface water entering the Slough. A stream gage at the west end of Barka Slough (where surface water discharges from the Basin), near California State Highway 1, would provide a more direct quantification of surface water discharge exiting the Slough. The addition of a stream gage at this location would inform the water budget for the Slough and improve the ability to assess the interconnected surface water SMCs. If it is determined that access can be obtained and maintained and California Department of Fish and Wildlife is willing to permit this activity, then the SABGSA is considering the installation of shallow piezometers within the Barka Slough sediments to allow monitoring of groundwater levels within the root zone of the plants in the Slough.

ES-5.1.4 LACSD Wellfield Pumping Coordination/Offsite Well Impact Mitigation

Based on the review of available well location data, it appears that the LACSD municipal wells are in an area that coincides with the presence of numerous agricultural irrigation wells. Pumping from this area of concentrated wells appears to be resulting in a localized and lower groundwater levels in the aquifer. The LACSD has been reviewing its pumping schedules and initiated discussions with the surrounding agricultural pumpers to explore the potential for implementing a coordinated pumping schedule program to assess the feasibility of distributing pumping from all wells in the affected area to address this localized issue and raise static and pumping levels at LACSD wells. The SABGSA plans to initiate a study to evaluate the localized impacts in the Basin that are occurring from the existing pumping operations and explore strategies for implementing a groundwater pumping management program to improve the conditions in the Basin and mitigate the impacts to the LACSD water supply system.

ES-5.1.5 Review/Update Water Usage Factors and Crop Acreages and Update Water Budget

Uncertainty remains in the estimates of water use from irrigated lands in the Basin and hence the assumed amount of pumping needed to meet the crop water requirement. To address this uncertainty and increase the accuracy of the annual groundwater pumping estimates and Basin water budget calculations in future years until a metering program is fully implemented, the SABGSA plans to review and update water usage factors and crop acreages.

ES-5.1.6 Survey and Investigate Potential GDEs and Further Characterize Barka Slough

At present there are insufficient data available to confirm the nature and spatial extent of GDEs within Barka Slough and elsewhere as well as the degree to which GDEs are supported by surface water and/or groundwater. To address this uncertainty, the SABGSA plans to perform a habitat survey in Barka Slough and further investigate potential GDEs elsewhere in the Basin. This information will be used to further identify GDEs that may be affected by pumping and groundwater management activities and to understand groundwater and surface water conditions in Barka Slough so that SMCs can be updated to avoid impacts to GDEs.

ES-5.1.7 Review USGS Groundwater Model/Update HCM, Develop Water Budget for Barka Slough

A groundwater model developed by the USGS is being calibrated as part of a multi-year groundwater basin study. When the model is made available by the USGS, the SABGSA plans to review and use the model to improve the accuracy of the annual groundwater pumping estimates and Basin water budget calculations in future years, and to assess the water budget for Barka Slough.

ES-5.2 Tier 1 Management Action 2 – Groundwater Pumping Fee Program

As part of the GSP implementation process, the SABGSA will explore various financing options to cover its operational costs and to generate funding for monitoring of the Basin and the implementation of management actions and potential future projects. Based on the results of these efforts, the SABGSA may adopt a management action to levy groundwater pumping fees for the purposes of (1) generating funding for the SABGSA operations, (2) ongoing monitoring of the condition of the Basin, and (3) development and implementation of the identified management actions and potential projects.

The initial phase of the program will be focused on program design, policy and regulatory development, compliance with the California Environmental Quality Act, and stakeholder outreach. The SABGSA will consider an investigative study to determine the most effective and equitable fee and incentive structure. In conjunction with the development of the Groundwater Pumping Fee Program, the SABGSA will ensure that any charges that the SABGSA plans to place on groundwater extraction will be carefully reviewed by legal counsel to determine whether those charges are appropriate, and what regulatory/statutory processes will be required for them. Potential charges on groundwater extraction will also be reviewed so that they take into consideration the fee structure that the San Antonio Basin Water District has in place. De minimus pumpers will not be metered and will not be required to pay an extraction-related pumping fee.

ES-5.3 Tier 1 Management Action 3 – Well Registration and Well Meter Installation Programs

Well registration is intended to establish a relatively accurate count of all the active wells in the Basin, including an accurate location of each well. All groundwater production wells, including wells used by de minimis pumpers, will be required to be registered with the SABGSA. Well metering is intended to improve estimates of the amount of groundwater extracted from the Basin. SGMA does not authorize GSAs to require metering of de minimis (and domestic) well users, and therefore well metering will be limited to non-de minimis wells. The information to be acquired through the well registration program can be used by the GSA for the purposes of potential risk and impact assessment with regard to the water supply adequacy and water quality for domestic and community drinking water wells within the Basin. If the information obtained through the well registration program indicates that there is a potential for adverse impacts to the future water supply adequacy or water quality of domestic and/or community drinking water supply wells then the GSA can elect to develop and implement a Drinking Water Well Impact Mitigation Program.

The SABGSA will require all non-de minimis groundwater pumpers to report extractions annually and use a water-measuring method satisfactory to the SABGSA. Guidelines and a regulatory framework will be developed to implement this program, which may also include a system for reporting and accounting for water conservation initiatives, voluntary irrigated land fallowing (temporary and permanent), stormwater capture projects, or other activities that individual pumpers may elect to implement.

As a Tier 1 management action, the SABGSA plans to initiate a pilot program to determine the most feasible means of complying with SGMA's measurement provision within 1 year of GSP adoption. The measurement alternatives and data processing methods to be evaluated may include the following:

- Use of power records to correlate energy usage with volume of water pumped
- Conventional mechanical or magnetic flow meters
- Automated meter infrastructure systems

ES-5.4 Tier 1 Management Action 4 – Water Use Efficiency Programs

Urban and agricultural water use efficiency has been practiced in the Basin for more than two decades and have been effective in significantly reducing water use within the region. Existing programs promote responsible design of landscapes and appropriate choices of appliances, irrigation equipment, and other water-using devices to enhance the wise use of water. The water use efficiency management actions to be developed for implementation by municipal, agricultural, and domestic pumpers will promote expansion and supplementation of the water use efficiency programs that currently exist.

The Water Use Efficiency Programs proposed include the following:

- **Urban Water Use Efficiency Programs:** Initiatives that promote increasing water use efficiency by achieving reductions in the amount of water used for municipal, commercial, industrial, landscape irrigation, and aesthetic purposes. These programs can include incentives, public education, technical support, and other efficiency-enhancing programs.
- **Agricultural Water Use Efficiency Programs:** Initiatives that promote increasing water use and irrigation efficiency and achieving reductions in the amount of water used for agricultural irrigation. These programs can include incentives, public education, technical support, training, implementation of best water use practices, and other efficiency-enhancing programs.

ES-5.5 Tier 2 Management Action 5 – Groundwater Base Pumping Allocation (BPA) Program

The volume of groundwater that is pumped from the Basin in recent years is more than the estimated Basin yield of about 8,900 AFY. The SABGSA has determined that the volume of groundwater being pumped must be reduced to the sustainable yield of the Basin. To achieve this goal, the SABGSA may develop and implement a regulatory program to equitably allocate a groundwater BPA volume of water to be pumped from the Basin annually. Once the program is implemented, individual non-de minimis pumpers will be provided an annual groundwater BPA that will start at historically used quantities of water and ramp down over time to bring pumping in the Basin within its sustainable yield by 2042. The amount of needed pumping reduction in the future is uncertain and will depend on several factors, including climate conditions, the effectiveness and timeliness of voluntary actions by pumpers, and the success of other management actions described in this GSP.

After GSP adoption, developing the Groundwater BPA Program would likely require the following steps:

- Establishing a methodology for determining baseline pumping, considering the following:
  - Historical pumping
  - Sustainable yield of the Basin
  - Groundwater level trends
  - Land uses and corresponding irrigation requirements
- Establishing a methodology to determine individual annual allocations considering documented historical water use, opportunities for improved efficiency, and evaluation of anticipated benefits from other relevant actions that individual pumpers may take. Alternatively, the SABGSA may define the allocations based on acreage and crop type.
- A timeline for implementing limitations on pumping (“ramp down”) within the Basin as required to avoid undesirable results and reduce the impact on local growers.
- Approving a formal regulation to enact the program.

The SABGSA realizes certain landowners will need or elect to periodically use an amount of groundwater in excess of their annual allocation. It is anticipated that the pumping fee policy will include provisions that will allow landowners, under special circumstances, to pump groundwater beyond the current groundwater allocation, but at considerably higher cost. In addition, the SABGSA may incorporate supplemental conditions to be placed on new wells and new production from existing wells in the Basin in conjunction with the development of the Groundwater BPA Program.

ES-5.6 Tier 2 Management Action 6 – Groundwater Extraction Credit (GEC) Marketing and Trading Program

As previously described, the SABGSA will develop and implement a regulatory program to equitably allocate a pre-determined groundwater BPA to be extracted from the Basin annually. As necessary, the allocations of individual non-de minimis pumpers will be ramped down over time to bring pumping in the Basin to within its sustainable yield by within 20 years of the adoption of the GSP. In conjunction with the Groundwater BPA Program, the SABGSA will pursue the development and implementation of a GEC Marketing and Trading Program to provide non-de minimis users with increased flexibility in using their annual allocations. The program will enable voluntary permanent transfer of allocations between parties, through an exchange of GECs. In addition, the program will provide options for potentially long-term or short-term temporary transfer of GECs, including credits derived from voluntary fallowing or conversion to lower water use crops (see Section 6.9). The program is intended to allow groundwater users or new development to acquire needed groundwater allocations, in the form of GECs, from other pumpers to maintain economic activities in the Basin, encourage and incentivize water conservation, encourage and incentivize temporary and permanent fallowing of agricultural lands, encourage conversion to lower water use crops, and facilitate a ramp-down of pumping allocations as water demands and Basin conditions fluctuate during the 20-year GSP implementation period. The SABGSA may adopt a policy to define groundwater extraction carryover provisions year-to-year and/or allow multi-year pumping averages to provide groundwater pumpers with more flexibility in using their groundwater allocation year to year.

ES-5.7 Tier 2 Management Action 7 – Voluntary Agricultural Crop Fallowing Programs

The SABGSA has identified voluntary agricultural crop fallowing as a necessary management action to achieve sustainability. The SABGSA will develop and implement a voluntary fallowing program that will facilitate the conversion of high water use irrigated agriculture to low water use agriculture use or open space, public land, or other land uses on a voluntary basis. The SABGSA will develop programs that will permit both voluntary temporary and long-term or permanent fallowing and conversion to other land uses. An important consideration in developing the voluntary fallowing program will be to include protections of water rights for the overlying landowners that choose to temporarily fallow ground. As part of this management action, the SABGSA will develop a Basin-wide accounting system that tracks landowners who decide to voluntarily fallow their land and cease groundwater pumping or otherwise refrain from using groundwater. The Voluntary Agricultural Crop Fallowing Programs will be developed in parallel to the Groundwater BPA and the GEC Marketing and Trading Programs. It is also noted that the Voluntary Fallowing Program may potentially be enhanced, or a separate program could be implemented, which may provide for GSA to lease or purchase agricultural land for fallowing. The GSA could use fees generated through the Groundwater Pumping Fee Program to lease/purchase the lands to be fallowed, if necessary or deemed desirable by the GSA. Additionally, the GSA may also consider purchasing groundwater extraction credits.

ES-5.8 Tier 3 Priority Projects

The SABGSA has concluded that the Basin sustainability goals are likely to be achieved through the implementation of the Tier 1 and 2 management actions and will annually assess the effectiveness that the implemented management actions have achieved in stabilizing groundwater levels. If the implemented management actions are proving insufficient to meet sustainability goals, then the SABGSA may decide to implement selected projects from the portfolio of identified priority projects in the future.

The priority projects listed below and described in more detail in Section 6.10 were identified by the SABGSA for future consideration:

- Non-Native/Invasive Species Eradication
- Barka Slough Augmentation Project with Groundwater Supplies
- Watershed Management Projects, Including Controlled Burns
- Distributed Storm Water Managed Aquifer Recharge (DWR-MAR) Basins (In-Channel and Off-Stream Basins)

ES-5.9 Tier 4 Non-Priority Projects

Although the SABGSA has no near-term plans to initiate construction of any specific non-priority projects, for the purposes of achieving Basin sustainability, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for any number of projects that were identified by the SABGSA for potential future consideration. The following projects listed below, and described in more detail in Section 6.11, were identified by the SABGSA for future consideration:

- LACSD Wastewater Treatment Facility Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse
- SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program
- Vandenberg Space Force Base Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)
- Barka Slough Augmentation Project with State Water Project or Banked Supplemental Water Supplies
- In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers
- SABGSA to provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses") Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge Projects
- Additional Projects for Potential Future Consideration by SABGSA
  - Development of Water Supply Wells in Bedrock Formations
  - Use of Treated Oilfield Produced Water for Irrigation
  - Water Exchanges to Secure Other Agency State Water Project Allocations

ES-6 Groundwater Sustainability Plan Implementation (GSP Section 7)

Section 7 provides a conceptual road map for the SABGSA's efforts to implement the GSP during the first 5 years after adoption and discusses implementation effects in accordance with SGMA regulations. This implementation plan is based on the SABGSA's current understanding of conditions and anticipated administrative considerations in the Basin that affect the management actions described in Section 6. Understanding of the conditions and administrative considerations in the Basin will evolve over time, based on future refinement of the hydrogeologic setting, groundwater flow conditions, and input from basin stakeholders. The SABGSA will evaluate the GSP at least every 5 years.

The SABGSA has developed a portfolio of management actions and projects that can be implemented in phases as the conditions in the Basin dictate. The management actions and potential future projects are classified with a tiered system, with the implementation of Tier 1 elements to be initiated within 1 year of GSP adoption by SABGSA and implementation of Tier 2 elements within 3 years of GSP adoption. Tier 3 and 4 projects will be considered for implementation in the future as conditions in the Basin dictate and as the effectiveness of the lower tier initiatives (Tier 1 and Tier 2) are assessed. Conceptual planning-level cost estimates for implementing the Tier 1 and Tier 2 management actions are presented in Table 7-1, and an estimate of the planning-level costs associated with Tier 3 priority projects and Tier 4 non-priority projects are summarized in Table 7-2. Potential funding sources are described in Section 7.7.

SECTION 1: Introduction to Plan Contents [Article 5 § 354]

§ 354 Introduction to Plan Contents. This Article describes the required contents of Plans submitted to the Department for evaluation, including administrative information, a description of the basin setting, sustainable management criteria, description of the monitoring network, and projects and management actions.

This section includes a brief description of Sustainable Groundwater Management Act (SGMA), the purpose of the Groundwater Sustainability Plan (GSP), and the sustainability.

1.1 Purpose of the Groundwater Sustainability Plan

In 2014, the State of California enacted SGMA. This law requires groundwater basins in California that are designated as medium or high priority be managed sustainably. Satisfying the requirements of SGMA generally requires four basic activities:

1. Forming a Groundwater Sustainability Agency (GSA) to fully cover the basin
2. Developing a GSP that fully covers the basin
3. Implementing the GSP and managing to achieve quantifiable objectives
4. Regular reporting to the California Department of Water Resources (DWR)

This document fulfills the GSP requirement for the San Antonio Creek Valley Groundwater Basin (Basin). It describes the Basin, develops quantifiable management objectives that account for the interests of the Basin's beneficial groundwater uses and users, and identifies a group of projects and management actions that will allow the Basin to achieve sustainability within 20 years of plan adoption.

The GSP was developed specifically to comply with SGMA's statutory and regulatory requirements. As such, the GSP uses the terminology set forth in these requirements (see e.g., Water Code § 10721 and 23 California Code of Regulations § 351), which may be different from the terminology used in other contexts (e.g., past reports or studies, judicial rules, or findings). The definitions from the relevant statutes and regulations are attached to this report for reference.

This GSP is a planning document and does not define or change water rights.

1.2 Description of the San Antonio Creek Valley Groundwater Basin

The Basin encompasses an area of approximately 123 square miles (USGS, 2020). Long and narrow, the watershed is approximately 30 miles long and 7 miles wide. The Casmalia Hills and Solomon Hills to the north and the Purisima Hills and Burton Mesa to the south are the primary Basin boundaries. The valley floor is relatively flat and narrow with a slope from east to west, terminating at the western edge of Barka Slough (Hutchinson, 1980). Section 2.2 of this GSP provides a more detailed description of the area using the description from the California Department of Water Resources Bulletin 118.

1.3 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

Hutchinson, C. B. 1980. *Appraisal of Ground-Water Resources in the San Antonio Creek Valley, Santa Barbara County, California*. U.S. Geological Survey Open-File Report 80-750.

USGS. 2020. *StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications.* Available at https://www.usgs.gov/mission-areas/water-resources/science/streamstats-streamflow-statistics-and-spatial-analysis-tools?qt-science_center_objects=0#qt-science_center_objects. (Accessed June 9, 2021.)

SECTION 2: **Administrative Information [Article 5, SubArticle 1]**

§ 354.2 Introduction to Administrative Information. This Subarticle describes information in the Plan relating to administrative and other general information about the Agency that has adopted the Plan and the area covered by the Plan.

2.1 Agency Information [§ 354.6]

2.1.1 Development of the Groundwater Sustainability Agency

In 2017, the Cachuma Resource Conservation District (CRCD) and the Los Alamos Community Services District (LACSD) entered into a Joint Exercise of Powers Agreement (JPA) to form the San Antonio Basin Groundwater Sustainability Agency (SABGSA) with the purpose of sustainably managing groundwater and developing this Groundwater Sustainability Plan (GSP) for the San Antonio Creek Valley Groundwater Basin (Basin).

Subsequent to the execution of the May 2017 JPA between the CRCD and LACSD, SABGSA notified the California Department of Water Resources (DWR) of a non-material change. In May 2020, the Santa Barbara County Local Agency Formation Commission approved the formation of the San Antonio Basin Water District (SABWD) as a California Water District formed pursuant to California Water Code § 34000 et seq. The formation of the SABWD meets the requirements set forth in the JPA to substitute the membership of CRCD with the membership of the SABWD (see Article 6 of the JPA in Appendix A) (SABGSA, 2020).

2.1.2 Member Agencies

2.1.2.1 San Antonio Basin Water District

The SABWD comprises approximately 86,484 acres in Santa Barbara County. The purpose of the SABWD is to sustainably manage, protect, and enhance the groundwater resource as an adjunct to each property within the SABWD, while preserving the ability of agricultural lands to remain productive. The SABWD focuses its water management responsibilities primarily on use of groundwater for agricultural purposes and has provided funding through its members for development of the GSP. The SABWD has a five-member board of directors that meets monthly.

2.1.2.2 Los Alamos Community Services District

Los Alamos is an unincorporated community approximately 15 miles south of Santa Maria and 15 miles north of Buellton. U.S. Highway 101 passes through the community in a northwest to southeast direction and provides the principal connection between Los Alamos and Santa Maria to the north and the Santa Ynez Valley, Goleta, and Santa Barbara to the south.

The LACSD was formed in 1956 to provide water treatment and distribution services to the community of Los Alamos. Since that time, LACSD has expanded its charter to operate and maintain water, wastewater, and recreational facilities for the community of Los Alamos. The LACSD has a five-member board of directors that meets monthly. Board members are elected to 4-year terms.

Although not a member agency, Santa Barbara County has land use planning authority in the Basin and participates in SGMA implementation through its representation on the Groundwater Sustainability Plan Committee.

2.1.3 Name and Mailing Address [§ 354.6(a)]

§ 354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

(a) The name and mailing address of the Agency.

San Antonio Basin GSA
920 East Stowell Road | Santa Maria, CA 93454
805 868 4013 | sanantoniobasingsa.org

2.1.4 Organization and Management Structure [§ 354.6(b)]

§ 354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

(b) The organization and management structure of the Agency, identifying persons with management authority for implementation of the Plan.

The SABGSA adopted its bylaws on June 14, 2017. The bylaws establish the JPA provisions as the basis for SABGSA's day-to-day operations and a structure for governance of the SABGSA as follows:

- A board of directors that votes to establish a principal office; a chair, vice chair, secretary, and treasurer with specific duties as outlined; regular monthly meetings and a provision for special meetings
- The responsibility for debts and liabilities as well as establishing indemnity of the officers and members

The bylaws are included in Appendix A.

2.1.5 Plan Manager and Contact Information [§ 354.6(c)]

§ 354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

(c) The name and contact information, including the phone number, mailing address and electronic mail address, of the plan manager.

Anna Olsen, Executive Director
San Antonio Basin GSA
920 East Stowell Road | Santa Maria, CA 93454
805 868 4013 | aolsen@sanantoniobasingsa.org
sanantoniobasingsa.org

2.1.6 Legal Authority [§ 354.6(d)]

§ 354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

(d) The legal authority of the Agency, with specific reference to citations setting forth the duties, powers, and responsibilities of the Agency, demonstrating that the Agency has the legal authority to implement the Plan.

2.1.6.1 Agency Information

The SABGSA developing this coordinated GSP is formed in accordance with the requirements of California Water Code § 10723 et seq. The May 2017 JPA outlines the specific authorities of the SABGSA in developing and implementing the GSP and is included, along with the resolution to form the SABGSA, in Appendix A. The SABGSA is not an exclusive agency. Therefore, the SABGSA has the legal authority to implement this GSP throughout the plan area. No authority is needed from any other GSA or agency to implement this plan.

Figure 2-1 shows the extent of the GSP plan area with the jurisdictional boundary of the SABWD and LACSD.

2.1.6.2 Authority under the Joint Exercise of Powers Agreement

The purpose of the 2017 JPA is to establish the SABGSA. The JPA stipulates that the purpose of the SABGSA is to implement and comply with SGMA in the Basin; key provisions for SABGSA in the JPA include the following:

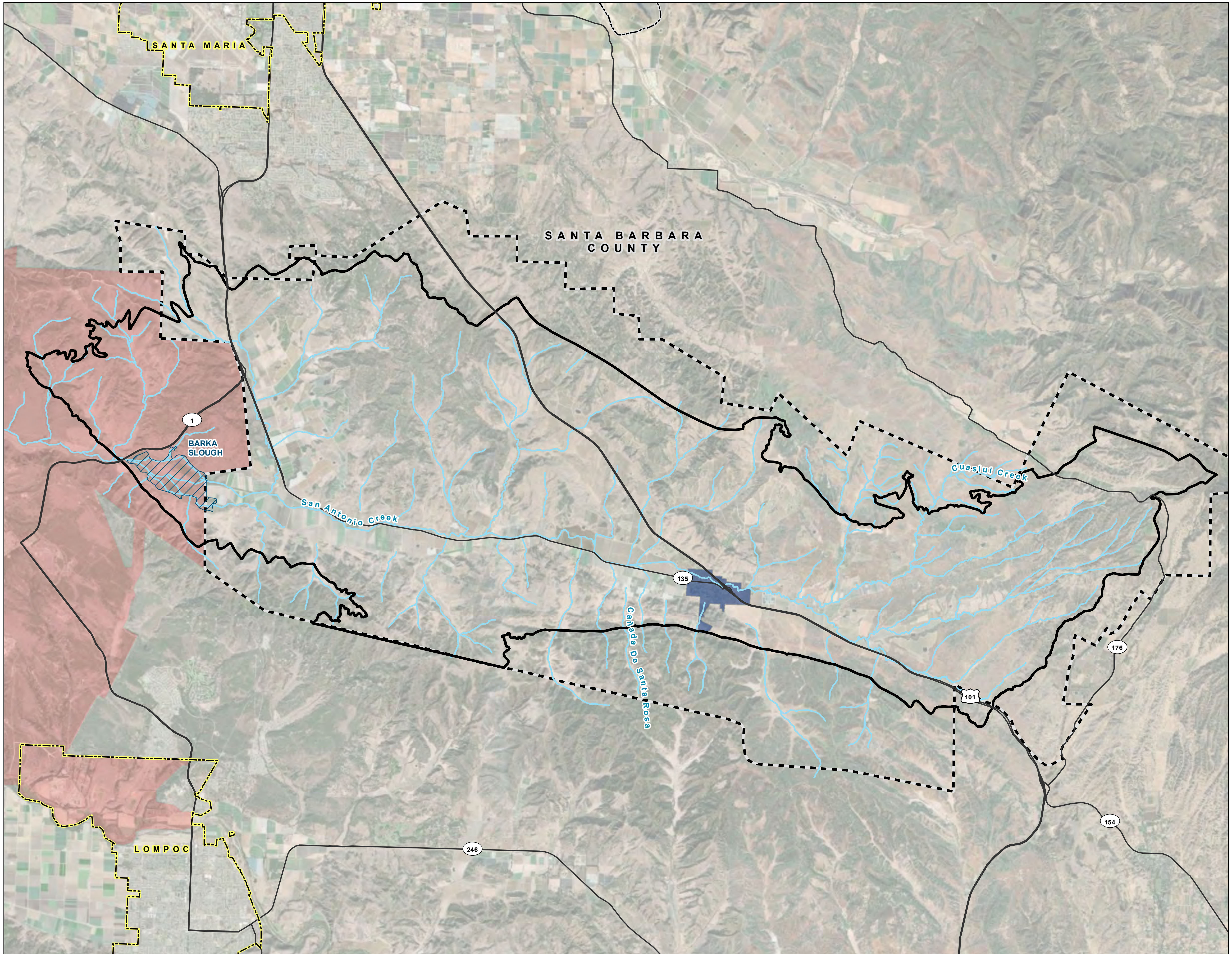
- Serve as the GSP for the Basin
- Develop, adopt, and implement a GSP that achieves the goals and objectives outlined in SGMA
- Adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency and adoption and implementation of the GSP in accordance with applicable law
- Obtain rights, permits and other authorizations for or pertaining to implementation of the GSP
- Make and enter into all contracts necessary to the full exercise of the GSA's powers
- Act cooperatively with other entities in exercising the powers of the GSA

The full list of activities that SABGSA is authorized to undertake are enumerated in Article 5 of the JPA, which is Appendix A of this GSP.

FIGURE 2-1

San Antonio Creek Valley Groundwater Basin Plan Area

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



LEGEND

- Los Alamos Community Service
- Vandenberg Space Force Base
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- San Antonio Basin Water
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section2\Figure2_1_San_Antonio_Creek_Valley_GW_Basin_Plan_Area.mxd, abarry

2.1.7 Cost and Funding of Plan Implementation [§ 354.6(e)]

§ 354.6 Agency Information. When submitting an adopted Plan to the Department, the Agency shall include a copy of the information provided pursuant to Water Code Section 10723.8, with any updates, if necessary, along with the following information:

(e) An estimate of the cost of implementing the Plan and a general description of how the Agency plans to meet those costs.

The GSP Implementation Plan, including the estimated cost for implementing the plan, is presented in Section 7 of the GSP.

2.2 Description of Plan Area [§ 354.8]

2.2.1 Summary of Jurisdictional Areas and Other Features [§ 354.8(a)(1),(a)(2),(a)(3),(a)(4),(a)(5), and (b)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(a) One or more maps of the basin that depict the following, as applicable:

(1) The area covered by the Plan, delineating areas managed by the Agency as an exclusive Agency and any areas for which the Agency is not an exclusive Agency, and the name and location of any adjacent basins.

(2) Adjudicated areas, other Agencies within the basin, and areas covered by an Alternative.

(3) Jurisdictional boundaries of federal or state land (including the identity of the agency with jurisdiction over that land), tribal land, cities, counties, agencies with water management responsibilities, and areas covered by relevant general plans.

(4) Existing land use designations and the identification of water use sector and water source type.

(5) The density of wells per square mile, by dasymetric or similar mapping techniques, showing the general distribution of agricultural, industrial, and domestic water supply wells in the basin, including de minimis extractors, and the location and extent of communities dependent upon groundwater, utilizing data provided by the Department, as specified in Section 353.2, or the best available information.

(b) A written description of the Plan area, including a summary of the jurisdictional areas and other features depicted on the map.

The San Antonio Creek Valley groundwater basin occupies approximately 130 square miles (DWR, 2003) in western Santa Barbara County. The basin is bound on the north by the Solomon-Casmalia Hills and the Santa Maria Valley groundwater adjudication boundary and on the east by the San Rafael Mountains and a watershed divide separating the adjoining Santa Ynez River Valley groundwater basin. Average annual precipitation ranges from 15 to 19 inches. There are no natural lakes or water supply reservoirs in the Basin. San Antonio Creek and its tributaries are the major waterbodies. San Antonio Creek discharges into Barka Slough (Slough), an unmanaged 660-acre wetland (Martin, 1985). The basin is bound on the south by the Purisima Hills and on the west by the approximate western boundary of the Slough. The valley is drained by San Antonio Creek (DWR, 2018; see Figure 2-1). The San Antonio Creek Basin has not been adjudicated.

2.2.1.1 Jurisdictional Areas

The majority of the Basin, including unincorporated Los Alamos, is under the jurisdiction of Santa Barbara County. At the west end of the Basin is Vandenberg Space Force Base (VSFB), which is under the jurisdiction of the U.S. Department of the Defense, Space Force Space Command (Santa Barbara County, 2019a).[2]

2.2.1.2 Land Use

Land use planning authority in the Basin is the responsibility of the Santa Barbara County. Santa Barbara County also coordinates on integrated regional water management, water planning, and land use issues with neighboring San Luis Obispo and Ventura counties. Land uses in the Basin are primarily agricultural. As of 2018, approximately 13,500 acres are in cultivation. As of 2021, the area of cultivation has reduced to approximately 12,900 acres. VSFB land surrounds Barka Slough to the west and draws a portion of its supply from wells completed in the Basin near the Slough. Several named oil and gas fields are located within or adjacent to the Basin (see Figure 3-47). The community plan area of Los Alamos is 1 square mile of residential, commercial, and recreational land uses in the central portion of the Basin (Santa Barbara County, 2011; Census Bureau, 2010; Dudek, 2019). Further details on land use planning are available in Section 2.2.4 of this GSP.

2.2.1.3 Water Use Sectors

By far, the largest water use sector in the Basin is agricultural, representing approximately 95 percent of all water use (see Table 2-1). VSFB represents the second-largest use, at just under 3 percent of all groundwater pumped. LACSD and rural domestic pumping account for approximately 1 percent and 1 percent, respectively, of total average annual pumping. Table 2-1 shows all the water uses in the Basin.

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[2] Vandenberg Space Force Base was formerly called the Vandenberg Air Force Base until a renaming ceremony in May 2021 (Associated Press, 2021).

Table 2-1. Annual Groundwater Pumping by Water Use Sector, Current Period

Water Use Sector	Average	Minimum	Maximum
LACSD	290	250	320
VSFB	670	0	1,800
Agricultural	22,000	22,000	22,200
Rural Domestic	160	160	170
Total[1]	23,100	—	—

Notes

All values in acre-feet.
[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

LACSD = Los Alamos Community Services District

VSFB = Vandenberg Space Force Base

2.2.2 Water Resources Monitoring and Management Programs [§ 354.8(c) and (d)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(c) Identification of existing water resource monitoring and management programs, and description of any such programs the Agency plans to incorporate in its monitoring network or in development of its Plan. The Agency may coordinate with existing water resource monitoring and management programs to incorporate and adopt that program as part of the Plan.

(d) A description of how existing water resource monitoring or management programs may limit operational flexibility in the basin, and how the Plan has been developed to adapt to those limits.

2.2.2.1 Groundwater Level Monitoring

Starting in 2018, the San Antonio Creek Groundwater Availability Project was implemented by the USGS to provide stakeholders with water quality and quantity data to help with effective use of available water resources and planning for the future. As part of this study, the USGS collected groundwater level data on a quarterly basis in over 30 wells in the Basin as part of the ongoing cooperative study that includes Santa Barbara County, and VSFB. In addition, since the fourth quarter of 2019, SABGSA took over the quarterly groundwater level monitoring in the Basin.

Groundwater level monitoring data are gathered from a combination of public and private wells in the Basin. The USGS National Water Information System (NWIS) program, USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program, and the California Statewide Groundwater Elevation Monitoring (CASGEM) program compile the data.

The network of approximately 56 wells (the number may vary)[3] that provide the elevation data are shown on Figure 5-1. A set of representative monitoring sites (RMSs) has been developed for this GSP. These representative sites are depicted and discussed further in Sections 3 and 5.

2.2.2.2 Groundwater Quality Monitoring

Groundwater quality samples have been collected from selected wells in the Basin and analyzed for various studies and programs. The USGS conducts a broad survey of groundwater quality as part of its GAMA Program. For this GSP, historical groundwater quality data from USGS NWIS and the State Water Resources Control Board (SWRCB) GeoTracker GAMA databases were compiled. Groundwater quality data collected as part of the state Irrigated Lands Regulatory Program (ILRP) are stored in the GeoTracker database. According to the GAMA database,[4] drinking water supply wells in the Basin include the LACSD wells, VSFB wells, and a few wells located in Harris Canyon and off Batchelder Road. Water quality data was also obtained for the LACSD wells as part of its Division of Drinking Water (DDW) compliance monitoring program.

This GSP focuses on constituents that relate to beneficial uses of groundwater that might be impacted by groundwater management activities. Groundwater quality information is provided in Section 3.2.3.

2.2.2.3 Surface Water Streamflow Monitoring

The USGS currently measures streamflow at three locations along San Antonio Creek: one upstream of the town of Los Alamos (Los Alamos gage), one where San Antonio Creek leaves the basin (Casmalia gage), and one on a tributary to San Antonio Creek (Harris Canyon Creek gage). The Los Alamos gage has been in operation since 1970; the Casmalia gage was re-activated with funding from a USGS hydrology study in the Basin;[5] the Harris Canyon Creek gage was installed in December 2016.[6] This GSP relies on data from the USGS Basin Characterization Model calibrated to gage data to determine native streamflow for the water budget. More information is available in Section 3.3.

2.2.2.4 Surface Water Quality Monitoring

SWRCB's Surface Water Ambient Monitoring Program (SWAMP) is an ongoing program to assess the effectiveness of SWRCB's and the Central Coast Regional Water Quality Control Board's (RWQCB's) regulatory water quality programs, to provide a statewide picture of the status and trends in surface water quality, and to develop site-specific information in areas that are known or suspected to have water quality problems. The Central Coast Ambient Monitoring Program, underway since 1997, represents the Central Coast Region's participation in the statewide SWAMP. More detailed information on the SWAMP program can be found at the SWRCB website (www.swrcb.ca.gov).

2.2.2.5 Climate Monitoring

Precipitation data has been collected at the Los Alamos Fire station since 1910. Weather data is measured at the Clos Mullet station: ID # KCALOSAL252 located in Los Alamos.

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[3] Access to some wells are negotiated with land owners and can change.
[4] GAMA data are available here: https://www.waterboards.ca.gov/water_issues/programs/gama/online_tools.html. (Accessed April 7, 2021.)
[5] The San Antonio Creek Hydrology Studies are described on the USGS site: https://ca.water.usgs.gov/projects/san-antonio-creek/index.html. (Accessed April 7, 2021.)
[6] The USGS gages are the following: San Antonio Creek at Los Alamos (USGS 11135800 SAN ANTONIO C A LOS ALAMOS CA); San Antonio Creek near Casmalia (USGS 11136100 SAN ANTONIO C NR CASMALIA CA); and Harris Canyon Creek near Orcutt (USGS 11136040 HARRIS CANYON C NR ORCUTT CA).

2.2.2.6 Existing Groundwater Management Plans

Groundwater management planning in the region has historically been conducted by Santa Barbara County. The LACSD conducts infrastructure planning associated with serving the local community. The RWQCB has responsibility for maintaining surface water and groundwater quality in the region (see below).

Water Quality Control Plan for the Central Coast Basin – Planning Elements

The *Water Quality Control Plan for the Central Coast Basin* (Basin Plan) (RWQCB et al., 2017) provides management strategies to ensure that surface water and groundwater in the Central Coast Region are managed to provide the highest possible quality. The Basin Plan includes the following elements:

- The water quality standards that must be maintained for all the water uses in the region
- An implementation plan that describes the programs, projections and other action necessary to achieve the water quality standards
- The existing plans and policies of the SWRCB and the RWQCB that protect water quality
- A description of the monitoring and surveillance programs to support ensuring management of surface and groundwater

The Basin Plan includes recommended actions, requirements, and management principles, including salt source control, to ensure high-quality surface water and groundwater for all beneficial uses. The present and potential future beneficial uses for inland waters listed in the Basin Plan include surface water and groundwater as municipal supply (water for community, military, or individual water supplies); agricultural purposes; groundwater recharge; recreational water contact and non-contact; sport fishing; warm freshwater habitat; wildlife habitat; rare, threatened or endangered species; and spawning, reproduction, and/or early development of fish.

The Basin Plan also describes the existing regulatory monitoring and assessment of point sources of pollution and a program to control nonpoint sources of pollution; the GAMA Program to assess groundwater quality; the Central Coast Ambient Monitoring Program, and the available state, federal, and regional assessments of water quality (see Section 3.2 for a summary of the natural groundwater quality in the Basin).

Santa Barbara County 2019 Groundwater Basins Status Report

The *Santa Barbara County 2019 Groundwater Basins Status Report* (Groundwater Report) (Santa Barbara County, 2019b) describes the conditions of groundwater and status of groundwater basins in Santa Barbara County since the publication of the 2011 *Santa Barbara County Groundwater Report.* The 2019 Groundwater Report provides data and information from state and federal monitoring for water quantity and quality in the wake of the local drought emergency that lasted from 2014 to 2019. Specifically, for each basin in the county, the report discusses basin characteristics and status, provides groundwater levels and hydrographs for selected wells, and describes developments in supplemental supplies and basin management plans.

Santa Barbara County Integrated Regional Water Management Plan

The Santa Barbara County *Integrated Regional Water Management Plan* (IRWMP) (Dudek, 2019), updated in 2019, provides guidance for integrating water management across the region. The IRWMP was updated through a 2-year process that included a broad array of stakeholders and objectives, priorities, and resource management strategies were revisited to respond to the changing conditions in the Region, including increasing vulnerabilities from climate change, and in response to new state-mandated requirements, including SGMA regulations.

The IRWMP integrated 34 selected water management strategies and considered and included an additional eight strategies for the region. The strategies included in the IRWMP that have or will have a role in protecting the region's water supply reliability, water quality, ecosystems, groundwater, and flood management objectives. The integration of these strategies resulted in a list of action items (projects, programs, and studies) needed to implement the IRWMP over the 25-year planning horizon.

No disadvantaged communities (DACs) were identified within the Basin, based on several datasets (refer to the IRWMP (Dudek, 2019); California Air Resources Board's (CARB) California Climate Investments (CCI) Priority Populations online mapping tool[7]; California Office of Environmental Health Hazard Assessment's CalEnviroScreen online mapping tool of Senate Bill 535 DACs[8]; and DWR's DACs online mapping tool[9]).

Los Alamos Community Services District Water Facilities Planning Study

The 2011 LACSD Water Facilities Planning Study describes the land uses and population at the time of publication and analyzes future water demand and infrastructure needs (Bethel, 2011).

2.2.2.7 Existing Groundwater Regulatory Programs

Agricultural Order

In 2017 the Central Coast RWQCB issued Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order) (RWQCB, 2017). The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve surface receiving water quality. Specific requirements for individual growers are structured into three tiers based on the relative risk their operations pose to water quality. Growers must enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they are assigned. All growers are required to implement groundwater monitoring, either individually or as part of a cooperative regional monitoring program. Growers electing to implement individual monitoring (i.e., not participating in the regional monitoring program implemented by the Central Coast Groundwater Coalition or CCGC) are required to test all on-farm domestic wells and the primary irrigation supply well for nitrate or nitrate plus nitrite, and general minerals, including, but not limited to, total dissolved solids (TDS), sodium, chloride and sulfate.

Title 22 Drinking Water Program

The SWRCB DDW regulates public water systems in the state to ensure the delivery of safe drinking water to the public. A public water system is defined as a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, industrial and irrigation wells are not regulated by the DDW.

The County of Santa Barbara has primacy and regulates state small water systems as defined in Chapter 34B Domestic Water Systems (Ordinance No. 12-4843) (Santa Barbara County, 2012). The SWRCB-DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations (CCR) for public water system wells, and all the data collected must be reported to the DDW. Title 22 also designates the regulatory limits (known as maximum contaminant levels [MCLs]) for various waterborne contaminants,

[7] Available at https://webmaps.arb.ca.gov/PriorityPopulations/. (Accessed November 4, 2021.)
[8] Available at https://www.arcgis.com/apps/View/index.html?appid=c3e4e4e1d115468390cf61d9db83efc4. (Accessed November 4, 2021.)
[9] Available at https://gis.water.ca.gov/app/dacs/. Mapped DACs data included Places (2018) and Tracts (2018). (Accessed November 3, 2021.)

including volatile organic compounds, non-volatile synthetic organic compounds, inorganic chemicals, radionuclides, disinfection byproducts, general physical constituents, and other parameters.

Water Quality Control Plan for the Central Coast Basin – Water Quality Requirements

The pollution control actions required by, and best management practices recommended by, the SWRCB and the RWQCB are described in the Basin Plan (RWQCB et al., 2017). The plans and policies of the SWRCB for managing water quality are listed in Section 5 and included as appendices to the Basin Plan. Key policies that affect the management of surface water and groundwater in the Basin include the State Policy for Water Quality Control, Sources of Drinking Water Policy, and the Nonpoint Source Management Plan. Discharge prohibitions outlined in the Basin Plan include regulations for groundwaters, salt discharge, and other discharge requirements. Best management practices recommended in the Basin Plan include source controls that prevent a discharge or threatened discharge and treatment controls that remove pollutants from a discharge before it reaches surface water or groundwater.

The Basin Plan also lists the thresholds for Total Maximum Daily Loads (TMDLs) for waterbodies covered by the plan. A nitrate TMDL was developed for San Antonio Creek by the RWQCB because of exceedances of nitrate surface water Basin Plan standards. During the development of the TMDL, a subsurface discharge from an agricultural source was identified and eliminated and subsequent sampling and analysis indicated that San Antonio Creek was no longer impaired due to high nitrate concentrations. Development of the TMDL was continued in the event that other sources contribute to nitrate impairment (Central Coast RWQCB, 2015).[10]

2.2.2.8 Conjunctive Use Programs [§ 354.8(e)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(e) A description of conjunctive use programs in the basin.

The Basin does not have a conjunctive use program.

[10] The TMDL also addresses exceedances of unionized ammonia and low dissolved oxygen levels, but the focus is nitrate.

2.2.3 Land Use and General Plans Summary [§ 354.8(f)(1),(f)(2), and (f)(3)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:

(1) A summary of general plans and other land use plans governing the basin.

(2) A general description of how implementation of existing land use plans may change water demands within the basin or affect the ability of the Agency to achieve sustainable groundwater management over the planning and implementation horizon, and how the Plan addresses those potential effects.

(3) A general description of how implementation of the Plan may affect the water supply assumptions of relevant land use plans over the planning and implementation horizon.

Land use planning authority in the Basin is the responsibility of the Santa Barbara County. The *Santa Barbara County Comprehensive Plan* (2016) includes the following elements that have a bearing on water quantity or quality:

- A land use element that outlines the distribution of real estate, open space and agricultural land, mineral resources, recreational facilities, schools, and waste facilities
- A conservation element[11] that addresses the conservation, development, and use of natural resources including water, forests, soils, rivers, and mineral deposits
- Community and specific plans for municipalities and more urban areas to provide goals, policies, and standards to guide community development
- An open space element that details plans and measures for preserving open space for natural resources, outdoor recreation, public health and safety, and agriculture

Land uses in the Santa Barbara County Comprehensive Plan are designated by the Santa Barbara County Board of Supervisors and include the following:

- Agriculture
- Mineral Resource Industry
- Oil/Petroleum Resource Industry
- Mineral Resource Area
- Utility-Scale Solar Photovoltaic Facility
- Waste Disposal Facility
- Incorporated City

[11] Various studies indicate slight to moderate levels of overdraft in several groundwater basins within the County and substantial overdraft in one basin (Santa Barbara County, 2019b). The goals and policies in the Santa Barbara County Comprehensive Plan (2016), Conservation Element, Groundwater Resources Section were developed to protect local groundwater.

- Unincorporated Urban Area
- VSFB
- Los Padres National Forest

Land uses in the Basin are primarily agricultural (USGS, 2020e; Santa Barbara County, 2020). Of note, in 2019 the Santa Barbara County Board of Supervisors placed a limit on outdoor cannabis cultivation in the unincorporated areas of the County outside the Carpinteria Agricultural Overlay District County to no more than 1,575 acres (Santa Barbara County Code § 50-7) and requires a special land use permit. VSFB land surrounds Barka Slough to the west. There are some small areas of petroleum production (Dudek, 2019). In the central portion of the Basin, the Los Alamos Community Plan, developed by Santa Barbara County and last updated in 2011, governs community development for the 1 square mile of residential, commercial, and recreational land uses in the unincorporated community (Census Bureau, 2010; Santa Barbara County, 2011).

2.2.3.1 How Land Use Plans May Impact Water Demands and Sustainable Groundwater Management

As mentioned, agriculture is the overwhelmingly predominant land use in the Basin. The rate of growth of planted acreage in the Basin has slowed in the last two decades to approximately 0.2 percent annually. Total municipal demand in the Basin is expected to decrease slightly from the historical period due to State Water Project (SWP) deliveries being allocated to VSFB starting in 1997 through the Central Coast Water Authority. Rural domestic demand is expected to increase by approximately 57 percent compared to the historical period. Section 3.3.5 discusses the projected water budget in greater detail.

Santa Barbara County Public Health Department has authority to issue permits for new wells. This is a ministerial permit and does not require approval from SABGSA. Installation of new wells used to irrigate additional lands in the basin will likely become an issue because there presently is a substantial annual deficit of groundwater in storage that this GSP is focused on addressing. In addition, Santa Barbara County Land Use Planning Department has not placed limits on growth that would increase demand for water.

2.2.3.2 How Sustainable Groundwater Management May Affect Water Supply Assumptions

Historical, current, and projected groundwater budgets are presented in Section 3.3. Groundwater budget components include natural and anthropogenic sources of recharge and discharge from the Basin. Projects and management actions implemented by the SABGSA to mitigate water supply deficit or future drought conditions are discussed in Section 6.

2.2.3.3 Existing Well Types, Numbers, Density [§ 354.8(f)(4)]

There are several different well types in the basin including agricultural, municipal, and domestic wells. Figures 2-2, 2-3, and 2-4 present the number and density of agricultural, municipal, and domestic wells in the Basin based on available data from DWR. The location and status (active, inactive, destroyed) of the wells shown on the maps have not been verified.

The Santa Barbara County Public Health Department's Environmental Health Services Division requires a Water Well Permit for all new and replacement wells and for modifications to wells, such as deepening, replacement or repairs. A permit application and map must be submitted describing the proposed location, construction, and intended use of the well. An Environmental Health Services representative reviews the application and conducts a site inspection before issuance of a permit can occur. Standards for well construction are set forth in Santa Barbara County Code § 34A-12. Once the well construction or replacement is completed, the property owner or well driller must provide a copy of the completed well log to Environmental Health Services.

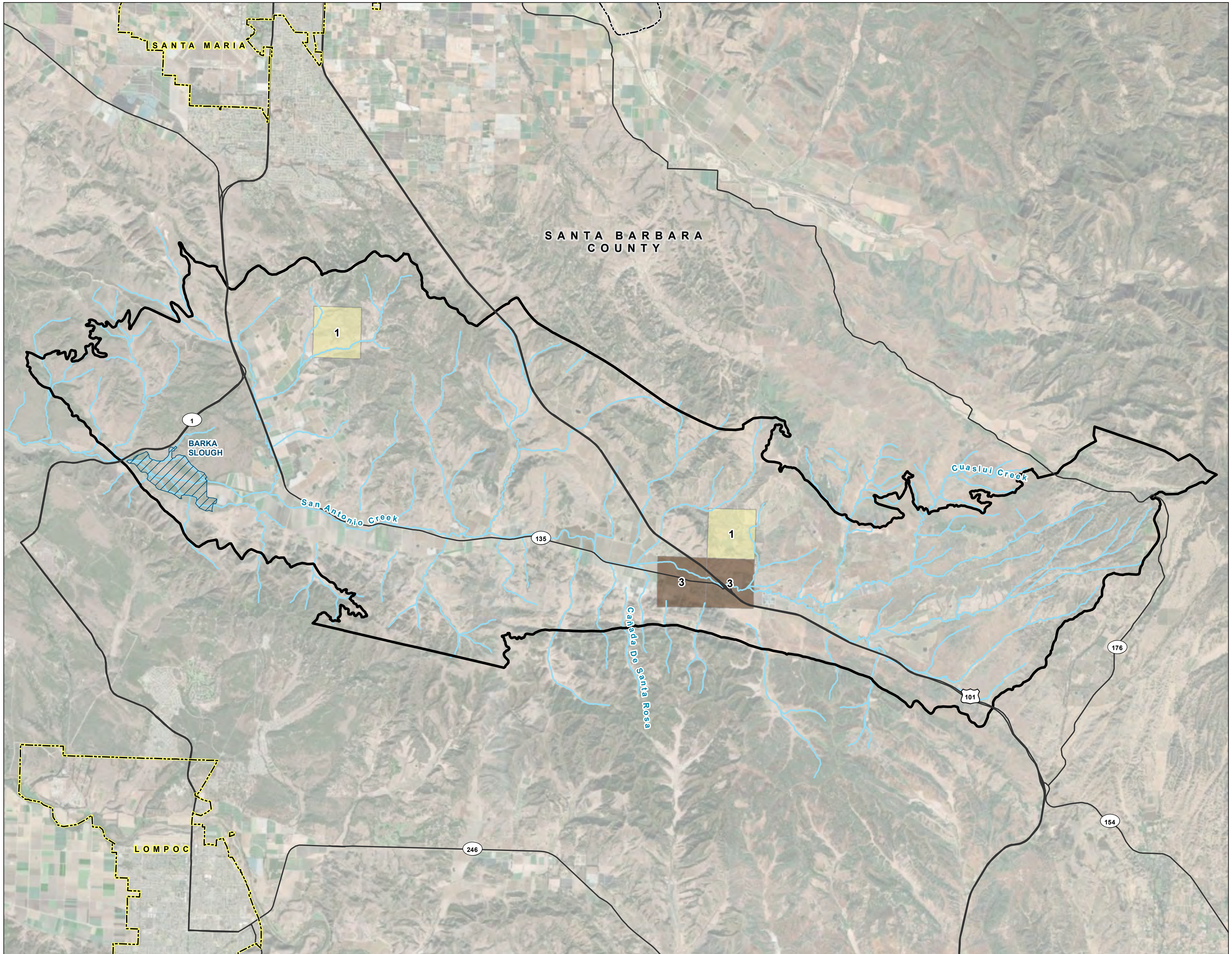


FIGURE 2-2

San Antonio Creek Valley Groundwater Basin Well Density Map - Municipal Wells

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Municipal Well Count by Section

- 1
- 2 - 3

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent

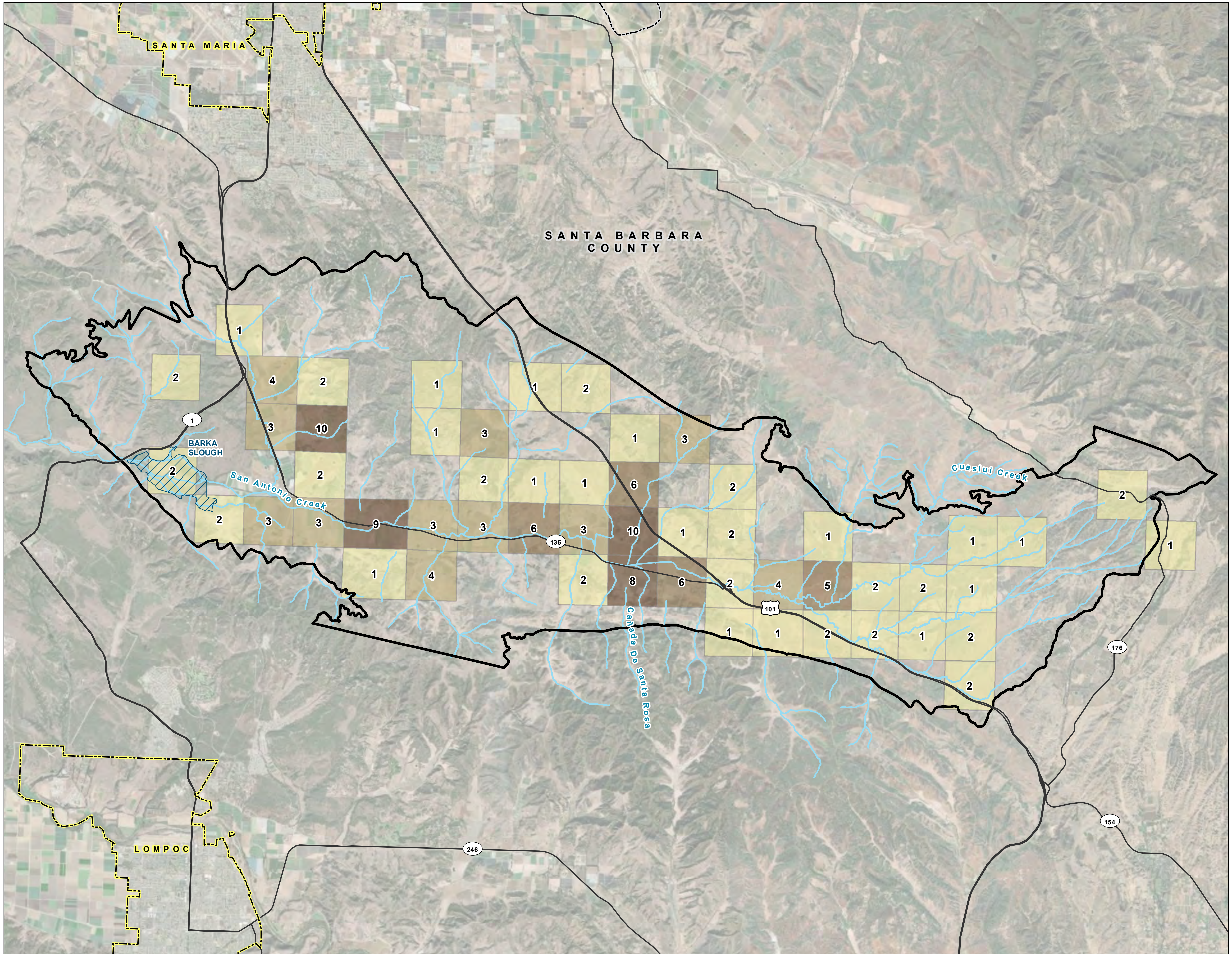
Date: November 3, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

FIGURE 2-3

Well Density Map - Agricultural Wells

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



LEGEND

Agricultural Well Count by Section

- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 10

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent

N

0 5,000 10,000 15,000
Feet

Date: November 3, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section2\Figure2_3_San_Antonio_Creek_Valley_GW_Basin_Well_Density_Ag.mxd, abarry

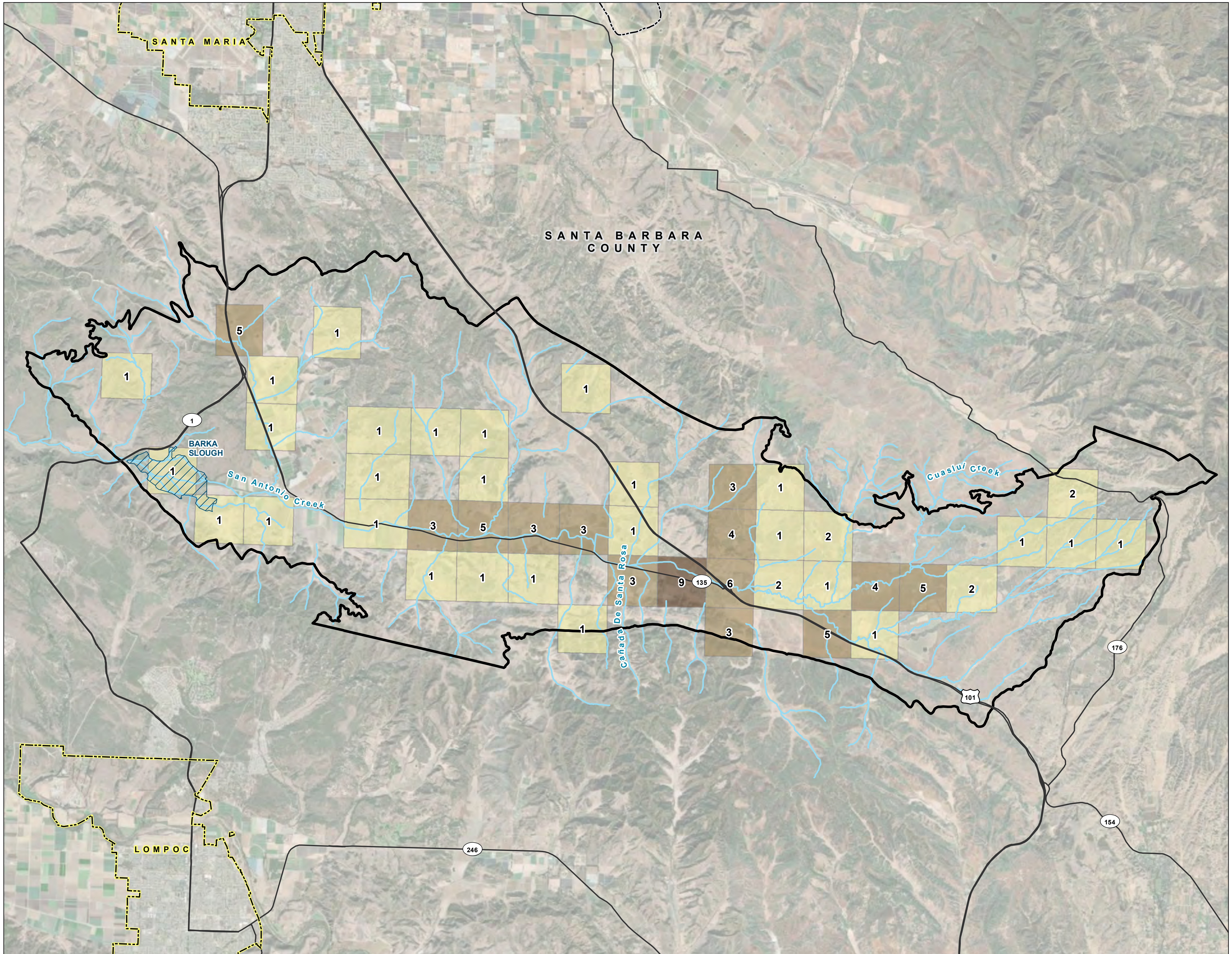


FIGURE 2-4

San Antonio Creek Valley Groundwater Basin Well Density Map - Domestic Wells

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Domestic Well Count by Section

- 1 - 2
- 3 - 6
- 7 - 9

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent

Date: November 15, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section2\Figure2_4_San_Antonio_Creek_Valley_GW_Basin_Well_Density_Dom.mxd, abarry

2.2.3.4 Impact of Land Use Plans Outside of Basin on Sustainable Groundwater Management [§ 354.8(f)(5)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(f) A plain language description of the land use elements or topic categories of applicable general plans that includes the following:

(5) To the extent known, the Agency may include information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management.

There are no additional land use plans outside of the Basin that impact groundwater management other than those described in Section 2.2.4. VSFB is exempt from SGMA and operates wells within the Basin when its allocation of SWP water has been interrupted. VSFB has developed a plan that proposes pumping an additional 1,000 acre-feet per year of groundwater from the Basin to serve several proposed golf courses (AECOM, 2019). This plan is presently under review by the California Coastal Commission and is following the guidelines of the National Environmental Policy Act. SABGSA has been tracking this process and intends to provide comments when appropriate.

2.2.4 Additional Plan Elements [§ 354.8(g)]

§ 354.8 Description of Plan Area. Each Plan shall include a description of the geographic areas covered, including the following information:

(g) A description of any of the additional Plan elements included in Water Code Section 10727.4 that the Agency determines to be appropriate.

Additional plan elements, appearing in the other sections of the GSP, discuss elements that have bearing on this GSP (see Section 4, Sustainable Management Criteria; Section 5, Monitoring Networks; and Section 6, Projects and Management Actions). These additional elements include the following:

- Migration of contaminated groundwater
- Well construction
- Measures addressing groundwater contamination, groundwater recharge, in lieu use, diversions to storage, conservation, and water recycling
- Efficient water management practices and water conservation methods to improve the efficiency of water use
- Efforts to develop relationships with state and federal regulatory agencies
- Efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity
- Impacts on groundwater-dependent ecosystems (GDEs)

2.3 Notice and Communication [§ 354.10]

2.3.1 Beneficial Uses and Users [§ 354.10(a)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.

The primary groundwater uses in the Basin include municipal, agricultural, and rural residential. Groundwater use also includes environmental use (such as GDEs). Municipal, domestic, and agricultural demands in the Basin currently rely entirely on groundwater. Agricultural and rural residential water demand is met from wells completed in both principal aquifers (the Paso Robles Formation and Careaga Sand). LACSD pumps exclusively from the Paso Robles Formation. The VSFB wellfield pumps exclusively from the Careaga Sand. There is reportedly no pumping from the shallow alluvial deposits that underlie San Antonio Creek. Refer to Section 3.1 for additional description of the principal aquifers. GDEs identified in the Basin are located in Barka Slough and are dependent on both surface water entering the Slough and groundwater upwelling into the Slough from the underlying Careaga Sand (see Section 3.2.6 for a description of GDE identification and Figure 3-31 for a conceptualized surface water and groundwater discharge into Barka Slough). No managed wetlands were identied in the Basin.

The SABGSA created an Advisory Committee representing many of the stakeholders and basin water users described above. Members of this group provide meaningful insight, support, and expertise from a variety of viewpoints for the SABGSA Board of Directors (the Board) to consider. The Advisory Committee is strictly advisory and does not vote on Board items, but members represent a number of social, cultural, and economic backgrounds to bring the widest possible perspective.

Potential committee members were identified through local outreach, word of mouth, and email to the stakeholder list. The qualifications of the candidates were reviewed, and the Stakeholder Advisory Committee (SAC) members were selected by the Board. The selected representatives reflect the interests of their group and are able to effectively communicate the group's opinions and feedback. The Advisory Committee is made up of the following committee representatives with up to 9 members each:

- County of Santa Barbara
- VSFB
- Environmental interests
- Agricultural interests
- Domestic water users

The members of the Advisory Committee were responsible for reviewing drafts of the various sections of the GSP, providing feedback on those drafts, reviewing presentations that were delivered during workshops and Board meetings, and soliciting input from their respective stakeholders as the plan was being developed.

The SABGSA Executive Director facilitated the Advisory Committee meetings; prepared agendas for the meetings; compiled questions, comments, and responses to comments made in the Advisory Committee meetings; prepared supporting materials; and maintained the SABGSA website.

2.3.2 Public Meetings [§ 354.10(b)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(b) A list of public meetings at which the Plan was discussed or considered by the Agency.

Opportunities for public comment are provided at all SABGSA Board meetings, Advisory Committee meetings, and workshops. Meetings are also an opportunity for stakeholders to stay informed about what is happening with the SABGSA and the GSP process. For each public meeting at which sections of the GSP were discussed or considered, notices were distributed to member agencies, interested parties, and stakeholders via email communication and website postings. Additionally, prior to the COVID-19 pandemic, meeting notices were publicly posted at the LACSD office and the CRCD office at least 72 hours prior to each meeting. During the statewide stay-at-home order issued in March 2020 in response to the COVID-19 pandemic,[12] all postings were made online as offices were closed to the public. SABGSA also provided notices for all public meetings, including the agenda and presentations on its website. Email notifications of meetings were also sent to interested parties, the SABGSA Board, and the Advisory Committee. (See Section 2.3.4.2 for more information on public outreach.) The SABGSA Board met on the third Tuesday of each month at 6 p.m., unless otherwise noticed. During the COVID-19 pandemic, all Board meetings and Advisory Committee meetings were held virtually. In-person meetings, when conducted, took place at the LACSD office. All agendas and meeting minutes from past meetings are available on the SABGSA website.

[12] Information about the order and subsequent amendments is available at California COVID-19 information website: https://covid19.ca.gov/stay-home-except-for-essential-needs/. (Accessed June 9, 2020.)

As of this writing in early November 2021, the public meetings at which the GSP was discussed or considered include the following:

Advisory Committee Meetings	SABGSA Board of Directors Meetings
June 5, 2018	July 17, 2018
July 10, 2018	March 17, 2020
November 6, 2018	April 21, 2020
February 5, 2019	May 19, 2020
October 1, 2019	July 21, 2020
March 3, 2020	October 20, 2020
November 3, 2020	November 17, 2020
July 7, 2020	January 19, 2021
December 1, 2020	February 16, 2021
February 2, 2021	March 16, 2021
May 4, 2021	April 20, 2021
July 6, 2021	May 18, 2021
August 3, 2021	June 15, 2021
September 14, 2021	July 13, 2021
October 5, 2021	August 17, 2021
November 2, 2021	September 21, 2021
	October 19, 2021
	November 16, 2021

In addition, the following upcoming SABGSA Board of Directors meetings are anticipated to include discussions of GSP elements:

Upcoming SABGSA Board of Directors Meetings
December 21, 2021

One in-person public workshop was held during development of the GSP to update stakeholders on the GSP progress and to solicit input on the water budget, sustainability criteria, and minimum thresholds. Additional public workshops would have been held had there not been the COVID-19 pandemic. The public workshop was held to discuss elements of the GSP as follows:

Public Workshops
July 28, 2021 – SGMA and sustainable management criteria
October 14, 2021 – SGMA and Projects and Management Actions

2.3.3 Public Comments [§ 354.10(c)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.

The SABGSA is committed to frequent and transparent communication with stakeholders and interested parties. During the Plan's development and after release of the public draft, public comments were received through the Groundwater Communication Portal, letters, and email. These comments were distributed to the SABGSA Board and consultant team for consideration as the GSP was developed. The comments were combined into a table and responses to the comments were also noted in the table with reference to where in the GSP the comment was addressed (see Appendix B). This information was formatted in a manner that could be included with the GSP document and uploaded to the DWR SGMA portal.

2.3.4 Communication [§ 354.10(d)]

2.3.4.1 Decision-Making Process [§ 354.10(d)(1)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(d) A communication section of the Plan that includes the following:

(1) An explanation of the Agency's decision-making process.

Outreach Roles

SABGSA Board of Directors. The Board, which comprises eight appointed members, make the ultimate decisions regarding how the groundwater basin will be managed and how the management actions described in the GSP will be financed. The two member agencies are LACSD and the SABWD. The final GSP will be adopted by the Board of Directors. As required by the 2017 JPA that created the SABGSA, the Board will consider the recommendations of the Advisory Committee (described below). The Board typically meets on the third Tuesday of the month at the LACSD office at 6:00 p.m. The Board is responsible for the following outreach activities:

- Adopting and overseeing implementation of the Stakeholder Communication and Engagement Plan.
- Receiving public comments made in writing and verbally at Board meetings and public hearings.
- Considering the recommendations of the Advisory Committee.

GSP Advisory Committee. Advisory Committee meetings are typically the first Tuesday of the month at the LACSD office (or online during the COVID stay-at-home order) at 1:30 p.m. The GSP Advisory Committee, which is made up of members appointed by the Board, spent time becoming familiar with issues related to the GSP. The Advisory Committee is charged with developing recommendations on GSP-related issues and incorporating the community and stakeholder interests into these recommendations. This charge was carried out through various venues and a variety of activities, but generally included the following:

- Actively seeking input from the represented public and stakeholder groups on issues before the SABGSA.
- Sharing input and feedback with the full Advisory Committee at Advisory Committee meetings.
- Making recommendations to the Board.

Executive Director. The executive director is considered SABGSA staff and was available to provide information about GSA and the GSP status. The SABGSA's executive director is Anna Olsen, and she may be reached by email at aolsen@sanantoniobasingsa.org, or by telephone at 805-868-4013. The Board, the Advisory Committee, and staff are committed to keeping the public informed; providing balanced and objective information to assist the public in understanding SGMA and the available options and recommendations; and creating an open process for public input on the development and implementation of the GSP. When evaluating the options and making decisions, the Board, Advisory Committee, and staff solicited public input through a variety of methods, including public workshops, written and verbal comments, meetings with stakeholder organizations, and community events. Input was also received during public comment periods at Advisory Committee and Board meetings and in writing. As posted on all Board and Advisory Committee meeting agendas, comments made in writing were also submitted directly to the SABGSA's executive director at aolsen@sanantoniobasingsa.org.

2.3.4.2 Public Engagement [§ 354.10(d)(2) and (d)(3)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(d) A communication section of the Plan that includes the following:

(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.

(3) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.

Outreach Methods

The communication and engagement plan (see Appendix C) describes the approach that was taken for outreach. Outreach methods included facilitating the public's access to information and documents through the SABGSA's website and email distribution list, as well as making information available, where needed, in hard copy form. For instance, SABGSA used already-established outreach venues in the Basin's predominantly rural, agricultural community, such as community posting locations for placement and/or distribution of informational materials (e.g., flyers or posters). Locations for posting of materials included LACSD, CRCD, Los Alamos Public Library, and the Los Alamos Post Office. Public meetings and project information were disseminated through email or direct mail, as requested. This communication provided information for the Basin community, public agencies, and other interested persons/organizations about milestones, meetings, and the progress of GSP development. The SABGSA would have invited participation of federally recognized Indian tribes sharing the interest of sustainability of the groundwater agency, as required by SGMA, but there are no federally recognized tribes within the Basin. Some of the outreach methods employed for this project are described below.

1. Public Notices. To ensure that the general public is apprised of local activities and allow stakeholders to access information, SGMA specifies several public notice requirements for GSAs. All meetings, hearings, and workshops were noticed in compliance with the Ralph M. Brown Act.13 As outlined below, there were a variety of opportunities for people to participate in the development and implementation of the GSP, including workshops, public hearings, providing comments at Board of Director and Advisory Committee meetings, and through written comments.

In addition to open meeting requirements, three sections of the California Water Code require public notice before establishing a GSA, adopting (or amending) a GSP, or imposing or increasing fees:

- Section 10723(b). "Before electing to be a groundwater sustainability agency, and after publication of notice pursuant to § 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin." In accordance with California Water Code § 10723(b), the following occurred: on May 10 and May 16, 2017, at the duly noticed public meetings of the LACSD and the CRCD, respectively, the two agencies approved the JPA creating the GSA. On June 14, 2017, SABGSA held a noticed public hearing to consider becoming a GSA for the San Antonio Basin and voted to become such a GSA. The June 14, 2017, public hearing was noticed in the *Santa Maria Times* in accordance with Government Code § 6066.
- Section 10728.4. "A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. …"
- Section 10730(b)(1). "Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting.…(3) At least 10 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based."

2. Public Meetings/Hearings. Stakeholder involvement included regularly scheduled public meetings of the Board, Advisory Committee meetings, and workshops to provide input during development of the GSP. In addition to signing up to receive information about GSP development at the SABGSA webpage, interested parties participated in the development of the GSP by attending and participating in public meetings (Water Code § 10727.8[a]). Public meetings or hearings are formal opportunities for people to provide official comments on programs, plans, and proposals. During development of the GSP, topics associated with each chapter were presented at various Board meetings to keep the Board and public informed about the progress of the GSP and to obtain input as the GSP was being prepared. Each meeting had a scheduled time for public comments. Information about the meetings can be found on the SABGSA website: sanantoniobasingsa.org.

3. Stakeholder Briefings. Regular meetings of the Advisory Committee facilitated technical review of GSP progress and allowed for increased opportunity for discussion and input. Advisory Committee members met with and communicated regularly with organizations made up of the stakeholder groups they represent. To

13 Brown Act requirements are provided on a website dedicated to the act: https://firstamendmentcoalition.org/facs-brown-act-primer/. (Accessed June 9, 2021.)

facilitate cohesive communication and messaging, all briefings were coordinated with SABGSA staff. All meetings are open to the public and stakeholder groups.

4. Public Input. Meetings were also held as GSP elements were being developed and served as opportunities for public input. Public educational meetings provide informal opportunities for people to learn about groundwater, SGMA, and GSP elements. Meetings included traditional presentations with facilitated question-and-answer sessions. Community meetings (i.e., workshops, Board meetings) were conducted for key stakeholders where project experts shared educational information by topic, clarified technical data and issues, and offered opportunities for public questions and input. The timing and precise format of public workshops were informed by the key issues that arose and by the input received during early stages of GSP development.

Multiple meetings were held in coordination with the following milestones/tasks:

- Preparation of the hydrogeologic conceptual model and draft groundwater conditions section of the GSP.
- Preparation of the Basin water budget.
- Establishment of Basin sustainability criteria.
- Establishment of monitoring objectives and a monitoring network.
- Identification and prioritization of projects and management actions.
- Draft GSP implementation.
- GSP draft document.

5. Briefings for the JPA Member Agencies. The CRCD (www.rcdsantabarbara.org) and LACSD (www.losalamoscsd.com) staff provided briefings to their respective board of directors regularly on GSA activities.

6. Website. The SABGSA website houses information about SGMA, the GSP process, Board, Advisory Committee, public meetings, project reports and studies, and groundwater data and information. The project website, sanantoniobasingsa.org is a tool for distributing and archiving meeting and communication materials as well as a repository for studies and other documents. Staff updated the website at least monthly, and more often when needed.

7. Email/Direct Mailings. Public meeting notices and other information were disseminated through email, from the SABGSA office, or via direct mail under special circumstances and/or if requested. This communication provided information for the community, public agencies, and other interested persons/organizations about milestones, meetings, and the progress of GSP development. A basin stakeholder list was developed from a number of sources, including lists of City government representatives, members of environmental groups, and state and county agencies. Those on the email list received news and updates about the GSP process and details about stakeholder forums and workshops. A total of 141 individuals registered to receive emails through this distribution list. Additional opportunities were sought during development of the GSP to grow and expand the email subscription list and the type of information distributed.

2.3.4.3 Progress Updates [§ 354.10(d)(4)]

§ 354.10 Notice and Communication. Each Plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

(d) A communication section of the Plan that includes the following:

(4) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.

Plan Progress Evaluation

The methods that will be used to inform the public, including key stakeholder groups, about progress implementing the Plan and to determine the level of success of the Community Engagement Plan include Board meetings, annual reports, and plan updates. Information about implementation, monitoring results, and the status of projects and management actions will also be posted on the SABGSA website.

SABGSA Board Meetings. Information pertaining to implementation of the GSP will be presented at regularly scheduled Board meetings. These meetings will be publicly noticed as was done during GSP development. The public will have an opportunity to provide comment on the progress. A record of those attending public meetings will be maintained during GSP implementation. SABGSA will use sign-in sheets and request feedback from attendees to determine adequacy of public education and productive engagement in the GSP implementation process. Meeting minutes will also be prepared and will be provided on the SABGSA website once approved.

Annual Reports. Information pertaining to GSP implementation and monitoring program will be presented in an annual report submitted to the Board and DWR. This information will be made available to the public and a summary presentation will be given at annual Board meetings.

Plan Update. The GSP will be reviewed and updated every 5 years. The updates will include review of progress made in achieving the sustainability goal, progress toward reaching interim milestones, and recommendations for any changes to the Plan. The draft updates will be discussed with stakeholders during a public meeting before submitting to DWR.

2.4 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

AECOM. 2019. *Potential Effects to California Red-legged Frog, El Segundo Blue Butterfly, Tidewater Goby, Unarmored Threespine Stickleback, and Beach Layia.* Prepared by AECOM Technical Services, Inc. Prepared for the Vandenberg Air Force Base.

Associated Press. 2021. "Vandenberg Air Force Base to Be Renamed Space Force Base." U.S. News & World Report website. Available at https://www.usnews.com/news/best-states/california/articles/2021-05-14/vandenberg-air-force-base-to-be-renamed-as-space-force-base. (Accessed July 2, 2021.)

Bethel. 2011. *Los Alamos Community Services District Water Facilities Planning Study.* Prepared by Bethel Engineering.

Central Coast RWQCB. 2015. *Total Maximum Daily Loads for Nitrate in Streams of the San Antonio Creek Watershed, Santa Barbara County, California.* Prepared by the Central Coast Regional Water Quality Control Board.

Census Bureau. 2010. *2010 Census U.S. Gazetteer Files – Places – California.* Published by the U.S. Census Bureau. Available at https://www2.census.gov/geo/docs/maps-data/data/gazetteer/2010_place_list_06.txt.

Dudek. 2019. *Santa Barbara County Integrated Regional Water Management Plan, Update 2019.* Prepared for the Santa Barbara County IRWM Cooperating Partners.

DWR. 2018. *Bulletin 118 Description for 3-014 San Antonio Creek Valley.* Prepared by the California Department of Water Resources.

Muir, K. 1964. *Geology and Ground-Water of San Antonio Creek Valley, Santa Barbara County, California.* U.S. Geological Survey Water-Supply Paper 1664, 53 p.

RWQCB. 2017. Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. Central Coast Regional Water Quality Control Board.

RWQCB et al. 2017. *Water Quality Control Plan for the Central Coast Basin.* Prepared by the Regional Water Quality Control Board, Central Coast Region, State Water Resources Control Board, and California Environmental Protection Agency.

SABGSA. 2020. Re: San Antonio Basin Groundwater Sustainability Agency Notice of Non-Material Change to GSA Notification. May 28, 2020, Letter from the San Antonio Basin Groundwater Sustainability Agency (SABGSA) Executive Director.

Santa Barbara County. 2011. *Los Alamos Community Plan.* Prepared by the Santa Barbara County Planning and Development Department.

Santa Barbara County. 2012. *Ordinance Amending County Code Chapter 34B - Domestic Water Systems, No. 12-4843.* Board of Supervisors of the County of Santa Barbara.

Santa Barbara County. 2016. *Santa Barbara County Comprehensive Plan.* Adopted 1980, Amended December 2016. Prepared by the County of Santa Barbara.

Santa Barbara County. 2019a. *Santa Barbara County Airport Land Use Compatibility Plan Update.* Prepared by the Santa Barbara County Association of Governments.

Santa Barbara County. 2019b. *Santa Barbara County 2019 Groundwater Basins Status Report.* Prepared by the Santa Barbara County Public Works Department Water Resources Division, Water Agency.

SECTION 3: **Basin Setting [Article 5, Subarticle 2]**

§ 354.12 Introduction to Basin Setting. This Subarticle describes the information about the physical setting and characteristics of the basin and current conditions of the basin that shall be part of each Plan, including the identification of data gaps and levels of uncertainty, which comprise the basin setting that serves as the basis for defining and assessing reasonable sustainable management criteria and projects and management actions. Information provided pursuant to this Subarticle shall be prepared by or under the direction of a professional geologist or professional engineer.

3.1 Hydrogeologic Conceptual Model [§ 354.14]

§ 354.14 Hydrogeological Conceptual Model.

(a) Each Plan shall include a descriptive hydrogeologic conceptual model of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.

This section describes the hydrogeologic conceptual model of the San Antonio Creek Valley Groundwater Basin (Basin), identified in the California Department of Water Resources (DWR) Bulletin 118[14] as groundwater basin 3-014. This section describes the boundaries, geologic formations and structures, and principal aquifer units of the Basin. The section also summarizes general basin water quality, the conceptual interaction between groundwater and surface water, and generalized groundwater recharge and discharge areas. This section draws upon previously published studies, primarily hydrogeologic and geologic investigations by the U.S. Geological Survey (USGS) in cooperation with the Santa Barbara County Water Agency (Muir, 1964) and by the USGS in cooperation with the Vandenberg Air Force Base (now called Vandenberg Space Force Base [VSFB]) (Hutchinson, 1980) (Mallory, 1980). Subsequent geologic and hydrogeologic investigations and development of a two-dimensional groundwater model (Martin, 1985), relied upon original geologic interpretations (Muir, 1964; Hutchinson, 1980; Mallory, 1980) with the exception of the basin boundaries that are defined in accordance with Bulletin 118 (DWR, 2003; DWR, 2016a). The hydrogeologic conceptual model presented in this section is a summary of aspects of the basin hydrogeology that influence groundwater sustainability based on available information. Understanding of the Basin will be adapted as hydrogeology is better understood in the future. Detailed information can be found in the original reports (Muir, 1964; Hutchinson, 1980; Mallory, 1980). This section, with Section 2.2, sets the framework for subsequent sections on groundwater conditions (Section 3.2) and the water budget (Section 3.3).

[14] Developed and distributed by the California Department of Water Resources Sustainable Groundwater Management Office, California's Groundwater (Bulletin 118) is the State's official publication on the occurrence and nature of groundwater in California. The publication defines the boundaries and describes the hydrologic characteristics of California's groundwater basins and provides information on groundwater management and recommendations for the future.

3.1.1 Regional Hydrology

3.1.1.1 Topography and Watershed Boundary [§ 354.14(d)(1)]

§ 354.14 Hydrogeological Conceptual Model.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(1) Topographic information derived from the U.S. Geological Survey or another reliable source.

The basin watershed includes an area of approximately 123 square miles (USGS, 2020a). The watershed is long and narrow, approximately 30 miles long and 7 miles wide, and is structurally controlled by an underlying northwest-trending synclinal trough (resulting from folding of the rock units), referred to as the Los Alamos Syncline. Topographical highs within the Basin occur at an elevation of approximately 1,200 feet (ft) above mean sea level (amsl) along the ridges that define the northern (Casmalia Hills and Solomon Hills) and southern (Purisima Hills and Burton Mesa) basin boundaries. Topographical lows of the Basin occur along the relatively flat and narrow valley floor, coincident with the axis of the Los Alamos Syncline. Ground surface elevations along the valley floor occur at elevations ranging from approximately 800 ft amsl to the east to 250 ft amsl at the western edge of Barka Slough (Slough) (Hutchinson, 1980).

Figure 3-1 shows the topography of the Basin using 40-ft contour intervals. The Basin boundary is controlled by the outcropping of bedrock of the Los Alamos Syncline.

The Basin watershed lateral boundaries are as follows:

- The western boundary of the Basin is defined by a bedrock ridge underlying the western edge of the Barka Slough. This bedrock ridge results in no groundwater movement to the west. West of the bedrock ridge is San Antonio Valley.
- The northern boundary of the Basin is defined by the topographic divide of the Casmalia and Solomon Hills. This boundary is formed by low-permeability bedrock that crops out at ground surface.
- The eastern boundary of the Basin is defined by the topographic divide of the San Rafael Mountains.
- The southern boundary is defined by the topographic divide of the Purisima Hills. This boundary is formed by low-permeability bedrock that crops out at ground surface.

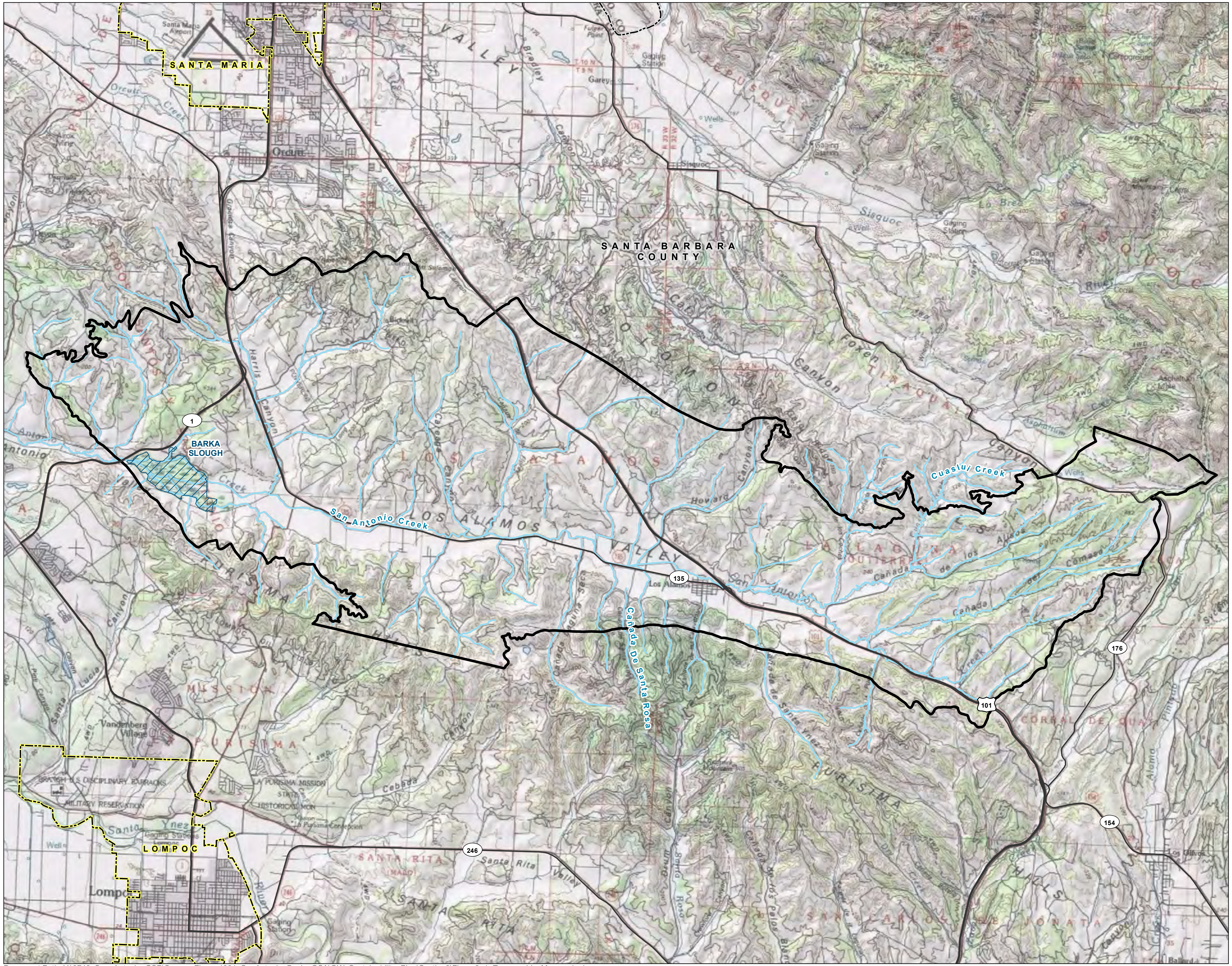


FIGURE 3-1

Topographic Map of the San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

San Antonio Creek or Adjacent Tributary

Barka Slough

San Antonio Creek Valley Groundwater Basin

All Other Features

County Boundary

City Boundary

Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000

Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: NGS (2013), USGS (2020b), ESRI, DWR (2018a)

3.1.1.2 Soil Types

Soil data from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service Soil Survey Geographic Database (SSURGO) (USDA, 2020) are shown in the four hydrologic groups on Figure 3-2.

The soil hydrologic groups shown on Figure 3-2 are determined by the water-transmitting properties of the soil, which include hydraulic conductivity and percentage of clays in the soil relative to sands and gravels. The hydrologic soil group is "determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to any layer that is more or less water impermeable or depth to a water table" (USDA, 2007). Saturated hydraulic conductivity of surficial soils is a good indicator of the soil's infiltration potential. The soil hydrologic groups are defined (based on characteristics within 100 centimeters (40 inches) of the surface) as the following:

- **Group A – High Infiltration Rate:** soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
- **Group B – Moderate Infiltration Rate:** soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
- **Group C – Slow Infiltration Rate:** soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
- **Group D – Very Slow Infiltration Rate:** soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material.

The soil hydrologic group generally correlates with the hydraulic conductivity of underlying geologic units, with lower soil hydraulic conductivity zones correlating to areas underlain by clayey portions of the Paso Robles Formation. The higher soil hydraulic conductivity zones correspond to areas underlain by alluvium or areas of coarser sediments within the Paso Robles Formation or Careaga Sand. The Paso Robles Formation and Careaga Sand are discussed in more detail in Sections 3.1.2 and 3.1.3.

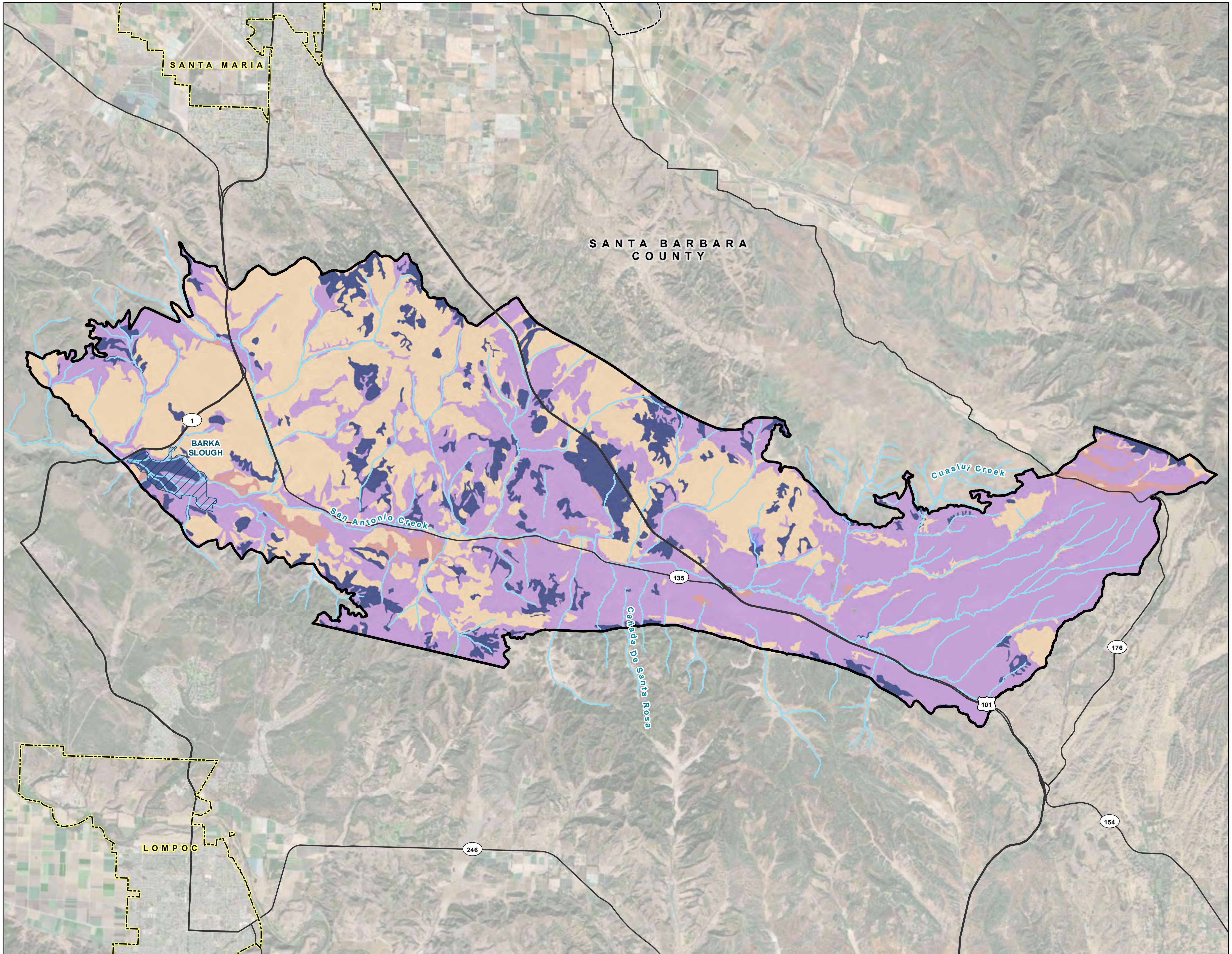


FIGURE 3-2

Hydrologic Soil Groups of the San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Hydrologic Soil Rating

- A
- B
- C
- C/D
- D

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

1. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.
2. **Hydrologic Soil Groups**
Group A. water transmitted freely through the soil; soils typically less than 10% clay and more than 90% sand or gravel.
Group B. water transmission through the soil is unimpeded; soils typically have between 10 and 20% clay and 50 to 90% sand.
Group C. water transmission through the soil is somewhat restricted; soils typically have between 20 and 40% clay and less than 50% sand.
Group D. water movement through the soil is restricted or very restricted; soil typically has greater than 40% clay, less than 50% sand.
If soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USDA (2020), USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

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3.1.1.3 Surface Water Bodies [§ 354.14(d)(5)]

§ 354.14 Hydrogeological Conceptual Model.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(5) Surface water bodies that are significant to the management of the basin.

Figure 3-3 shows the creeks in the Basin that are considered significant to the management of groundwater in the Basin (USGS, 2020b). Streams in the Basin are classified in the USGS National Hydrography Dataset (NHD) as intermittent (refer to Figure 3-53) (with the exception of those located in Barka Slough) and include Cuaslui Creek, Cañada De Santa Rosa, San Antonio Creek, and Harris Canyon Creek. Cuaslui Creek, Cañada De Santa Rosa, and Harris Canyon Creek are tributaries to San Antonio Creek. Available stream-gage data indicate that the majority of surface flow in these creeks percolates into the San Antonio Creek channel alluvium and the underlying Paso Robles Formation during most of the year. San Antonio Creek discharges into the Barka Slough, an approximate 660-acre wetland (Martin, 1985) at the west end of the Basin. There are no natural lakes in the Basin. There are no water supply reservoirs in the Basin.

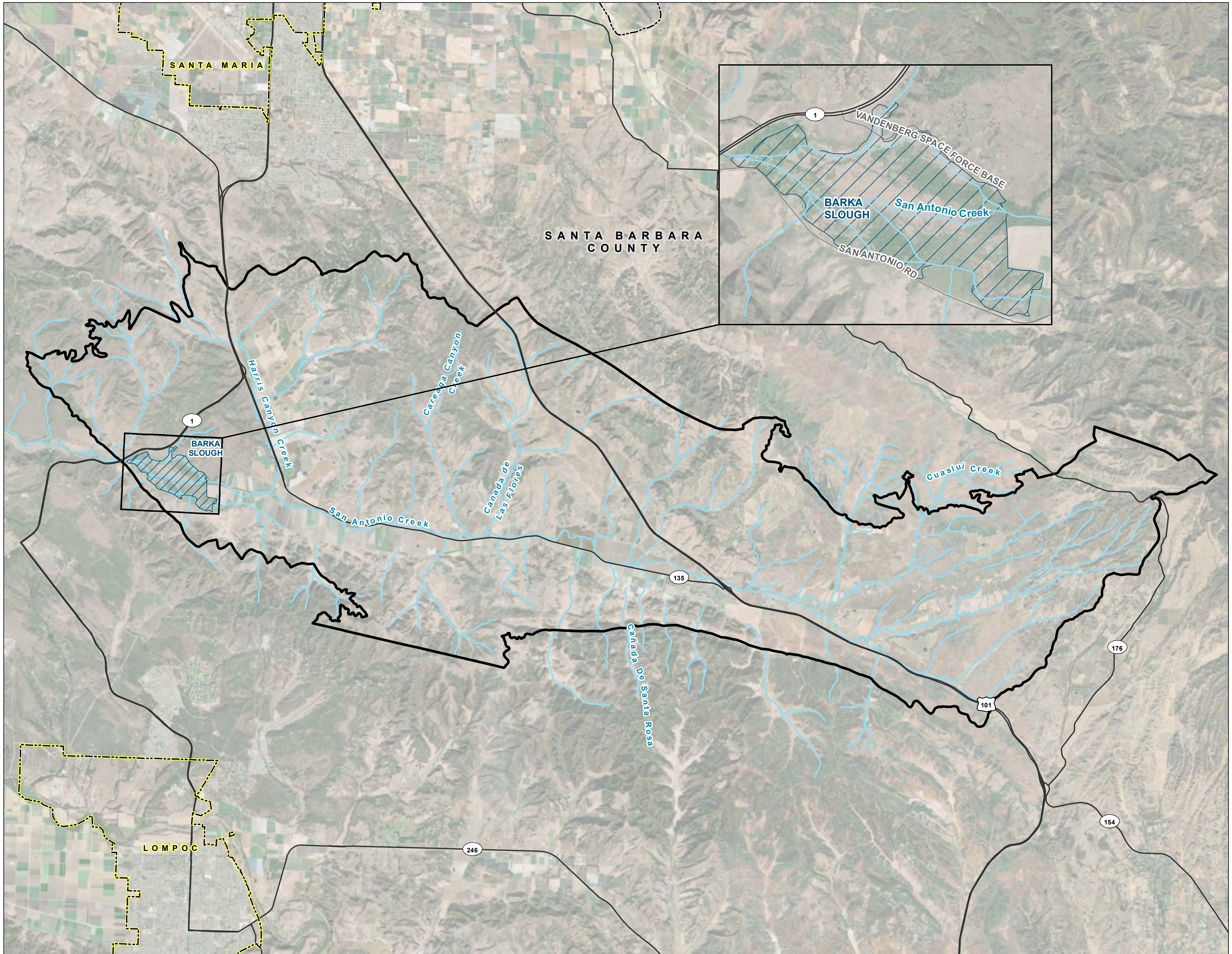

FIGURE 3-3

Surface Water Features of the San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

San Antonio Creek or Adjacent Tributary

Barka Slough

San Antonio Creek Valley Groundwater Basin

All Other Features

County Boundary

City Boundary

Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

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3.1.2 Regional Geology [§ 354.14(b)(1),(d)(2), and (d)(3)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(1) The regional geologic and structural setting of the basin including the immediate surrounding area, as necessary for geologic consistency.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(2) Surficial geology derived from a qualified map including the locations of cross-sections required by this Section.

(3) Soil characteristics as described by the appropriate Natural Resources Conservation Service soil survey or other applicable studies.

This section provides a description of the geologic formations in the Basin. These descriptions are summarized from previously published reports (Muir, 1964; Hutchinson, 1980). Figure 3-4 shows the surficial geology and geologic structures of the Basin, as well as the locations of the geologic cross sections shown on Figure 3-5 (USGS, 2020c).

The selected geologic cross sections illustrate the relationship of the geologic formations that constitute the Basin and the geologic formations that underlie and surround the Basin. The cross sections are based on lithologic data from outcrops, wells, and exploratory borings. The cross sections were generated by the USGS as part of the San Antonio Creek Geohydrologic Framework Model (USGS, 2020c). The USGS is in the process of calibrating a groundwater model—corresponding to the San Antonio Creek Geohydrologic Framework Model—that was developed subsequent to, and based on, the cross sections and base map included in this GSP.

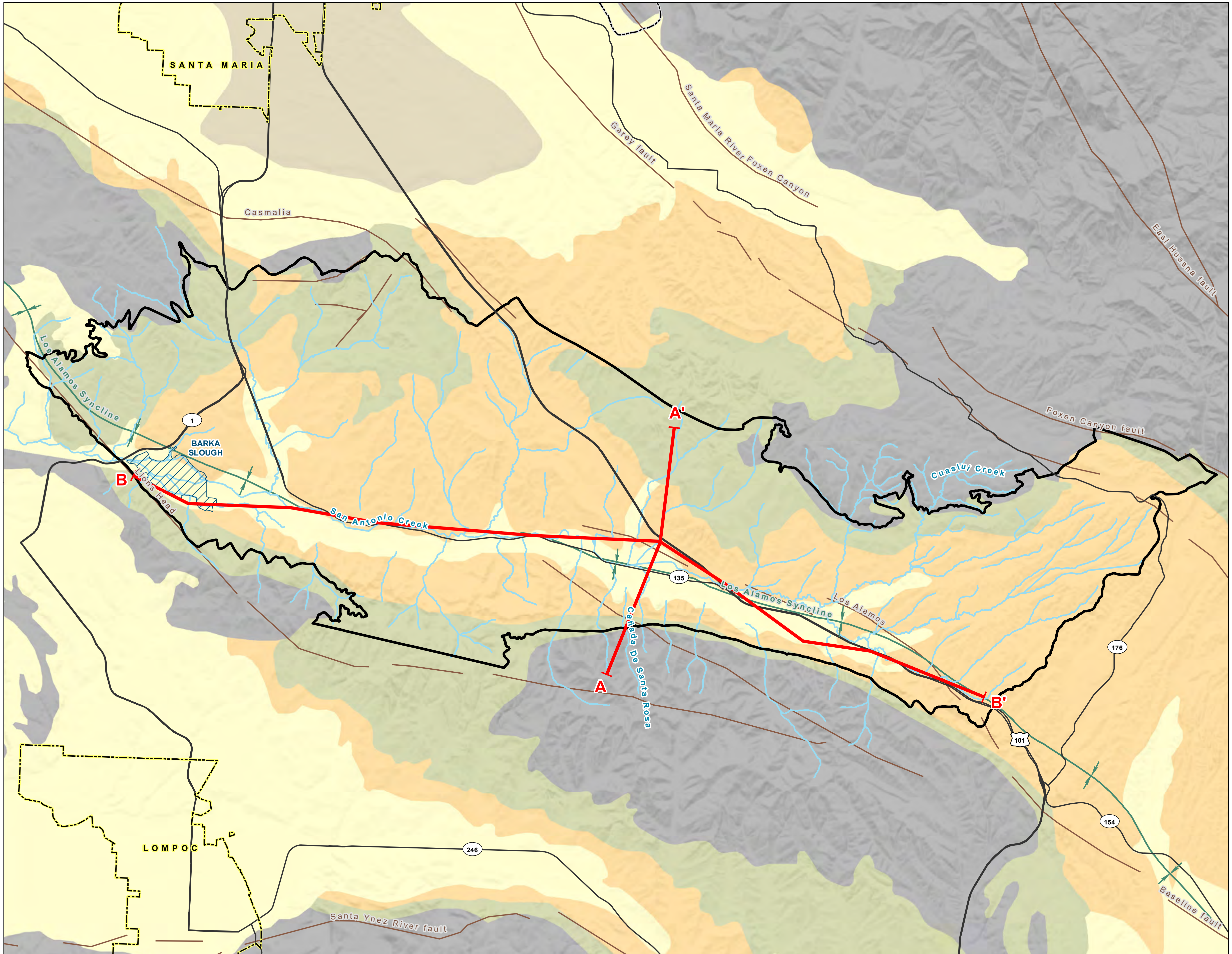

FIGURE 3-4

Geologic Map of the San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Cross Section Line
- San Antonio Creek or Adjacent Tributary
- Barka Slough
- B118 San Antonio Creek Valley Groundwater Basin

Geology

- Fault
- Syncline
- Channel Alluvium
- Paso Robles Formation
- Lake Deposits
- Careaga Sand
- Bedrock

All Other Features

- County Boundary
- City Boundary
- Major Road

NOTES

1. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.
2. Geologic cross sections shown on Figure 3-5.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020c), ESRI, DWR (2018a), Dibblee & Ehrenspeck (1974, 1989, 1993, 1994)

GSI Water Solutions, Inc.

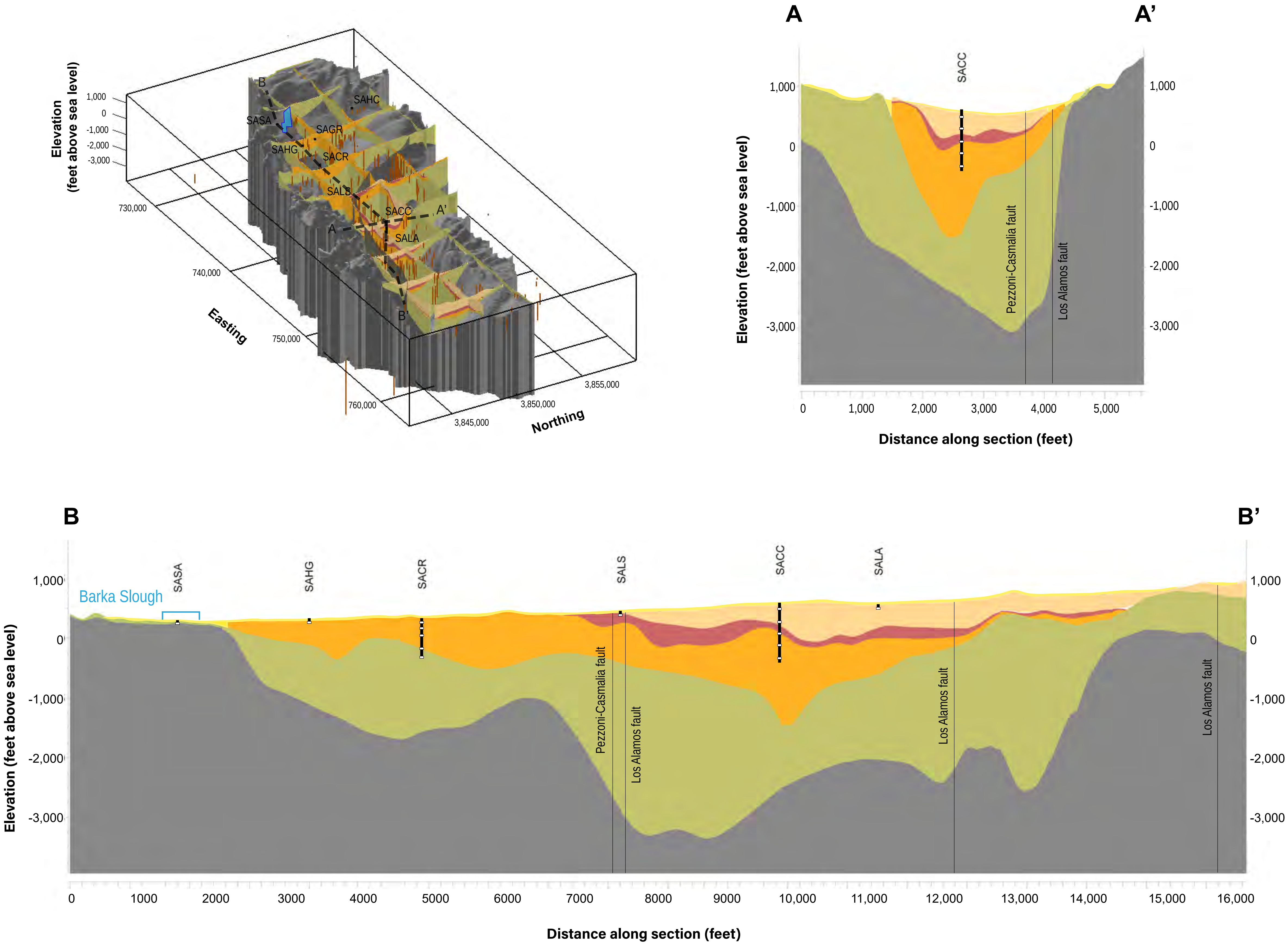

FIGURE 3-5

Geologic Cross Sections, San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley Groundwater Basin

LEGEND

- Channel Alluvium
- Upper member - Paso Robles Formation
- Middle member - Paso Robles Formation
- Lower member - Paso Robles Formation
- Careaga Sand
- Consolidated bedrock

WELL LEGEND

Screen

NOTE
Geologic cross section locations shown on Figure 3-4.

Date: September 16, 2021
Data Sources: USGS (2020c)

GSI Water Solutions, Inc.

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3.1.2.1 Regional Geologic Structures

The Basin has undergone significant deformation (folding and faulting) caused by compressional forces resulting in a series of anticlines, synclines, and faults. This region is located between the Coast Ranges (San Rafael Mountains) Geomorphic Province on the northeast and the Transverse Ranges (Santa Ynez Mountains) Geomorphic Province on the south (Muir, 1964).

The topographic expression of the valley is caused by two nearly parallel underlying synclines (downwarped geological units), the Los Alamos and San Antonio Synclines. The synclines include Miocene-to-Holocene-aged deposits and may be thought of as an elongated bowl with the thickest and deepest portion located along the center axis. The axis of the northwest-trending Los Alamos Syncline is nearly coincident with the axis of the valley and passes through the town of Los Alamos. Deposits along the axis of the syncline reach a thickness of approximately 10,000 ft. The north side of the syncline has a gentle southward dip, whereas the south side has a steep northward dip that is overturned in the vicinity of Los Alamos. The Los Alamos Syncline extends eastward into the Santa Ynez Valley near Los Olivos. The San Antonio Syncline trends northwest and is located south of Harris Canyon. East of Harris Canyon, the axis of the San Antonio Syncline is along the south flank of the valley. A few miles west of Harris Canyon, the axis of the syncline trends northwest and passes through the town of Casmalia. The limbs of the syncline generally have moderate dips (Muir, 1964).

The geology shown on Figure 3-4 was provided by the USGS (USGS, 2020c) and did not depict the location of the Los Alamos or San Antonio Synclines. The projection of the Los Alamos Syncline shown on Figure 3-4 was added based on Dibblee and Ehrenspeck, 1989, 1993a, 1993b, and Dibblee et al., 1994, who surveyed the Los Alamos and San Antonio Syncline as a single geologic structure.

The flanking Casmalia Hills, Solomon Hills, and Purisima Hills are northwest-trending anticlines (upwarped geologic units). A number of faults have been identified in the hills that flank the valley; however, they are not discussed in this GSP because they have not been observed to control the occurrence or movement of groundwater in the Basin (Muir, 1964).

3.1.2.2 Geologic Formations Within the Basin

Geologic formations in the Basin are described in this section and shown in map view on Figure 3-4 (geologic map) and in cross-sectional view on Figure 3-5.

Alluvium

Holocene alluvium underlies the valley, primarily along the San Antonio Creek and its tributary canyons. It rests unconformably on older deposits, including the Paso Robles Formation and Careaga Sand.[15] The alluvium consists of unconsolidated clay, silt, sand, and gravel and is typically coarser-textured east of Harris Canyon than west. A semi-continuous gravel bed at the base of the alluvium ranges from approximately 5 to 15 ft in thickness. The alluvium ranges in thickness up to approximately 100 ft with an average thickness of approximately 80 ft. Near the town of Los Alamos, the alluvium is approximately 90 ft thick and observed to thin to approximately 65 ft between Harris Canyon and the Marshallia Ranch. The alluvium rests on consolidated Tertiary rocks west of Harris Canyon (Muir, 1964).

[15] A conformity and unconformity are geology terms—specifically relating to stratigraphy—that describe a geologic contact between two rock layers with respect to the geologic record. If there is a large time gap between two layers, the contact is referred to as an unconformity. Large time gaps between rock units can be caused by periods of non-deposition or erosion. Conversely, if the age of rock layers indicate there is no time gap in the geologic record, the contact is referred to as a conformity.

Paso Robles Formation

The Paso Robles Formation is present within the downwarped Los Alamos Syncline underlying the San Antonio Creek Valley and outcrops in large areas along the valley flanks and in the adjacent Solomon Hills, Casmalia Hills, and Zaca Canyon. The Paso Robles Formation is Pliocene to Pleistocene in age and is the oldest nonmarine deposit in the Basin. The overlying formations rest unconformably on the Paso Robles Formation, while the Paso Robles Formation rests conformably on the Careaga Sand. The Paso Robles Formation is distinguished from the underlying Careaga Sand by its heterogeneity and the lack of marine megafossils; as well, its greater degree of deformation distinguishes it from the overlying younger formations. The Paso Robles Formation consists of poorly consolidated stream-deposited lenticular beds of gravel, sand, silt, and clay. Generally, the sand is cross bedded, poorly sorted, silty, and includes stringers of coarse sand and small pebbles. The lower part of the formation contains occasional beds of freshwater limestone ranging in thickness from approximately 1 to 30 ft. The Paso Robles Formation is about 2,000 ft thick beneath the central part of the Basin (Muir, 1964).

As shown on Figure 3-5, the USGS divided the Paso Robles Formation into three members (unofficial geologic units) during development of the San Antonio Creek Geohydrologic Framework Model (USGS, 2020c) based on differences in lithologic and hydraulic properties. The middle member of the Paso Robles Formation was identified as a confining layer inhibiting vertical flow of groundwater in the Paso Robles Formation.

Careaga Sand

The late Pliocene-age Careaga Sand outcrops extensively in the Purisima Hills and in large areas in the Solomon and Casmalia Hills and underlies the Paso Robles Formation in the Basin. The exposed Careaga Sand dips northward in the Purisima Hills and passes under the San Antonio Creek Valley at a depth of several thousand feet. The Careaga Sand is predominately of marine origin and has undergone considerable deformation in the Purisima Hills and the western area of the Solomon Hills; however little deformation of the Careaga Sand has been observed elsewhere in the Basin. Two members have been identified in the Careaga Sand: a fine-grained lower member, Cebada; and a coarse-grained upper member, Graciosa. Geologically, the two members are often mapped together, as is done in this GSP. The Careaga Sand rests conformably on the Foxen Mudstone west of the Graciosa Canyon-Harris Canyon divide and in the central and western Purisima Hills. Elsewhere in the valley, the Careaga Sand rests unconformably on the Sisquoc Formation. The Careaga Sand is distinguished from the underlying formations by its coarser-grained texture and its lesser degree of consolidation. It is distinguished from the overlying Paso Robles Formation by the uniformity of its grain size and its marine megafossils. The Careaga Sand is a gray-white to yellow-buff loosely consolidated massive fine- to medium-grained sand containing some silt and abundant well-rounded pebbles in the upper member. The pebbles are quartzite, porphyritic igneous rocks, chert, and shale of the Monterey Formation. Numerous megafossils are contained in the formation. The Careaga Sand has its maximum exposed thickness in the Purisima Hills, where it is approximately 1,425 ft thick. Northward, passing under the valley, it thins to approximately 1,000 ft, and still farther north beyond the basin boundary, under the Solomon and Casmalia Hills, it is approximately 700 ft thick (Muir, 1964).

3.1.2.3 Geologic Formations Surrounding the Basin

Underlying and surrounding the Basin are older geologic formations that are considered consolidated and impermeable. In general, the geologic units underlying the Basin include Miocene- to Pliocene-age consolidated sedimentary beds.

Figure 3-6 (DOC, 2020) shows the approximate location of active and idle oil and gas wells drilled in the Basin. These oil and gas wells help identify the depth and extent of the deeper geologic formations that surround and underlie the Basin. Figure 3-7 (Sweetkind, et al., 2010) shows a generalized regional geologic cross section based on available stratigraphic data from oil and gas wells.

Foxen Mudstone

The middle to late Pliocene-age Foxen Mudstone is marine in origin, rests conformably on the Sisquoc Formation, and is exposed in the Purisima and Casmalia Hills. In the Purisima Hills, the formation consists of mudstone and siltstone with increasing sand content west of State Highway 1. The Foxen Mudstone is estimated to be approximately 800 ft thick in the western region of the Purisima Hills but thins to the east and disappears in the central region of the Purisima Hills (Muir, 1964).

Sisquoc Formation

The Sisquoc Formation is a late-Miocene to early- and middle-Pliocene-age marine deposit that rests unconformably on the Monterey Formation. It underlies all of the valley and is exposed along the north flank of the Purisima Hills, in Foxen Canyon, and in the Casmalia Hills. It underlies the Burton Mesa and San Antonio Terrace. In the western region of the valley, the formation is covered by a veneer of younger deposits. Under the central and western valley, the formation lies at a suspected depth of approximately 3,000 ft to 4,000 ft below the land surface. The Sisquoc Formation is predominantly made up of diatomaceous mudstone, porcelaneous shale, mudstone, laminated diatomite, sandstone, and diatomaceous siltstone (Muir, 1964).

Monterey Formation

The Monterey Formation is a middle- and late-Miocene-age marine deposit. It is the principal source rock for petroleum in the region. The formation underlies the entire region and forms the core of the Casmalia, Solomon, and Purisima Hills. Two members have been described in the Monterey Formation. The lower member is composed of thin-bedded chert and cherty shale interbedded with porcelaneous shale and is of unknown thickness. The upper member is composed of either porcelaneous shale containing layers of thin-bedded concretionary limestone or porcelaneous shale overlain by laminated diatomite and diatomaceous shale and is approximately 1,000 ft thick. The base of the Monterey Formation is not exposed in the valley; therefore, its relationship to older, underlying rocks is not known (Muir, 1964). According to oil and gas well and exploratory boring logs available from the California Department of Conservation, Geologic Energy Management Division online Well Finder, or WellSTAR, tool, the top of the Monterey Formation ranges from approximately 6,500 ft (American Petroleum Institute [API] well number 08321976) below ground surface in the uplands east of Harris Canyon to 10,000 ft below ground surface (API well numbers 08322648 and 08322388) near Los Alamos and along the San Antonio Creek in the Basin.

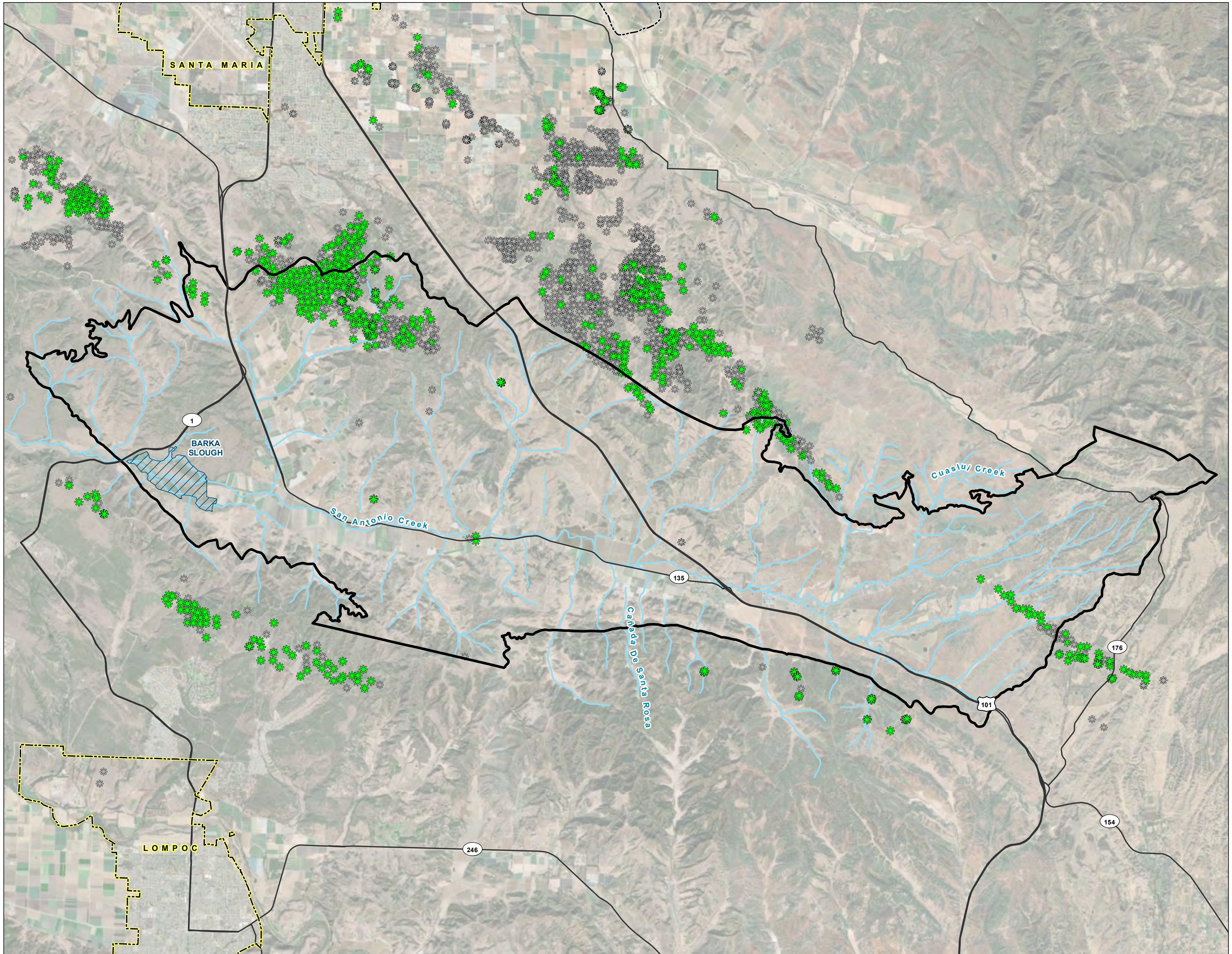

FIGURE 3-6

Oil and Gas Wells of the San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

WellStatus

- Active
- Idle

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Department of Conservation (2020), Maxar imagery (2020)

GSI Water Solutions, Inc.

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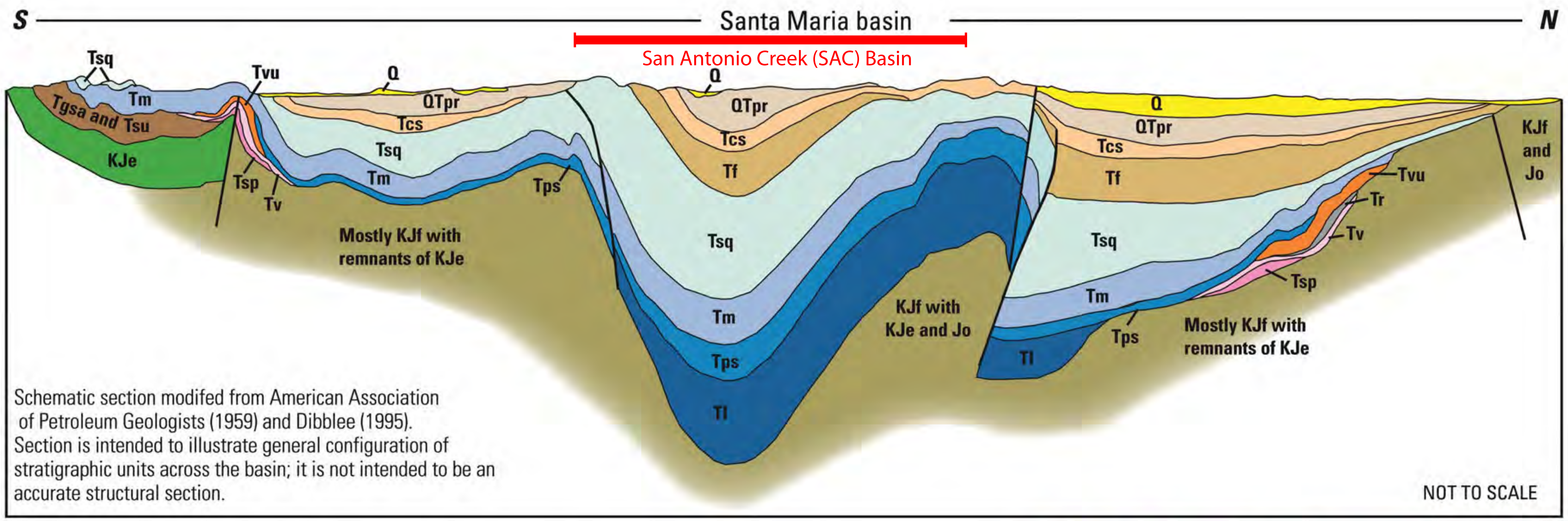
FIGURE 3-7

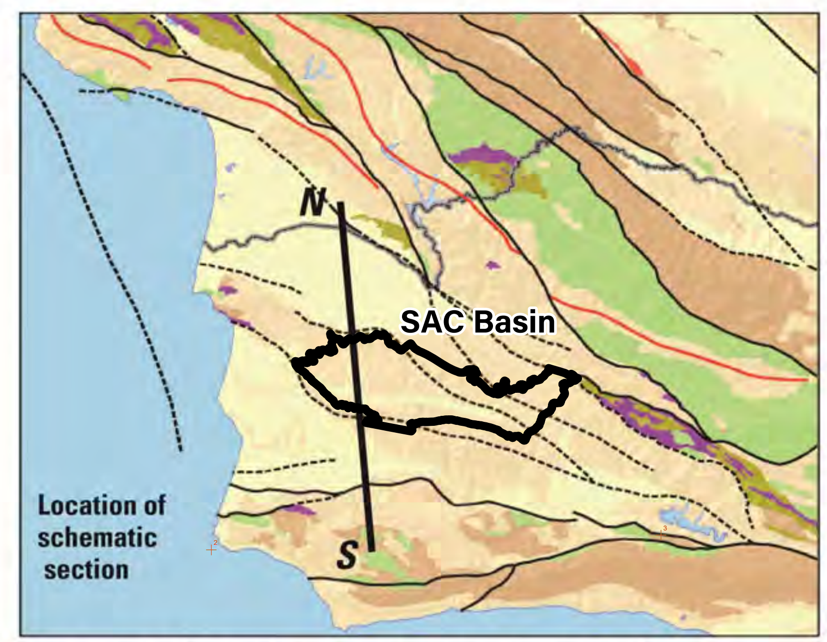
Regional Geologic Cross-Section from San Antonio Creek Valley Oil and Gas Well Stratigraphic Data

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



Stratigraphic units shown are those compiled in data tables:

Q : Undivided Quaternary deposits
QTpr : Paso Robles Formation
Tcs : Careaga Sandstone
Tf : Foxen Mudstone
Tsq : Sisquoc Formation
Tm : Monterey Formation
Tps : Point Sal Formation
Tl : Lospe Formation
Tvu : Miocene volcanic rocks, undivided
Tr : Rincon Shale
Tv : Vaqueros Formation
Tsp: Sespe Formation
Tgsa : Gaviota Formation
Tsu: Eocene marine sandstones, undivided
KJe : Espada Formation
KJf : Franciscan Complex
Jo : Jurassic ophiolite



Date: September 16, 2021
Data Sources: Sweetkind et al. (2010)

GSI Water Solutions, Inc.

3.1.3 Principal Aquifers and Aquitards [§ 354.14(b)(4)(A)(B)(C)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(A) Formation names, if defined.

(B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.

(C) Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.

Water-bearing sand and gravel beds that may or may not be laterally and vertically continuous are generally grouped together into zones that are referred to as aquifers. The aquifers can be vertically separated by fine-grained zones that can impede movement of groundwater between aquifers. These are referred to as aquitards. Two principal aquifers have been identified in the Basin:

- The Paso Robles Formation
- The Careaga Sand

The alluvium may be water bearing, particularly in the lower reaches of San Antonio Creek, because it receives recharge from San Antonio Creek; however, it is not considered a principal aquifer because there are no known wells completed in this unit and it does not produce sufficient quantities of water to support agricultural operations.

3.1.3.1 Physical Properties of the Aquifers and Aquitards

Paso Robles Formation

The Paso Robles Formation is approximately 2,000 ft thick and much of it is saturated. Large exposures of the formation north and east of the valley receive direct infiltration of rainfall, particularly in upper elevations. The Paso Robles Formation is likely also recharged by seepage from the alluvium present beneath San Antonio Creek and its tributaries and from upward leakage from the underlying Careaga Sand in some areas of the Basin. Vertical heterogeneity in the water-bearing properties of the Paso Robles Formation is the result of coarse-grained beds that yield water freely to wells alternating with fine-grained beds that do not. Higher well yields are typically attributed to the wells that penetrate several of the coarse-grained lenses. Yields of 500 gallons per minute (gpm) and specific capacities of 5 gpm to 15 gallons per minute per foot (gpm/ft) of drawdown are common (see Table 3-1. Principal Aquifer Hydrologic Properties). A storage coefficient of 0.15 was calculated for the Paso Robles Formation (Martin, 1985). Historically, artesian groundwater occurred locally in the Paso Robles Formation (Muir, 1964). Artesian conditions exist presently within the Paso Robles Formation (although, they are less frequently observed than in the past) and were observed in a completed agricultural well as recently as 2020. Dependent on location within the Basin, artesian conditions are due to localized confining layers created by the synclinal structure of the

Basin, the presence of overlying fine-grained deposits, and or faults present within the Basin, such as the Los Alamos Fault and the Pezzoni-Casmalia Fault (Carlson, 2019) (USGS, 2021a).

Careaga Sand

The Careaga Sand is approximately 1,500 ft thick and much of the formation is saturated. There are large exposures of the formation in the Purisima Hills, Solomon Hills, and the Casmalia Hills that receive direct infiltration of rainfall at higher elevations. The formation passes below the valley at a depth of several thousand feet. The upper member of the Careaga Sand is coarse grained and uniformly graded. The Careaga Sand has a large storage capacity and transmits water readily to wells and to the overlying younger formations (Muir, 1964). Yields of less than 100 and exceeding 1,000 gpm and specific capacities of less than 10 to more than 30 gpm/ft of drawdown have been measured in wells completed in the Careaga Sand (see Table 3-1. Principal Aquifer Hydrologic Properties). A storage coefficient of 0.001 for the confined portion (Barka Slough area) of the Careaga Sand was calculated (Martin, 1985).

3.1.3.2 Basin Boundary (Vertical and Lateral Extent of Basin) [§ 354.14(b)(2),(b)(3),(b)(4)(B), and (c)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(2) Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.

(3) The definable bottom of the basin.

(4) Principal aquifers and aquitards, including the following information:

(B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.

(c) The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.

The groundwater basin includes an area of approximately 130 square miles (DWR, 2003). Similar to the Basin's watershed, the groundwater basin is structurally controlled by the underlying Los Alamos Syncline (Hutchinson, 1980).

Figure 3-1 shows the lateral boundaries of the groundwater basin as defined by DWR in Bulletin 118. The groundwater basin boundary is controlled by the outcropping of bedrock of the Los Alamos Syncline.

The bottom of the groundwater basin is generally defined as the base of the Pliocene-age Careaga Sand. The Basin bottom is considered a barrier to flow because the geologic units underlying the Careaga Sand are considered impermeable and produce limited quantities of water. In addition, groundwater is generally suspected to be of poor quality (Muir, 1964). Therefore, these units are not considered part of the Basin.

Figure 3-5 includes geological cross sections that illustrate the vertical boundaries of the Basin and the approximate depth to the bottom of the Careaga Sand.

The Basin lateral boundaries are as follows:

- The western boundary of the Basin is defined by a bedrock ridge underlying the western edge of the Barka Slough. The bedrock ridge forces virtually all groundwater to the surface as base flow in the San Antonio Creek or as vertical flux into the Barka Slough.
- The northern boundary of the Basin is defined by the outcropping of the impermeable consolidated bedrock underlying the Careaga Sand in the Casmalia and Solomon Hills.
- The eastern boundary of the Basin is defined by the outcropping of the impermeable consolidated bedrock underlying the Careaga Sand in the San Rafael Mountains.
- The southern boundary is defined by the outcropping of the impermeable consolidated bedrock underlying the Careaga Sand in the Purisima Hills.

Groundwater Flow Barriers [§ 354.14(b)(4)(C) and (c)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(2) Lateral basin boundaries, including major geologic features that significantly affect groundwater flow.

(3) The definable bottom of the basin.

(4) Principal aquifers and aquitards, including the following information:

(C) Structural properties of the basin that restrict groundwater flow within the principal aquifers, including information regarding stratigraphic changes, truncation of units, or other features.

(c) The hydrogeologic conceptual model shall be represented graphically by at least two scaled cross-sections that display the information required by this section and are sufficient to depict major stratigraphic and structural features in the basin.

Dependent on location within the Basin, groundwater flow barriers exist due to localized confining layers created by the synclinal structure of the Basin, the presence of overlying fine-grained deposits, and or faults, such as the Los Alamos Fault and the Pezzoni-Casmalia Fault, present within the Basin (Carlson, 2019) (USGS, 2021a).

The Paso Robles Formation consists of stream-deposited lenticular beds of gravel, sand, silt, and clay. Generally, the sand is cross bedded, poorly sorted, silty, and includes stringers of coarse sand and small pebbles. Conceptually, the presence of laterally continuous zones of fine-grained strata within the aquifers can restrict vertical movement of groundwater. Fine-grained and coarse-grained zones have been identified within the Paso Robles Formation; however, these zones are generally not laterally continuous. The sediments of the Paso Robles Formation are heterogenous and have undergone a high degree of deformation. Vertical heterogeneity in the water-bearing properties of the Paso Robles Formation is the result of coarse-grained beds that yield water freely to wells alternating with fine-grained beds that do not.

These fine-grained zones act as confining beds and are the cause of the artesian conditions that were historically reported in some wells screened within the Paso Robles Formation. The lower part of the Paso Robles Formation contains occasional beds of limestone ranging in thickness from approximately 1 to 30 ft that may restrict vertical movement of groundwater.

As shown on Figure 3-5, the USGS divided the Paso Robles Formation into three members (unofficial geologic units) during development of the San Antonio Creek Geohydrologic Framework Model (USGS, 2020c) based on differences in lithologic and hydraulic properties. The middle member of the Paso Robles Formation was identified as a confining layer inhibiting vertical flow of groundwater within the Paso Robles Formation.

The Careaga Sand consists of fine- to medium-grained sand with some silt and abundant pebbles. Lithologic logs from wells drilled into this unit do not show that confining beds are present within the Careaga Sand that may create barriers to flow.

A number of faults and folds have been mapped in the valley; however, they are not discussed in this GSP because there is no evidence that they control the occurrence or movement of groundwater in the Basin (Muir, 1964). However, folding and uplift have brought low-permeability bedrock units to the ground surface on the north and south sides of the Basin, which prevents groundwater movement from adjacent groundwater basins into the Basin. On the west end of the Basin, faulting has brought bedrock units closer to the surface, thus forming a barrier to westward groundwater flow. This barrier causes groundwater to upwell and discharge into Barka Slough. On the east end of the Basin, there is a small segment where there could be groundwater interaction with an adjacent groundwater subbasin, the Eastern Management Area (EMA) of the Santa Ynez Groundwater Basin as well as the San Antonio Basin. Preliminary reporting of the USGS numerical groundwater model (during calibration of the model) indicate that, to reasonably simulate hydraulic head conditions in well 22J1—located along the northwest boundary of the Basin (see Figure 3-11)—a source of water from outside the model area that supplied water to two cells was simulated. It was assumed that groundwater pumping in 22J1 induced the groundwater flow from the EMA of the Santa Ynez Groundwater Basin through hydrologically connected aquifer material. The rate of flow was equal to the difference in hydraulic head and regulated by a specific hydraulic conductance (Woolfenden et al., 2021). Because the segment identified is small, and potential flow is assumed to be induced by pumping in a single well, the amount of groundwater inflow to the Basin from the EMA is considered negligible and will be further evaluated upon finalization of the USGS numerical groundwater model.

Hydraulic Properties [§ 354.14(b)(4)(B)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(B) Physical properties of aquifers and aquitards, including the vertical and lateral extent, hydraulic conductivity, and storativity, which may be based on existing technical studies or other best available information.

Historical data sources published by the USGS, constant rate pumping test data provided by the Los Alamos Community Services District (LACSD), and hydraulic properties calculated for Four Deer Ranch and VSFB were reviewed to determine the hydraulic properties of the Paso Robles Formation and the Careaga Sand aquifers. Pumping tests referred to in the historical USGS reports were not available and did not discern the aquifer(s) in which the respective wells were completed. Additionally, historical USGS reports extend the Basin west to the Pacific Ocean coastline, which does not align with the current western boundary of the Basin as defined in the DWR Bulletin 118. Only constant rate pumping test data for wells LASCD 3a and 5 were available and complete for review. These wells are completed within the Paso Robles Formation. The results of the LACSD constant rate pumping test and analysis are included in Appendix D. The results of the Four Deer Ranch and VSFB well field pumping tests are also included in Appendix D.

Estimated aquifer properties based on the review of the data sources discussed above are summarized in Section 3.1.3.1 and Table 3-1. Table 3-1 includes the following characteristics:

- **Specific capacity:** the rate of discharge of a water well per unit of water level drawdown (gallons per minute per foot of drawdown).
- **Storativity:** the volume of water an aquifer releases from, or takes into, storage per unit surface area of the aquifer per unit change in head.
- **Transmissivity:** the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient.
- **Hydraulic conductivity:** the rate of flow of water in gallons per day through a cross section of 1 square ft under a unit hydraulic gradient.

Table 3-1. Principal Aquifer Hydraulic Properties

Well Name	Aquifer	Test Duration (hours)	Flow (gpm)	Drawdown (ft)	Well Depth (ft bgs)	Screened Interval (ft bgs)	Total Screened Interval (ft)	Specific Capacity (gpm/ft)	Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)
LACSD 3[1,4,5]	Paso Robles Formation	–	330	57	–	–	–	6	1,604	–
LACSD 3a[2,3]		24	401	69	510	180–300 320–400 420–510	290	6	1,920	7
LACSD 4[4,5]		–	323	79	535	230–530	300	4	1,093	4
LACSD 5[2,3]		24	785	112	962	217–352 502–702 792–952	395	7	2,706	5
LACSD 6[4,5]		–	624	96	959	196–296 338–700 823–959	598	6	1,738	3
4 - Deer (Ex Ag – 2)[5,6]	Careaga Sand	–	100	10	460	220–460	240	10	2,674	11
4 - Deer – (New Ag – 2)[5,6]		–	900	32	455	100–450	350	28	7,520	21
4 -Deer – (New Ag 3)[5,6]		–	750	46	455	100–480	380	16	4,359	11
4 - Deer Field (New Ag - 4)[5,6]		–	900	124	600	100–440	340	7	1,941	6
4 - Deer Highway (Ex Ag - 1)[5,6]		–	38	3	460	240–460	220	13	3,387	15
VSFB Well #4[5,7]		2.3	956	54	334	162–219 234–273 319–334	111	18	4,734	43
VSFB Well #7[5,7]		3	1,200	37.85	410	200–210 220–230 270–290 300–320 330–340 350–360 370–390	190	32	8,477	45
VSFB Well #6[5,7]		4	684	33.5	–	210–390	180	20	5,459	30
VSFB Well #5[5,7]		3.1	768	46.5	400	200–390	110	17	4,416	40

Notes

[1] LACSD 3 was taken offline in 2010 replaced with LACSD 3A.
[2] Transmissivity and hydraulic conductivity were calculated using the modified Cooper-Jacob Nonequilibrium Equation (Driscoll, 1986)
[3] Value for flow is an arithmetic mean of pumping rates during pump tests after well construction activities:

- LACSD 3A: A & A Pump & Well Service, (2010). Constant Run 24hr+.
- LACSD 5: Cleath & Associates, (2006). Well construction and testing report for St. Joseph Street Well #5, Los Alamos Community Services District, Santa Barbara County, December.

[4] Specific capacity was calculated using mean production and water level data provided by the LACSD.
[5] Hydraulic conductivity was calculated by using the following equation (Driscoll, 1986):

K = T / B

- K = Hydraulic conductivity (feet per day)
- T = Transmissivity (square feet per day)
- B = Aquifer thickness or screened interval (feet)

Transmissivity and specific capacity were calculated using the following formula (Driscoll, 1986):

T = [(Q/s) x 2,000] / 7.48

- T = Transmissivity, in gallons per day per foot (gpd/ft)
- Q/s = Specific Capacity, in gallons per minute per foot (gpm/ft)
- 2,000 = Constant for confined aquifers
- 7.48 = Conversion from gallons per day per foot to square feet per day.

[6] From Katherman Exploration Co., LLC, 2009.
[7] Christian Mathews, Operations Manager, American Water, for Vandenberg Space Force Base, personal communication, Friday, June 18, 2021.

– = No value on record or uncalculated
Ag = Agricultural well
Ex = Existing
ft = feet
ft bgs = feet below ground surface
ft/day = feet per day
ft^2/day = square feet per day
gpd/ft = gallons per day per foot
gpm = gallon per minute
gpm/ft = gallons per minute per foot
LACSD = Los Alamos Community Services District
VSFB = Vandenberg Space Force Base

Reference

Driscoll, F. G. *Groundwater and Wells, Second Edition*. (St. Paul, Minnesota; Johnson Screens; 1986).

Based on the LACSD pumping test data for LACSD wells, the estimated transmissivity of the Paso Robles Formation ranges between approximately 1,093 square feet per day (ft^2/day) and 2,706 ft^2/day. The geometric mean of the Paso Robles Formation transmissivity values is approximately 1,738 ft^2/day. The estimated hydraulic conductivity of the Paso Robles Formation ranges from 3 feet per day (ft/d) to 7 ft/d. The estimated specific capacity of the Paso Robles Formation ranges from 4 gpm/ft to 7 gpm/ft. The geometric mean of the specific capacity values for the Paso Robles Formation is 6 gpm/ft.

The estimated transmissivity of the Careaga Sand (based on pumping test data summarized in Table 3-1) ranges between approximately 1,941 ft^2/day and 8,477 ft^2/day. The geometric mean of the Careaga Sand transmissivity values is approximately 4,350 ft^2/day. The estimated hydraulic conductivity of the Careaga Sand ranges from 5 ft/d to 45 ft/d. The geometric mean of the hydraulic conductivity values for the Careaga Sand is 20 ft/d. The estimated specific capacity of the Careaga Sand ranges from 7 gpm/ft to 32 gpm/ft. The geometric mean of the specific capacity values for the Careaga Sand is 16 gpm/ft.

The LACSD also provided water level and production data for wells in the LACSD-operated wellfield. The LACSD wellfield provides drinking water to the town of Los Alamos. Table 3-1 lists calculated hydraulic properties values and well construction details for the LACSD wells using the gaging and production data (also referred to as specific capacity data) previously mentioned. All four LACSD wells are screened entirely within the Paso Robles Formation.

3.1.3.3 Groundwater Recharge and Discharge Areas [§ 354.14(d)(4)]

§ 354.14 Hydrogeological Conceptual Model.

(d) Physical characteristics of the basin shall be represented on one or more maps that depict the following:

(4) Delineation of existing recharge areas that substantially contribute to the replenishment of the basin, potential recharge areas, and discharge areas, including significant active springs, seeps, and wetlands within or adjacent to the basin.

Areas of significant natural areal recharge and discharge within the Basin are discussed below. Quantitative information about natural and anthropogenic recharge and discharge is provided in Section 3.3.

Groundwater Recharge Areas Inside the Basin

In general, natural areal recharge occurs through the following processes:

1. Distributed areal infiltration of precipitation
2. Infiltration of surface water from streams and creeks

Figure 3-8 is a map that ranks soil suitability to accommodate groundwater recharge based on five major factors that affect recharge potential, including deep percolation, root zone residence time, topography, chemical limitations, and soil surface condition. The map was developed by the California Soil Resource Lab at University of California (UC) Davis and the UC Agricultural and Natural Resources Department. Areas with soils that have excellent recharge properties are shown in dark green, moderate recharge properties are shown in yellow, and areas with poor recharge properties are shown in orange and red.

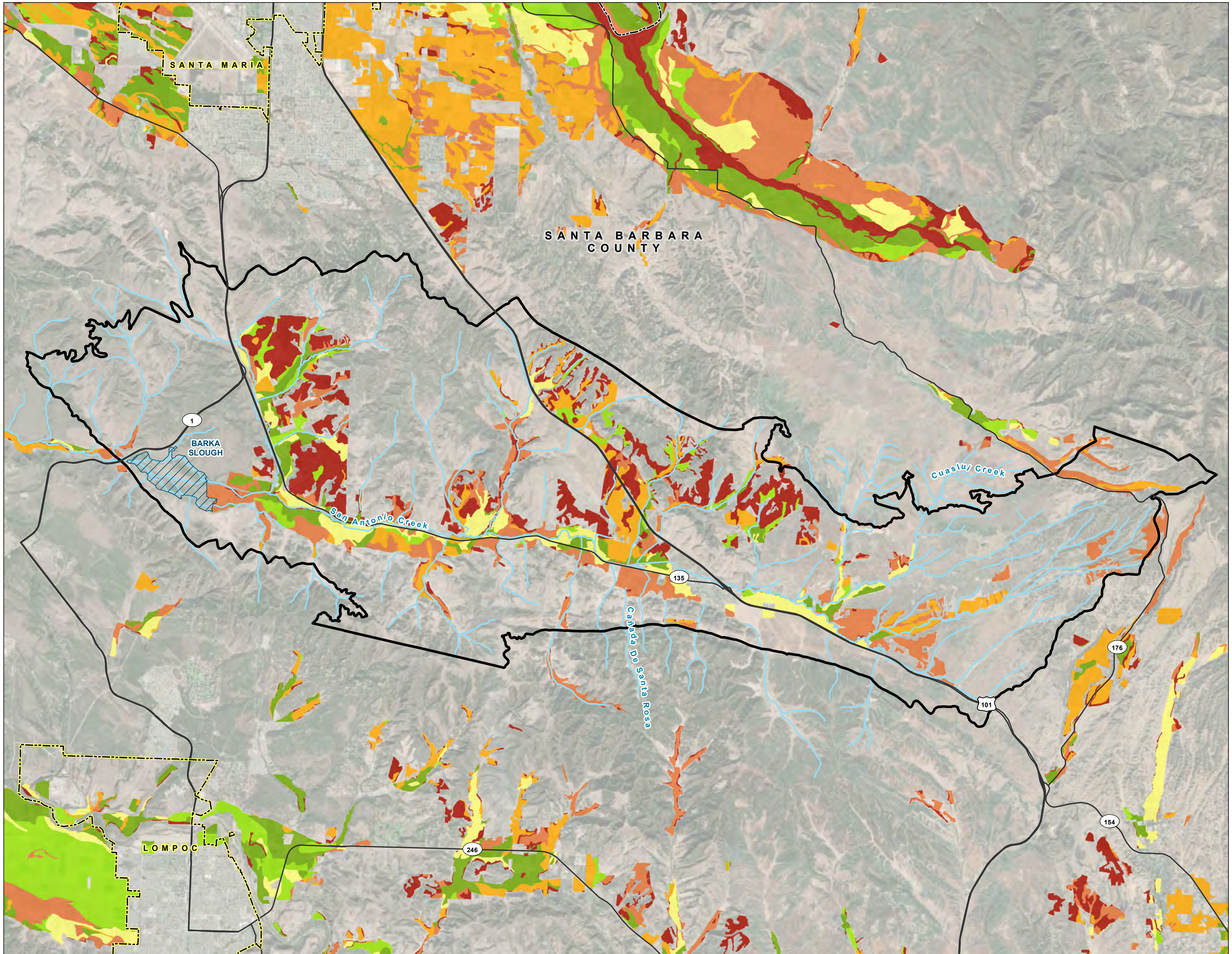


FIGURE 3-8

Potential Recharge Areas

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Soil Agriculture Groundwater Banking Index (SAGBI) Rating

- Excellent (86 - 100)
- Good (70 - 85)
- Moderately Good (50 - 69)
- Moderately Poor (30 - 49)
- Poor (16 - 29)
- Very Poor (0 - 15)

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), SAGBI (n.d.), Maxar imagery (2020)

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Recharge to the Paso Robles Formation and Careaga Sand aquifer also occurs through direct infiltration of precipitation and infiltration in creek beds in the higher elevations where these units crop out at the surface. Figure 3-8 shows the general locations of occurrence in the Basin. Natural recharge processes are discussed in more detail in Section 3.3. Appendix D includes a table of annual precipitation data for the Los Alamos Fire Department (LAFD) weather station for the water years 1910 to 2019.

Groundwater Discharge Areas Inside the Basin

Natural groundwater discharge areas in the Basin include springs and seeps, groundwater discharge to surface water bodies, and evapotranspiration (ET) by phreatophytes. Phreatophytes are plants with roots that tap into groundwater present in the alluvium along creeks and streams. Springs and seeps that have been identified by the USGS based on the NHD and reported by basin stakeholders are shown on Figure 3-9. The springs tend to be located in the uplands of the Solomon Hills and San Rafael Mountains ranges. Based on the elevation of mapped springs and seeps, it is likely that these discharge groundwater from shallow, and possibly perched, water-bearing zones.

Groundwater discharge to streams has not been mapped to date. However, groundwater discharge likely occurs in the vicinity of Barka Slough on the west end of the Basin, as evidenced by the formation and continued existence of the Barka Slough, an upward vertical hydraulic gradient calculated from nested wells in the area, and the underlying geologic structure (bedrock high) that exists at the west end of the Basin. Groundwater is inferred to discharge from the shallow alluvium, Paso Robles Formation, and from the Careaga Sand in this vicinity. Figure 3-31 is a conceptual diagram illustrating this process.

Figure 3-10 shows the distribution of potential groundwater-dependent ecosystems (GDEs) and Natural Communities Commonly Associated with Groundwater (NCCAG) within the Basin. In areas where the water table is sufficiently high, groundwater discharge may occur as ET from phreatophyte vegetation. Figure 3-10 shows only *potential* GDEs identified in the NCCAG data set. Additional verification of potential GDEs was completed and is described in Section 3.2.6.

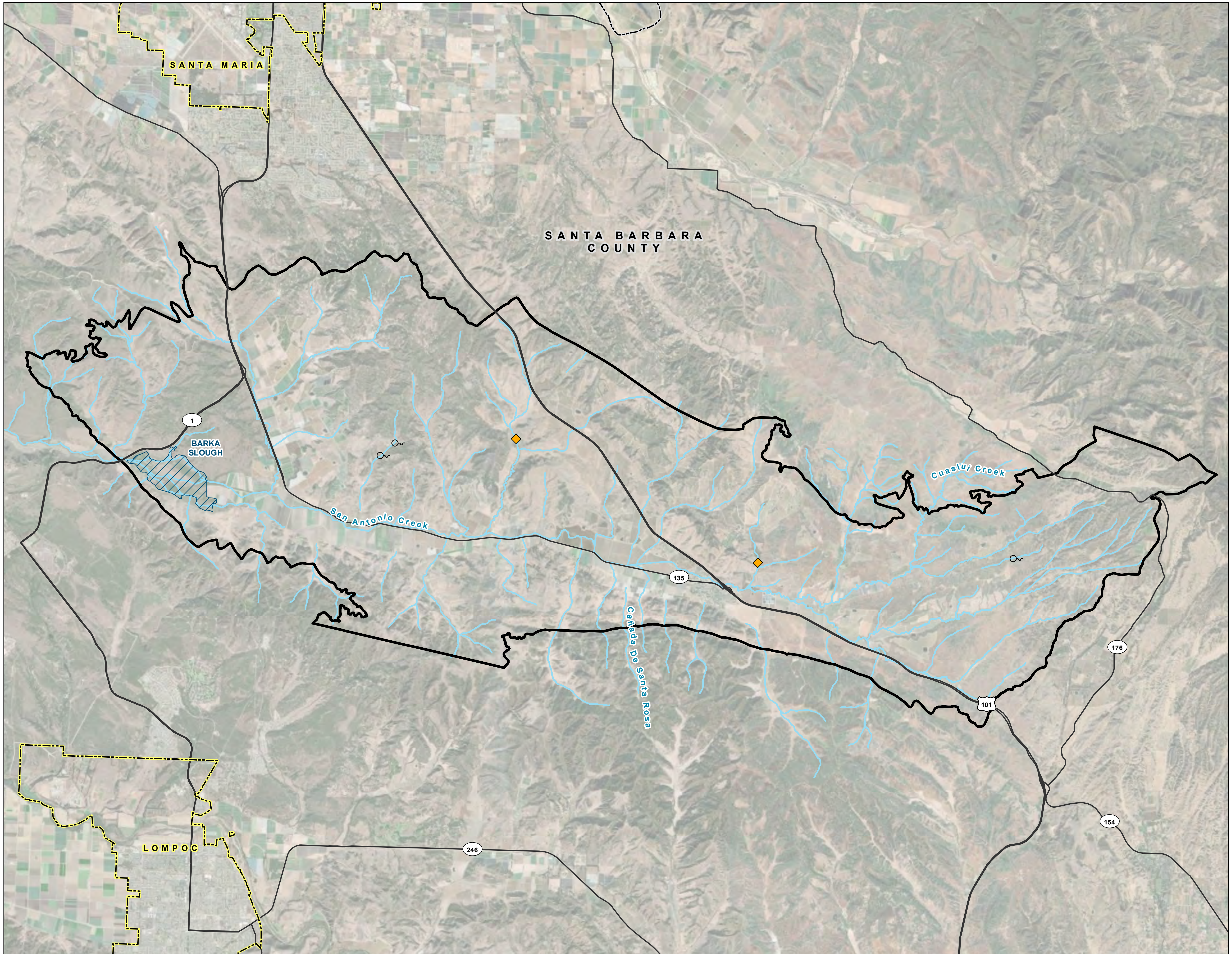

FIGURE 3-9

Springs and Seeps

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Reported Seep

USGS Spring

All Other Features

San Antonio Creek or Adjacent Tributary

Barka Slough

San Antonio Creek Valley Groundwater Basin

County Boundary

City Boundary

Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020c), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_9_Springs_and_Seeps.mxd, abarry

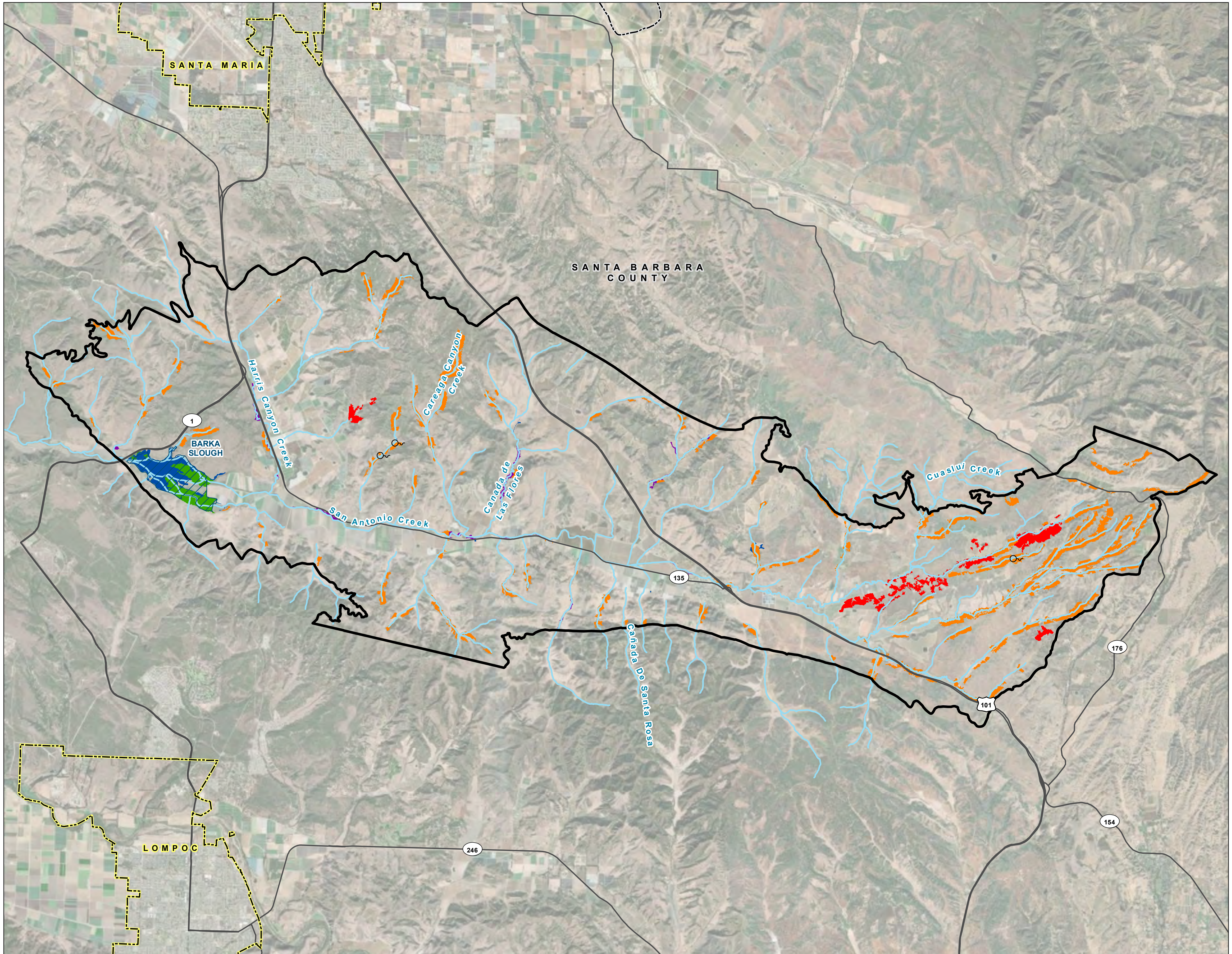

FIGURE 3-10

Natural Communities Commonly Associated with Groundwater Data Set

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Natural Communities Commonly Associated with Groundwater (NCCAG)

- Wetland Area

VEGETATION

- Coast Live Oak
- Valley Oak
- Riparian Mixed Hardwood
- Willow

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- Major Road
- City Boundary
- USGS Spring

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a, 2020b), Maxar imagery (2020)

GSI Water Solutions, Inc.

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3.1.3.4 Water Quality [§ 354.14(b)(4)(D)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(D) General water quality of the principal aquifers, which may be based on information derived from existing technical studies or regulatory programs.

This section presents a general discussion of the natural groundwater quality in the Basin. A more complete discussion of the distribution and concentrations of specific constituents is presented in Section 3.2.3. The general water quality of the Basin is based on the results from water quality samples collected for compliance with regulatory programs, sampling conducted by the USGS, data from the USGS National Water Information System (NWIS), and the California State Water Resources Control Board (SWRCB) GeoTracker USGS Groundwater Ambient Monitoring and Assessment (GAMA) database.[16]

Groundwater in the Basin is generally suitable for drinking and agricultural uses. In the past 10 years, no exceedances of maximum contaminant levels (MCLs) were indicated in drinking water supply wells. According to the GAMA database, drinking water supply wells include the LACSD wells, VSFB wells, and a few wells located in Harris Canyon and off Batchelder Road. Exceedances of secondary MCLs (SMCLs) and basin water quality objectives (WQOs) set by the Regional Water Quality Control Board (RWQCB) have been reported in both drinking water supply wells and agricultural wells. Concentrations of dissolved solids and salts increase from east to west along San Antonio Creek and are greatest near Barka Slough and in the northern portion of Harris Canyon. Summary tables of general groundwater quality are provided in Section 3.2.3.

3.1.3.5 Primary Beneficial Uses [§ 354.14(b)(4)(E)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(4) Principal aquifers and aquitards, including the following information:

(E) Identification of the primary use or uses of each aquifer, such as domestic, irrigation, or municipal water supply.

The primary groundwater uses in the Basin includes municipal, agricultural, rural residential, and environmental (such as for GDEs). Municipal, domestic, and agricultural demands in the Basin currently rely entirely on groundwater. The LACSD pumps exclusively from the Paso Robles Formation. The VSFB wellfield

[16] Available at the California State Water Resources Control Board website: https://geotracker.waterboards.ca.gov/. (Accessed August 5, 2021.)

pumps exclusively from the Careaga Sand. Agricultural and rural residential water demand is met from wells completed in both principal aquifers. There is reportedly no pumping from the shallow alluvial deposits that underlie San Antonio Creek.

3.1.4 Data Gaps and Uncertainty [§ 354.14(b)(5)]

§ 354.14 Hydrogeological Conceptual Model.

(b) The hydrogeologic conceptual model shall be summarized in a written description that includes the following:

(5) Identification of data gaps and uncertainty within the hydrogeologic conceptual model.

Sustainable Groundwater Management Act (SGMA) regulation § 351(l) defines the term "data gap" as "a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed." SGMA regulation § 351(ai) defines the term "uncertainty" as the following:

> *…a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.*

All hydrologic conceptual models contain a certain amount of uncertainty and can be improved with additional data and analysis. The hydrogeologic conceptual model of the San Antonio Creek Valley Groundwater Basin could be improved with certain additional data and analyses. The data gaps are identified below.

3.1.4.1 Barka Slough Surface Water Budget

The Barka Slough is supported by groundwater upwelling as it encounters an impermeable bedrock high at the west end of the Basin as well as surface water entering from San Antonio Creek (see Figure 3-31 for conceptualized surface and groundwater discharge into Barka Slough). Groundwater levels measured in wells located near the Slough indicate that, since about 1983, groundwater levels have fallen below the Slough surface elevation in a number of locations. In addition, upward vertical gradients within the Careaga Sand near the Slough (see Figure 3-71) have been reduced. This indicates that groundwater flow into the Slough has likely declined. Currently no stream gage exists where surface water flow enters or exits the Slough. The Casmalia stream gage (11136100) is located more than 2.5 miles west of the Slough and indicates a strong correlation between precipitation and measured flow. Due to gaps in recorded data at the Casmalia stream gage (from 2003 through 2015) it is not possible to accurately determine the direct effect of pumping in the Basin on measured surface water flow using the Casmalia stream gage. Additionally, without a stream gage at the east end of the Slough, it is not known whether surface water flow into the Slough has been decreasing. Installation of surface water gages in the east and west end of the Slough and evaluation of the Slough water budget using the USGS groundwater model (when it is available) would significantly improve understanding of this dynamic. These management actions are described in Section 6.

3.1.4.2 Groundwater Level Monitoring Well Spatial Distribution and Well Construction Information

Although the existing groundwater level monitoring network satisfies the well density guidance cited in the best management practice (BMP) guidance for monitoring networks developed by DWR (DWR, 2016a, DWR 2016b), there are areas identified within the Basin (see Figure 5-3) where the addition of monitoring wells would improve the hydrogeologic conceptual model discussed in this section. Two low-density areas in both principal aquifers were identified in the Basin: the eastern uplands and the central to northwestern uplands. The SWRCB Irrigated Lands Regulatory Program indicates that private agricultural supply wells have been identified in the eastern uplands area. An effort will be made during GSP implementation to contact owners of wells in the eastern uplands area to determine whether they can be included in the monitoring program. Including these additional wells in the groundwater level monitoring network would minimize the uncertainty of groundwater elevation trends and benefit sustainable management of the Basin. Two wells in the central to northwestern uplands area, completed in the Careaga Sand, were previously monitored by the USGS or the San Antonio Basin Groundwater Sustainability Agency (SABGSA). However, well access has been denied by the well owners. The SABGSA will make an effort to negotiate access to these wells.

Well completion reports (WCRs) are available online through DWR's Online System for Well Completion Reports database; however, the WCR identification numbers are unknown for many of the wells in the groundwater level monitoring network and therefore it is not possible to always identify the associated WCRs. These are data gaps that, when filled, will improve the accuracy of the hydrogeologic conceptual model and understanding of groundwater flow in the Basin.

3.1.4.3 Hydraulic Properties

The current estimates of the hydraulic conductivity (permeability) and specific yield of the various sedimentary layers composing the Paso Robles Formation and Careaga Sand are based on limited data. This is a data gap that, when filled, will improve the ability of a groundwater flow model to reflect Basin conditions and interactions.

3.2 Groundwater Conditions [§ 354.16]

This section describes the current and historical groundwater conditions in the Paso Robles Formation and Careaga Sand in the Basin. In accordance with the SGMA Emergency Regulation § 354.16,[17] current conditions are any conditions occurring after January 1, 2015. By implication, historical conditions are any conditions occurring prior to January 1, 2015. This section focuses on information required by the GSP regulations and information that is important for developing an effective plan to achieve sustainability. The organization of this section aligns with the five sustainability indicators applicable to the Basin as prescribed by DWR. The objective is to evaluate groundwater conditions and identify whether any of the following conditions are significant and unreasonable in the Basin.

1. Chronic lowering of groundwater elevations
2. Changes in groundwater storage
3. Subsidence
4. Depletion of interconnected surface waters
5. Groundwater quality

The sixth sustainability indicator, seawater intrusion, is not applicable to the Basin.

[17] On May 16, 2016, the State Water Board adopted Resolution 2017-33 to adopt an Emergency Regulation for Implementation of the Sustainable Groundwater Management Act of 2014 (SGMA). On June 19, 2017, the regulation was submitted to the Office of Administrative Law (OAL) for review. OAL approved the regulation on June 29, 2017.

3.2.1 Groundwater Elevations [§ 354.16(a)]

The following assessment of groundwater elevation conditions is largely based on historical groundwater gaging data compiled by the USGS, the USGS GAMA Program, and quarterly groundwater gaging completed by GSI Water Solutions, Inc. (GSI), beginning in the fourth quarter of 2019 and continuing to the present. Groundwater levels are measured by GSI through a network of public and private wells in the Basin. Historical groundwater elevation data compiled by the USGS include data obtained from available sources such as the California Statewide Groundwater Elevation Monitoring (CASGEM) Program database and other regulatory compliance programs. The locations of the wells (totaling approximately 56, depending on the year) used for the groundwater elevation assessment are shown on Figure 3-11. Access to some of these wells is currently being negotiated or has been denied. Consequently, more recent (2020 to the present) groundwater elevation data are not available for these wells. The set of wells shown on Figure 3-11 denoted as *representative wells* were selected from the larger set of monitoring wells included in the Basin's groundwater level monitoring network. This subset of wells was selected based on the existence of sufficient information to assign the well to either the Paso Robles Formation or the Careaga Sand and whether the well has a sufficiently long period of record to identify groundwater elevation trends in the well's hydrograph.

Groundwater elevation data were deemed representative of static conditions, based on a check of consistency with nearby wells. Additional information about the monitoring network is provided in Section 5. In accordance with the SGMA regulations, the following information, based on available data for both principal aquifers in the Basin, is presented:

- Groundwater elevation contour maps for the seasonal high and low periods for 2018
- Hydrographs for wells with publicly available data
- Assessments of horizontal and vertical groundwater gradients

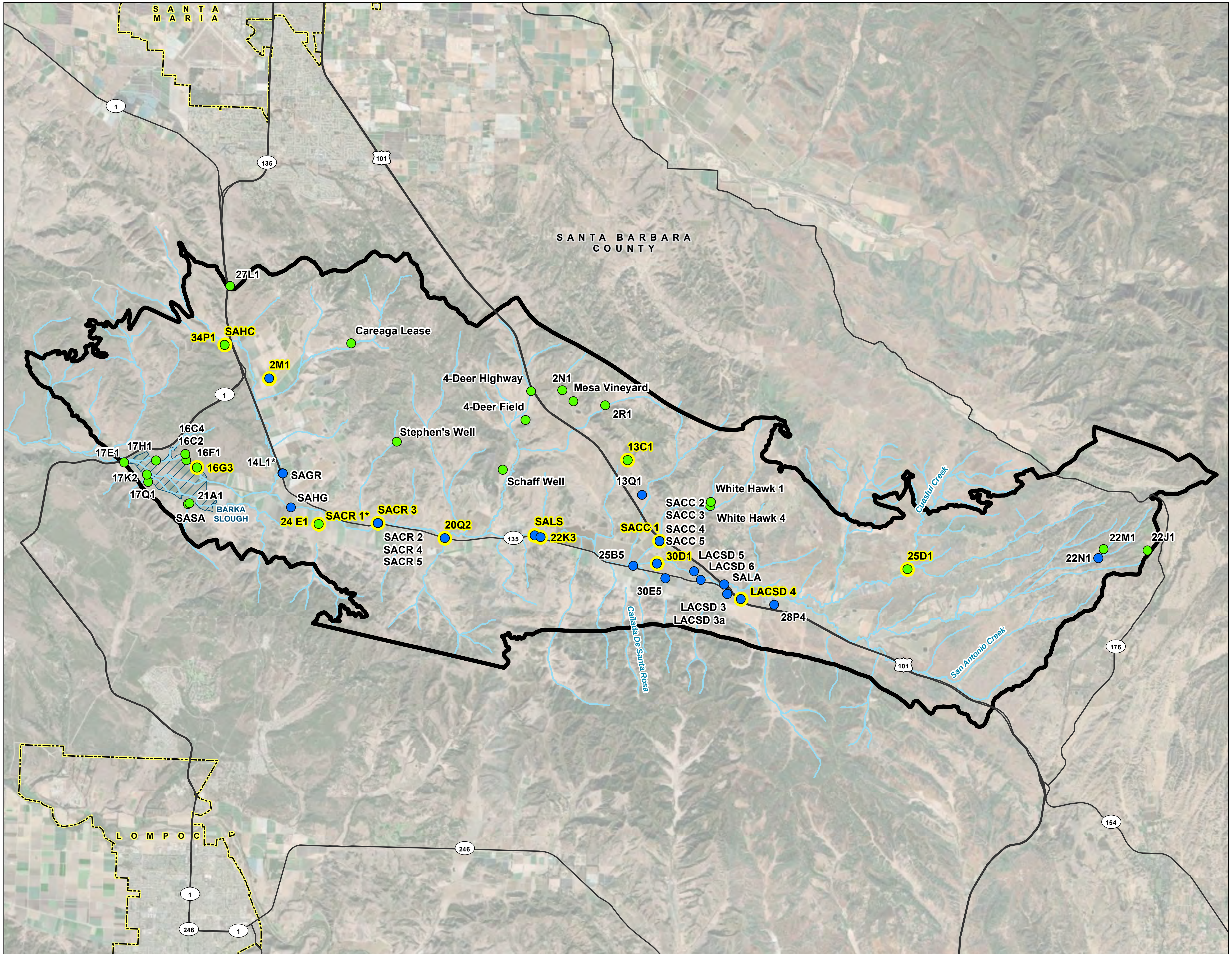

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FIGURE 3-11

Wells Included in the San Antonio Creek Valley Groundwater Basin Groundwater Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Representative Well

Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand

All Other Features

- San Antonio Creek or Tributary
- Major Road
- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019a), Maxar imagery (2020)

GSI Water Solutions, Inc.

3.2.1.1 Groundwater Elevation Contours [§ 354.16(a)(1)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:

(1) Groundwater elevation contour maps depicting the groundwater table or potentiometric surface associated with the current seasonal high and seasonal low for each principal aquifer within the basin.

Groundwater elevation data for 2018 for the Paso Robles Formation and Careaga Sand were contoured to assess current spatial variations, groundwater flow directions, and horizontal groundwater gradients. Contour maps were prepared for the seasonal high groundwater levels, which typically occur in the spring, and the seasonal low groundwater levels, which typically occur in the fall. In general, the spring groundwater data are for March and the fall groundwater data are for October. Data from public and private wells were used for contouring; information identifying the owner or detailed location of private wells is not shown on the maps. The contours are based on groundwater elevations measured at the well locations shown on Figure 3-11. Contour maps were generated using a computer-based contouring program and checked for representativeness by a qualified hydrogeologist. Groundwater elevation data deemed unrepresentative of static conditions, or erroneous, were not used for contouring.

Paso Robles Formation Groundwater Elevation Contours and Horizontal Groundwater Gradients

Figures 3-12 and 3-13 show the contours of groundwater elevations in the Paso Robles Formation for spring and fall 2018, respectively. In general, groundwater conditions in the Basin in the spring and fall of 2018 were similar. Close inspection of the contour maps indicates that groundwater elevations are generally lower in the fall than spring. Groundwater elevations in 2018 ranged from approximately 1,120 ft amsl in the northeast portion of the Basin to about 270 ft amsl just east of Barka Slough. Groundwater flow direction is inferred as being from high to low elevations in a direction perpendicular to groundwater elevation contours. Groundwater flow direction is generally to the west across most of the Basin, except in the northwest area of the Basin, where groundwater flow is to the south. In general, groundwater flow in the Basin tends to converge toward the lower groundwater levels in the San Antonio Creek and Barka Slough. Low groundwater elevation contour lines near the town of Los Alamos indicate a groundwater pumping center. Low groundwater elevations along Harris Canyon indicate another potential pumping center. Horizontal groundwater gradients range from approximately 0.004 ft/ft along the San Antonio Creek between Los Alamos and the Barka Slough to approximately 0.02 ft/ft in the area between Alisos Canyon Road and Fox Canyon Road east of Los Alamos.

The groundwater level contours in this GSP are based on a reasonable and thorough analysis of the currently available data. As discussed in Section 5, the monitoring network may be expanded to more completely assess Basin conditions and demonstrate compliance with the sustainability goal for the Basin. Expanding the monitoring network and acquiring more groundwater elevation data will allow the SABGSA to refine and modify this GSP in the future based on a more complete understanding of basin conditions.

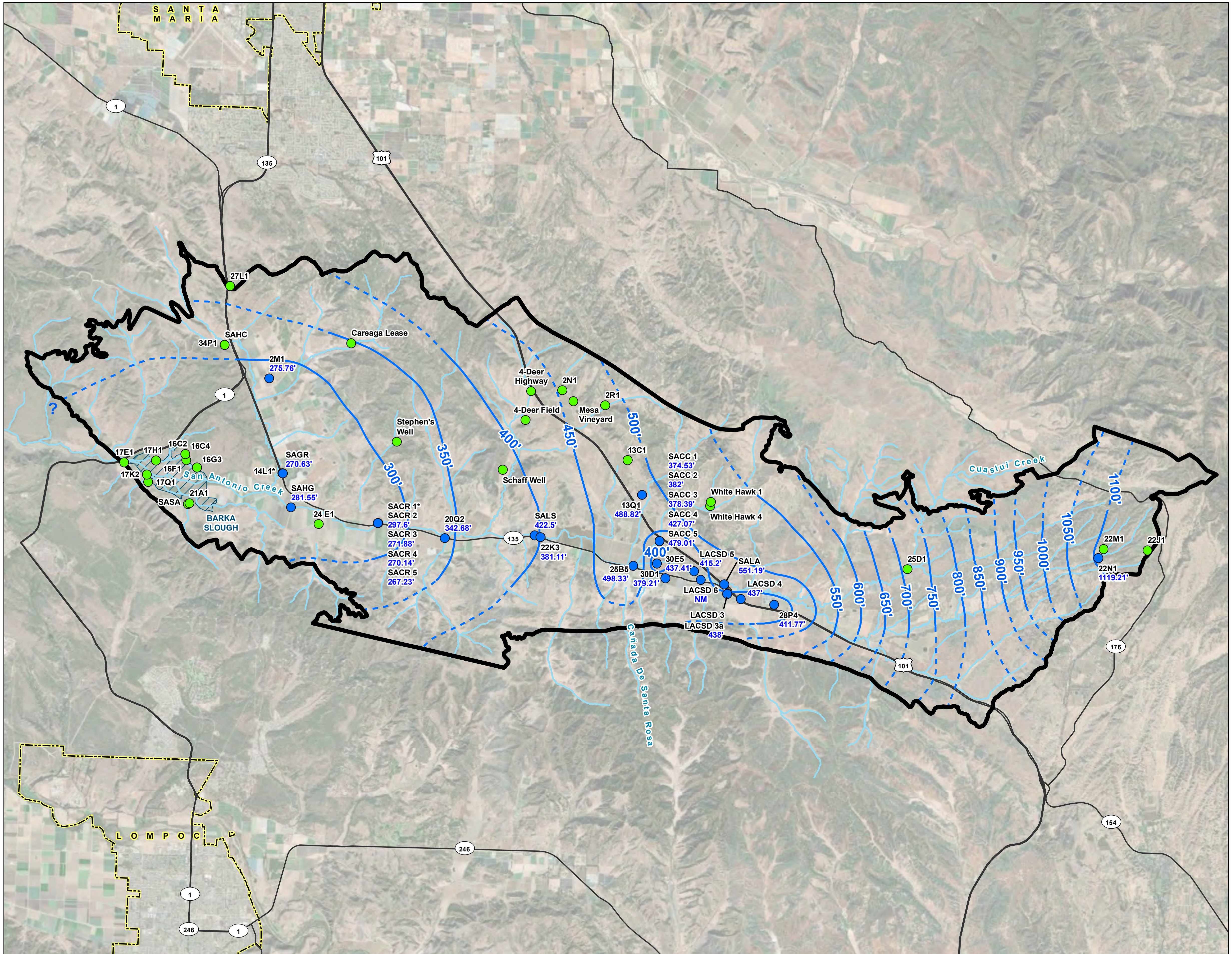

FIGURE 3-12

Paso Robles Formation Groundwater Elevation Contours Spring 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Groundwater Elevation Contour, feet amsl (dashed where inferred)

Wells (by screened aquifer)

Paso Robles Formation
Groundwater Elevation (feet amsl)

Careaga Sand

All Other Features

San Antonio Creek or Adjacent Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

amsl: above mean sea level
NM: not measured

N

0 5,000 10,000 15,000
Feet

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

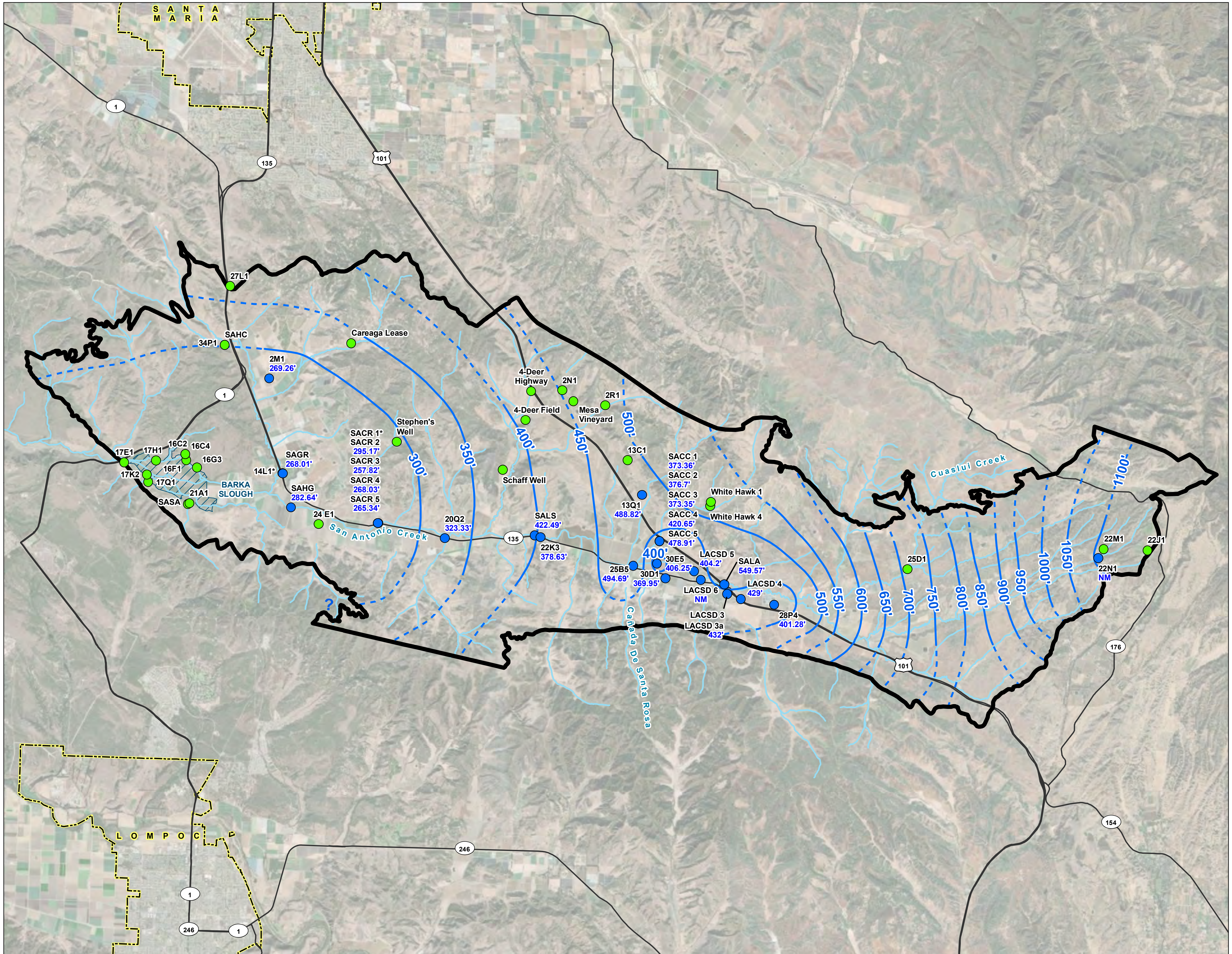

FIGURE 3-13

Paso Robles Formation Groundwater Elevation Contours Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Groundwater Elevation Contour, ft amsl (dashed where inferred)

Wells (by screened aquifer)

Paso Robles Formation
Groundwater Elevation (feet amsl)

Careaga Sand

All Other Features

San Antonio Creek or Adjacent Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

amsl: above mean sea level
NM: not measured

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_13_GW_Contours_PasoRoblesFall2018.mxd

Careaga Sand Groundwater Elevation Contours and Horizontal Groundwater Gradients

Figures 3-14 and 3-15 show contours of current groundwater elevations in the Careaga Sand for spring and fall 2018, respectively. In general, groundwater conditions in the Basin in the spring and fall of 2018 were similar. Close inspection of the contour maps indicates that groundwater elevations are generally lower in the fall than spring. Groundwater elevations in 2018 ranged from approximately 1,157 ft amsl in the northeast portion of the Basin to about 227 ft amsl at the west end of Barka Slough. Groundwater flow direction is inferred as being from high to low elevations in a direction perpendicular to groundwater elevation contours. Groundwater flow direction is generally to the west over most of the Basin, except in the northwest area of the Basin where groundwater flow is to the south-southwest. In general, groundwater flow in the Basin tends to converge toward the lower groundwater levels in the San Antonio Creek and Barka Slough. Low groundwater elevations near well 24E1 indicate a potential pumping center. The horizontal groundwater gradient is steeper east of Los Alamos (at approximately 0.02 ft/ft) than between Los Alamos to the Barka Slough (where it flattens to approximately 0.01 ft/ft).

The groundwater level contours in this GSP are based on a reasonable and thorough analysis of the currently available data. As discussed in Section 5, the monitoring network should be expanded to more completely assess Basin conditions and demonstrate compliance with the sustainability goal for the Basin. Expanding the monitoring network and acquiring more groundwater elevation data will allow the SABGSA to refine and modify this GSP in the future based on a more complete understanding of basin conditions.

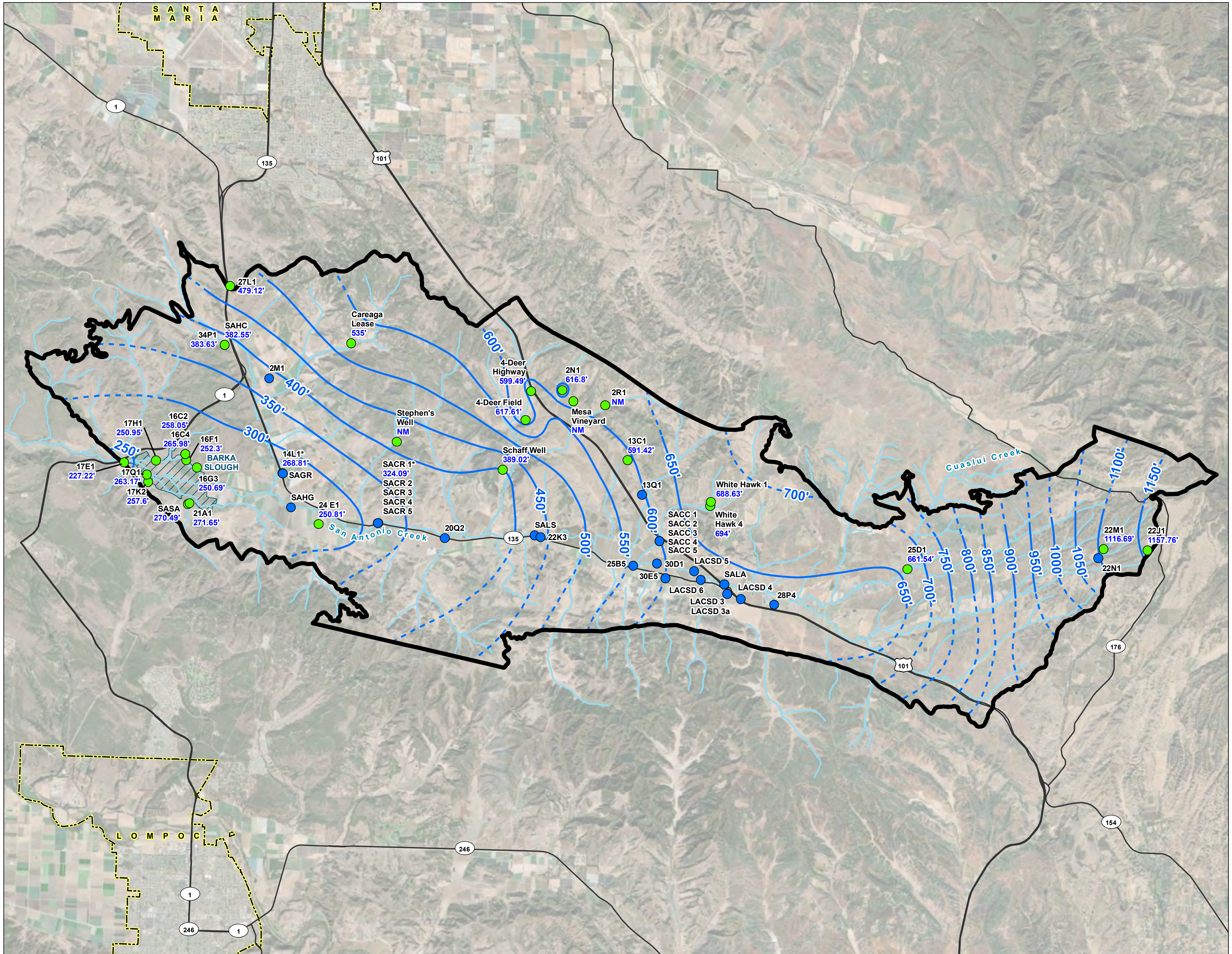

FIGURE 3-14

Careaga Sand Groundwater Elevation Contours Spring 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Groundwater Elevation Contour, ft amsl (dashed where inferred)

Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand
  Groundwater Elevation (feet amsl)

All Other Features

- San Antonio Creek or Adjacent Tributary
- Major Road
- San Antonio Creek Valley Groundwater Basin
- City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

amsl: above mean sea level
NM: not measured

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

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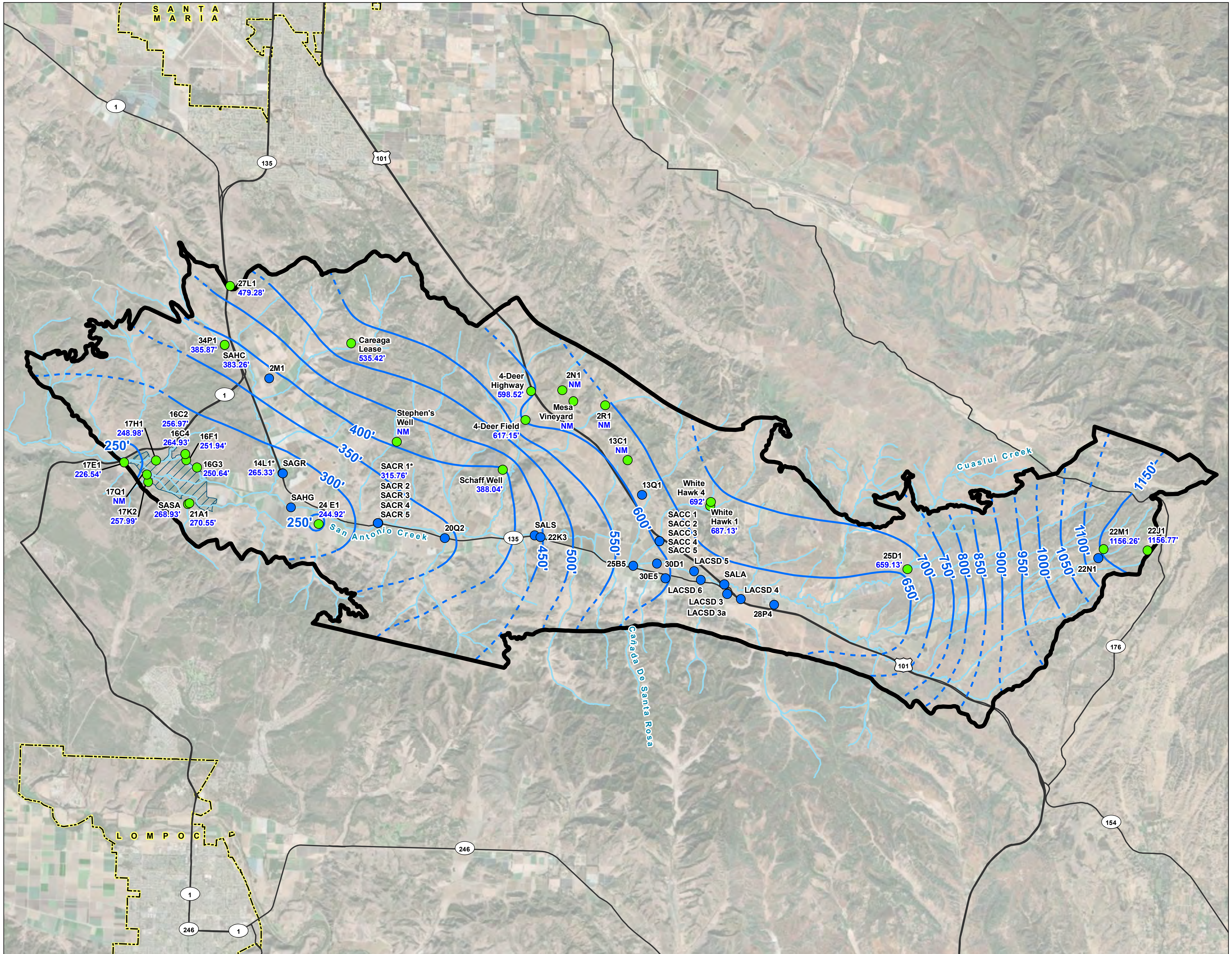

FIGURE 3-15

Careaga Sand Groundwater Elevation Contours Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Groundwater Elevation Contour, ft amsl (dashed where inferred)

Wells (by screened aquifer)

Paso Robles Formation

Careaga Sand
Groundwater Elevation (feet amsl)

All Other Features

San Antonio Creek or Adjacent Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

amsl: above mean sea level
NM: not measured

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

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3.2.1.2 Groundwater Elevation Hydrographs [§ 354.16(a)(2)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(a) Groundwater elevation data demonstrating flow directions, lateral and vertical gradients, and regional pumping patterns, including:

(2) Hydrographs depicting long-term groundwater elevations, historical highs and lows, and hydraulic gradients between principal aquifers.

Paso Robles Formation Hydrographs

Appendix D includes hydrographs for the wells in the Paso Robles Formation that have publicly available data. A total of 27 of the 57 monitoring wells included in the Basin monitoring network were identified as screened in the Paso Robles Formation. The aquifer in which wells are screened was determined from historical well logs, wells with reported screened interval data, hydrograph signatures, and the USGS San Antonio Creek Geohydrologic Framework Model (USGS, 2020c). As of June 2020, access agreements have been secured for 19 of the 27 monitoring wells. Areas within the Basin with lower well density and limited publicly available groundwater level data for the Paso Robles Formation have been identified on Figure 5-3.

Long-term groundwater elevation declines are evident on the hydrographs shown in Appendix D. The magnitude of measured declines for wells with a period of record of at least 10 years ranges from approximately 26 (25B5) to 143 ft (30D1). The most significant water level declines occurred during the current drought (2012 to the present).

Precipitation data were reviewed and analyzed to determine the occurrence and duration of wet and dry periods for the Basin. Precipitation from the LAFD weather station was used for this analysis because it is representative of conditions in the Basin and has the longest period of record of any station in the Basin. Figure 3-16 shows total annual precipitation by water year recorded at the LAFD station. Mean annual precipitation during the period from 1910 to 2019 is 15.3 inches. Wet and dry periods were determined based the positive or negative trend of the slope generated using the cumulative departure from mean annual precipitation.

Figures 3-12 and 3-13 depict current groundwater elevations in the Basin for the Paso Robles Formation. Figures 3-17, 3-18, and 3-19 are hydrographs for wells 30D1, 20Q2, and 2M1, respectively. The hydrographs represent groundwater elevation over time shown by a dark blue line. In addition to groundwater levels, the figures also have a light blue line plotted that represents the cumulative departure from mean annual precipitation for the Basin.

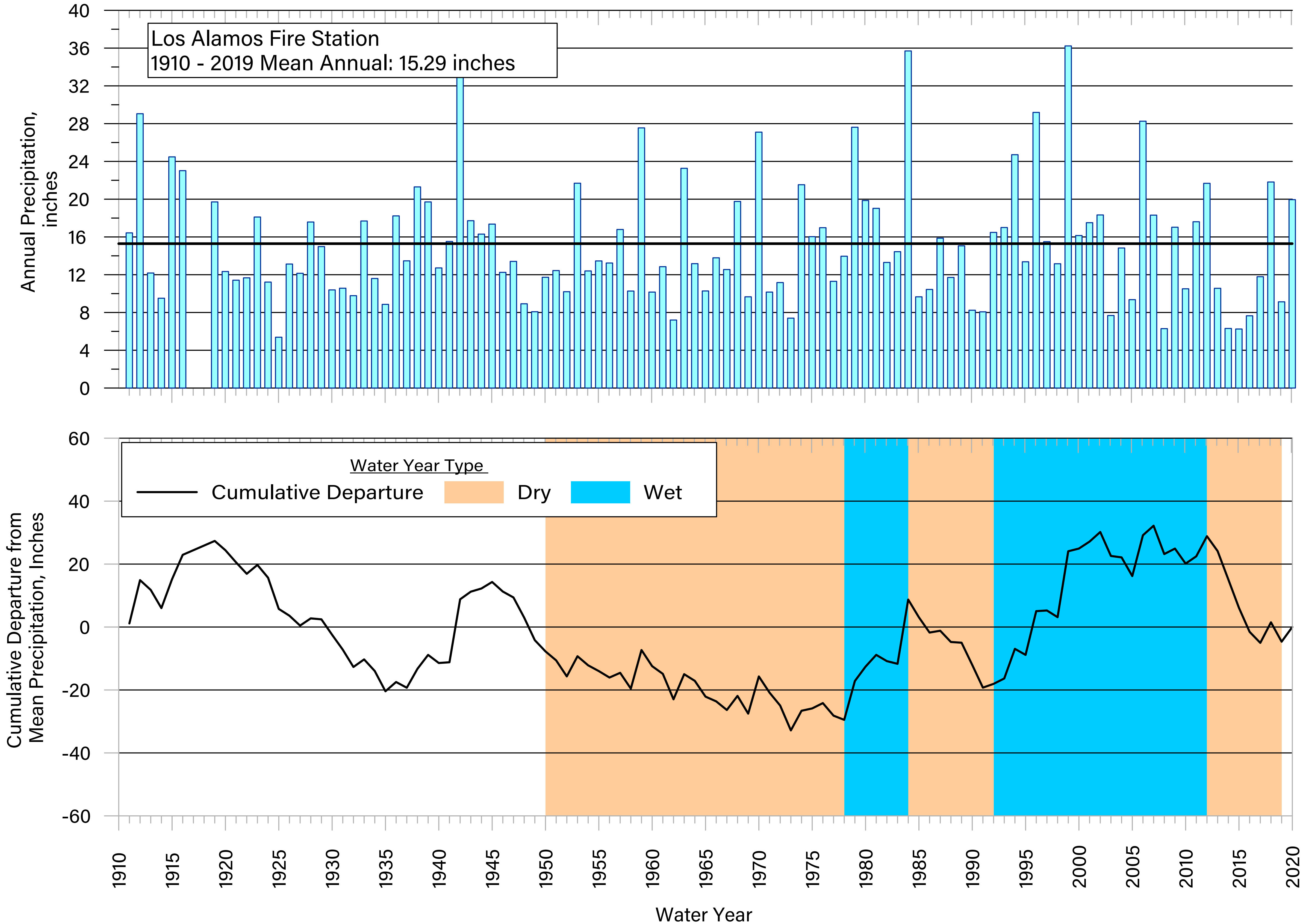

FIGURE 3-16

LAFD Annual Precipitation and Cumulative Departure from Mean Annual Precipitation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Date: September 16, 2021
Data Sources: County of Santa Barbara Public Works Department (n.d.)

GSI Water Solutions, Inc.

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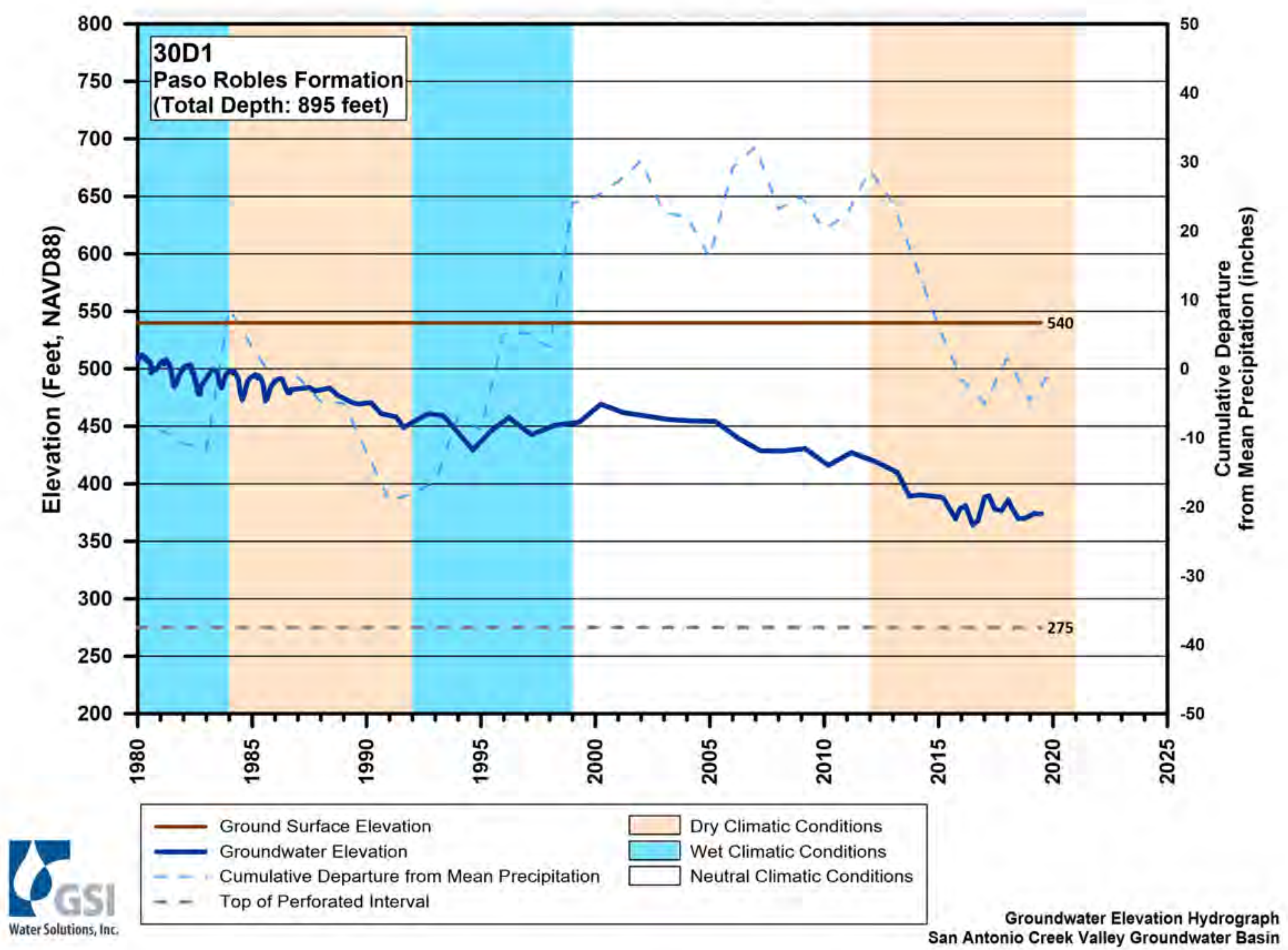

Figure 3-17. Hydrograph for Well 30D1, Paso Robles Formation

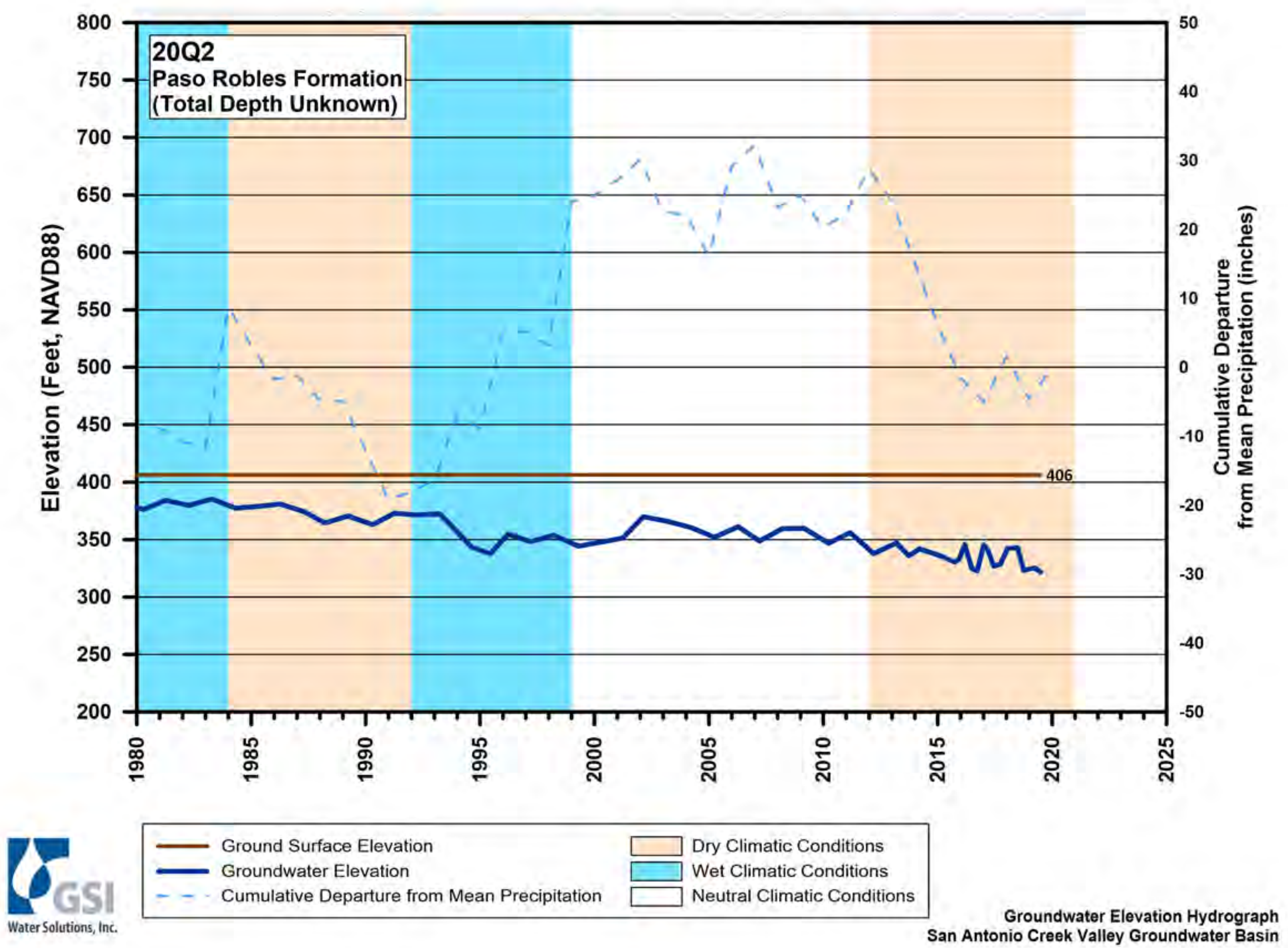

Figure 3-18. Hydrograph for Well 20Q2, Paso Robles Formation

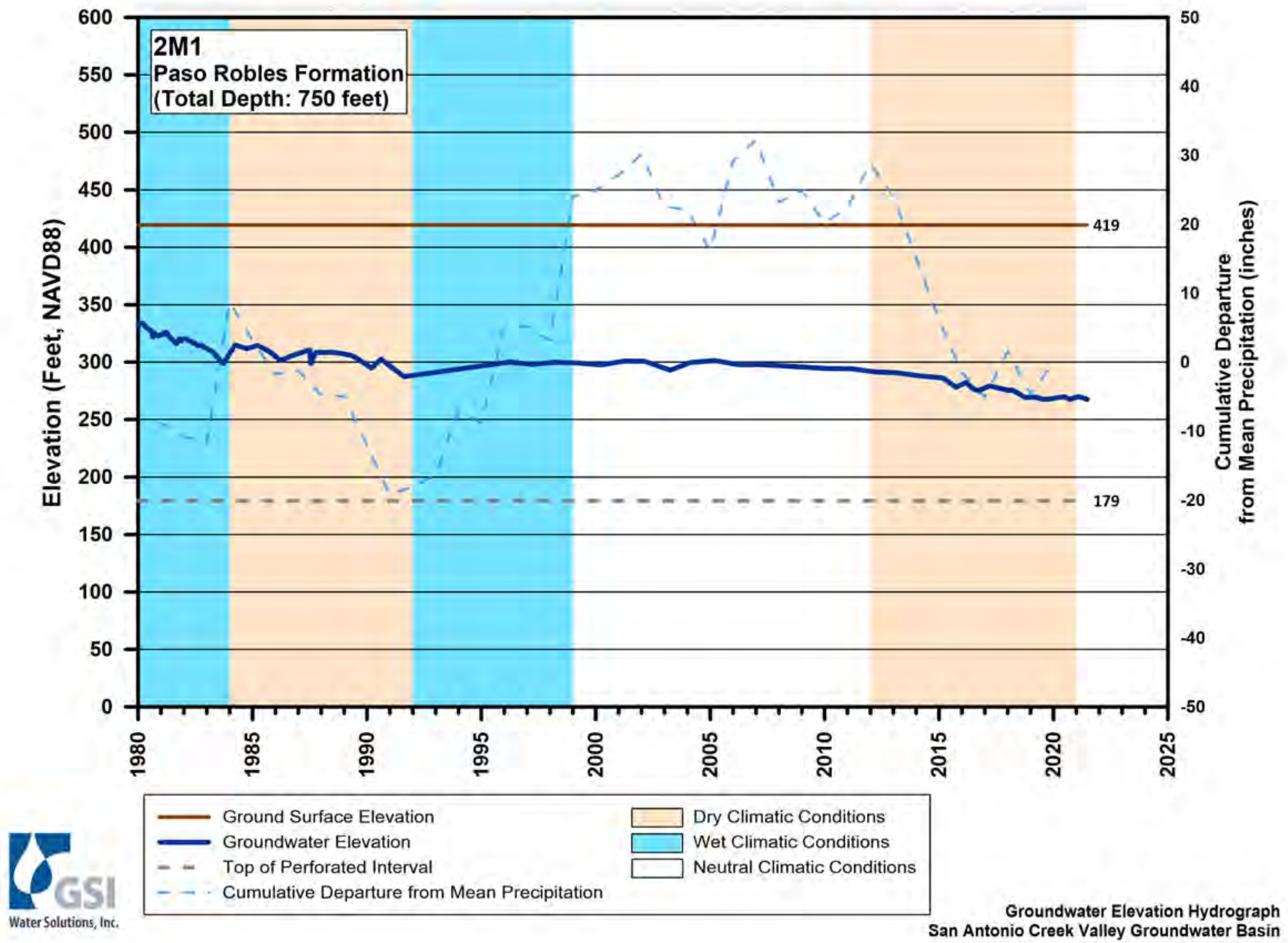

Figure 3-19. Hydrograph for Well 2M1, Paso Robles Formation

The locations of wells 30D1, 20Q2, and 2M1 can be seen on Figure 3-11. Well 30D1 is near the town of Los Alamos. Well 20Q2 is along the San Antonio Creek, approximately halfway between Los Alamos and the Barka Slough. Well 2M1 is in Harris Canyon, near the intersection of State Highway 1 and State Highway 135. The locations of the three wells provides a spatially representative picture of groundwater levels in the Basin from approximately 1980 to the present. Groundwater levels in all three hydrographs indicate a downward trend until approximately 2017. A plot of the cumulative departure from mean annual precipitation indicates a period of above-average precipitation beginning prior to 1980 and lasting until 1983. That period was followed by below-average rainfall until 1990. A period of above-average rainfall continued until 2011. These changes in rainfall are generally reflected in the water level hydrographs. Although some recovery has occurred in groundwater levels during periods of above-average rainfall, the overall trend shows sharply declining water levels. Since 2017, which had above average precipitation, the observed water levels in wells 30D1 and 2M1 indicate stabilization. It is unclear whether this is the case at well 20Q2.

Table 3-2 lists the groundwater elevation high, low, and total change over the period of record for wells 30D1, 20Q2, and 2M1. The historical groundwater elevation low for all three wells has occurred in the last 5 years.

Table 3-2. Change in Groundwater Elevations – Paso Robles Formation

Well Name	Aquifer	Groundwater Elevation High (ft amsl)	Year	Groundwater Elevation Low (ft amsl)	Year	Total Change (ft)	Period of Record (Years)
30D1	Paso Robles Formation	516.82	1978	364.45	2016	(142.57)	42
20Q2	Paso Robles Formation	399.01	1958	321.80	2019	(77.21)	61
2M1	Paso Robles Formation	335.89	1978	267.21	2019	(62.71)	43

Notes

Parentheses around a value, such as (142.57), indicate a negative value.

ft amsl = feet above mean sea level ft = feet

Careaga Sand Hydrographs

Appendix D includes hydrographs for wells with publicly available data completed in the Careaga Sand. A total of 30 of the 57 monitoring wells included in the Basin monitoring network were identified as being screened in the Careaga Sand. Screened interval data are not available for many of the wells included in the Basin monitoring network. The aquifer in which wells are screened was determined from historical well logs, wells with reported screened interval data, hydrograph signatures, and the USGS San Antonio Creek Geohydrologic Framework Model (USGS, 2020c). As of June 2020, access agreements have been secured for 17 of the 30 monitoring wells. The limited spatial coverage of publicly available groundwater level data for the Careaga Sand is a significant data gap. Long-term groundwater elevation declines are evident in virtually all of the hydrographs shown in Appendix D. The magnitude of measured declines for wells with a period of record of at least 10 years ranges from approximately 1 (22J1) to 70 ft (14L1).

Figures 3-14 and 3-15 depict current groundwater elevations within the Basin for the Careaga Sand. Figures 3-20, 3-21, and 3-22 are hydrographs for wells 25D1, 14L1, and 16G3, respectively. The hydrographs represent groundwater elevations over time shown by a dark blue line. In addition to groundwater levels, the figures also have a light blue line plotted representing the cumulative departure from mean annual precipitation for the Basin.

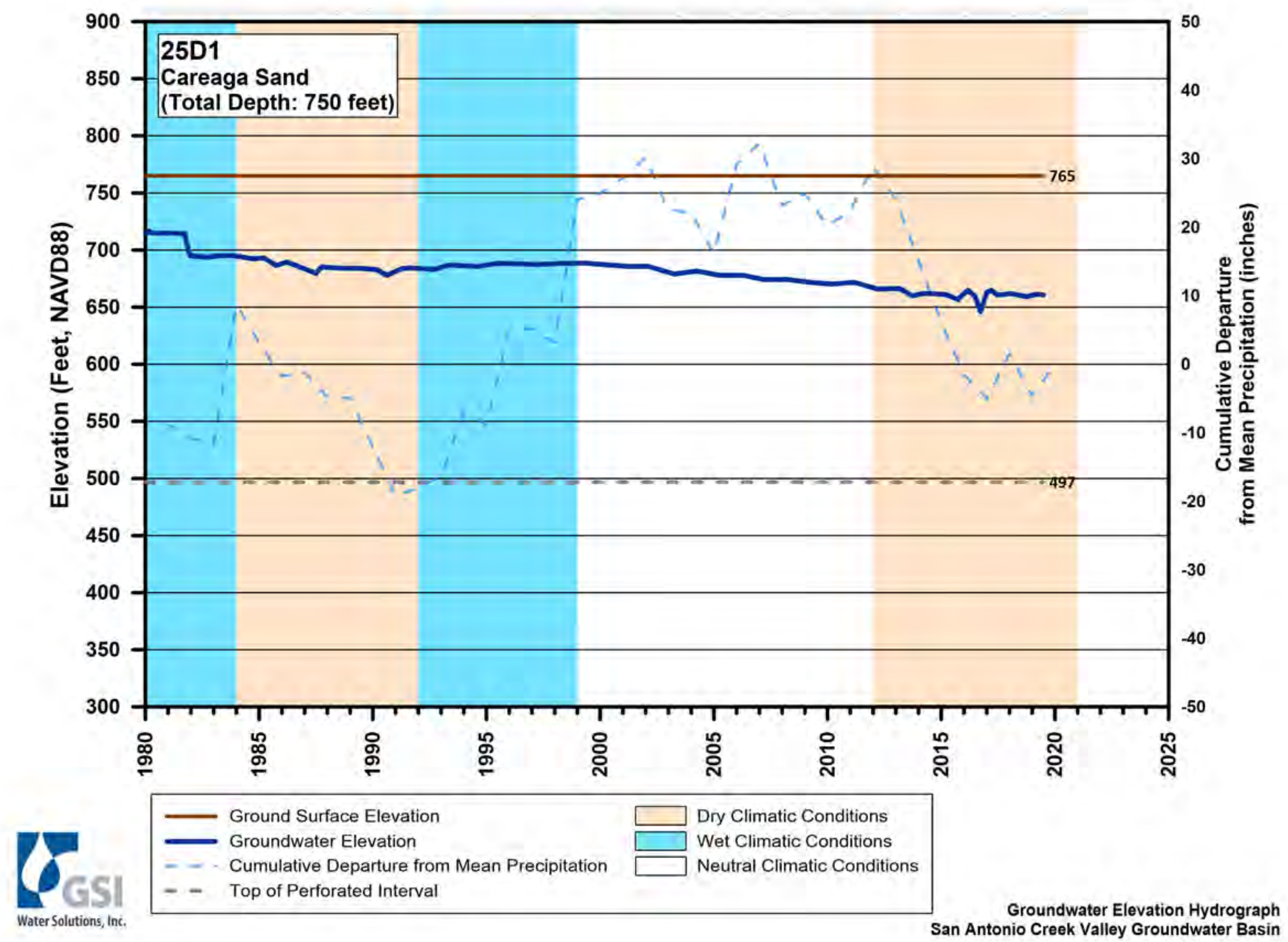

Figure 3-20. Hydrograph of Well 25D1, Careaga Sand

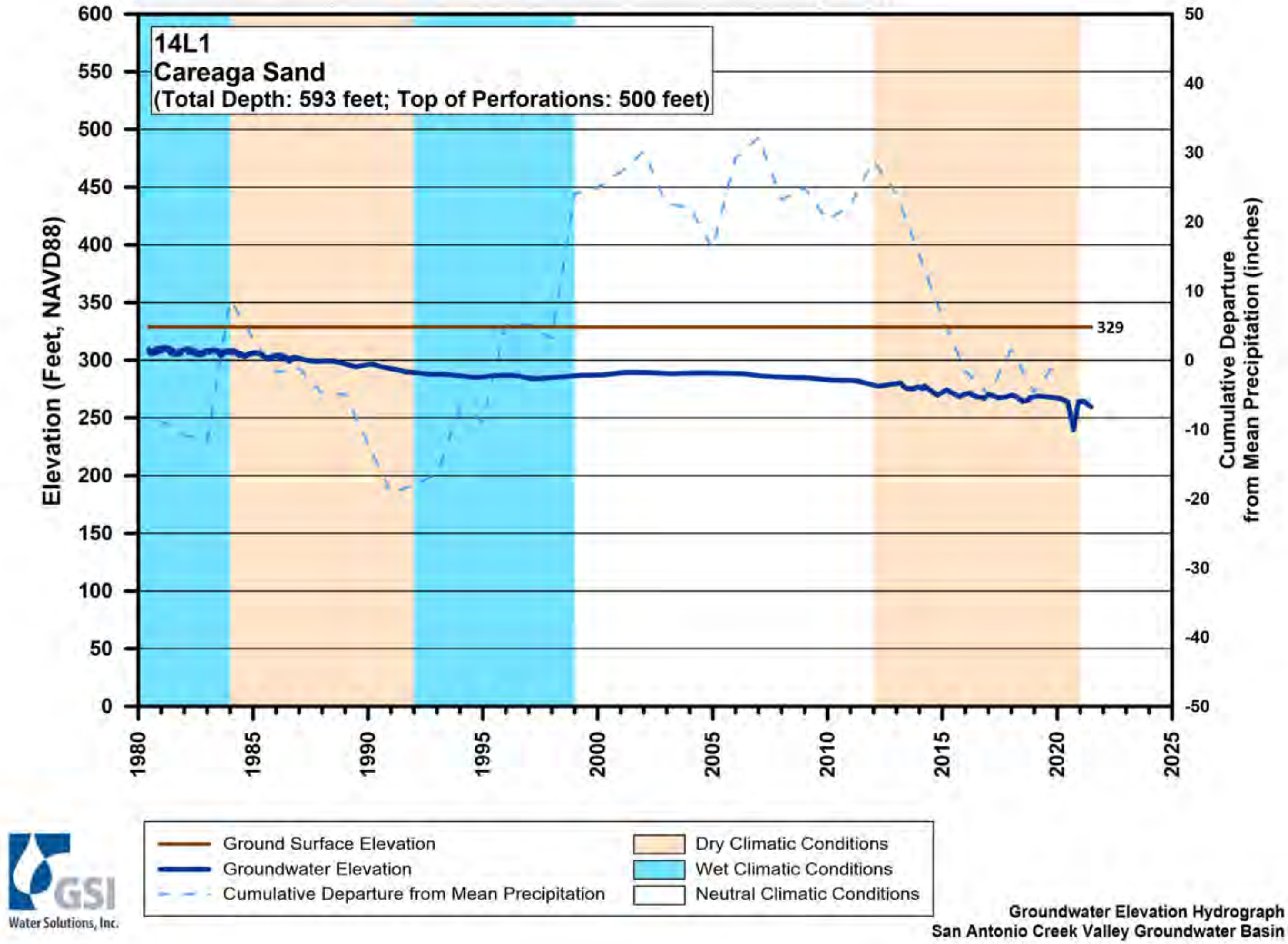

Figure 3-21. Hydrograph of Well 14L1, Careaga Sand

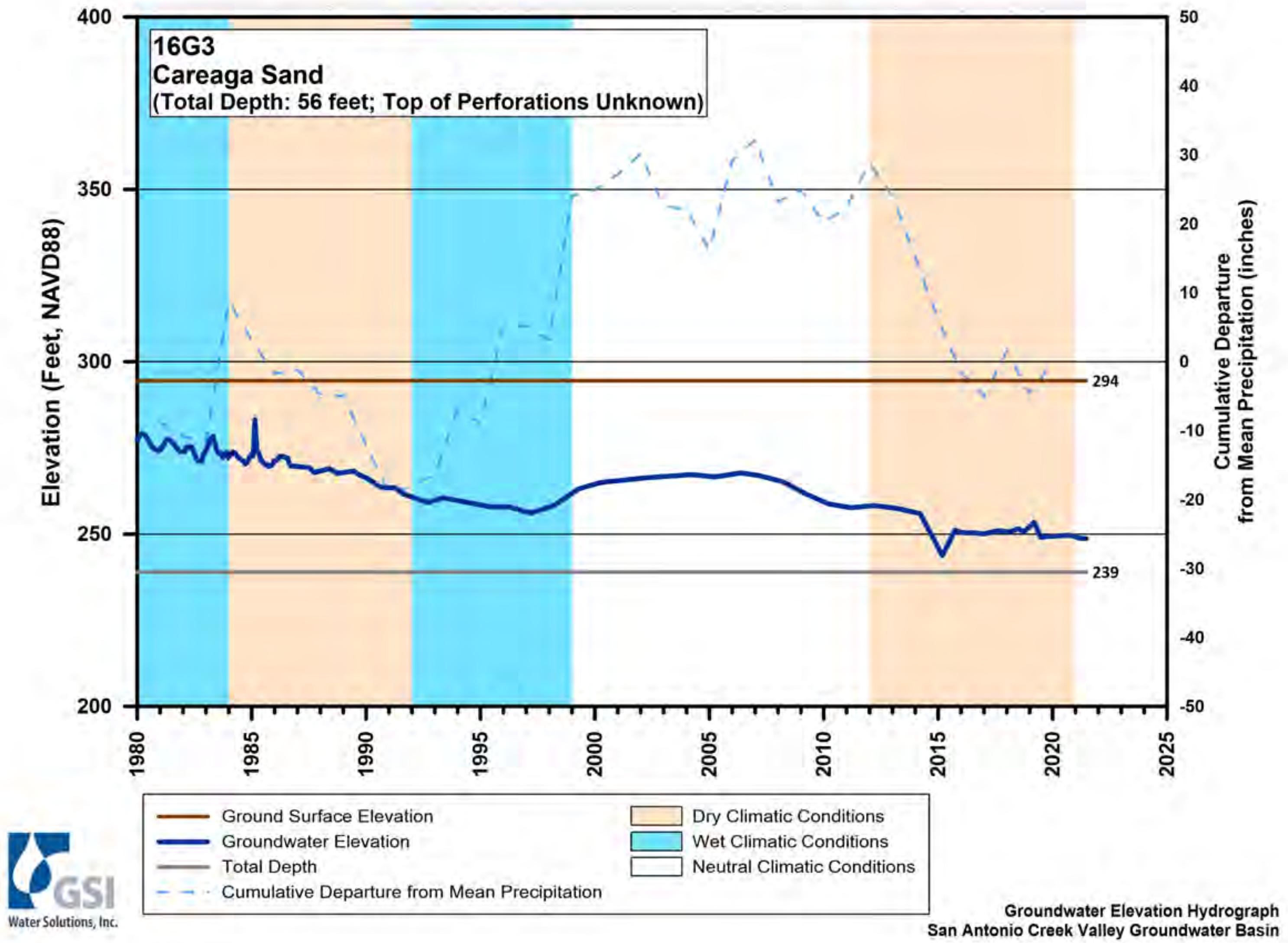

Figure 3-22. Hydrograph of Well 16G3, Careaga Sand

The locations of wells 25D1, 14L1, and 16G3 are shown on Figure 3-11. Well 25D1 is northwest of the town of Los Alamos. Well 14L1 is near the intersection of State Highway 135 and San Antonio Road. Well 16G3 is adjacent to the Barka Slough. The locations of the three wells provide a spatially representative picture of groundwater levels in the Basin from approximately 1980 to present day. Changes in rainfall are generally reflected in the water level hydrographs. Groundwater levels in all three hydrographs have indicated a downward trend until 2017, when above-average precipitation occurred. A plot of the cumulative departure from mean annual precipitation indicates a period of above-average rainfall beginning prior to 1980 and lasting until 1983. That period was followed by below-average rainfall until 1990. A period of above-average rainfall continued until 2011. Although some recovery has occurred in groundwater levels during periods of above-average rainfall, the overall trend shows sharply declining water levels. Since 2017, when the Basin received above-average precipitation, the observed water levels in wells 25D1 and 16G3 show stabilization. Water levels measured in well 14L1 continue to show a steep decline in water levels.

Table 3-3 lists the groundwater elevation high, low, and total change over the period of record for wells 25D1, 14L1, and 16G3. The historical groundwater elevation low for all three wells has occurred in the past 6 years.

Table 3-3. Change in Groundwater Elevations – Careaga Sand

Well Name	Aquifer	Groundwater Elevation High (ft amsl)	Year	Groundwater Elevation Low (ft amsl)	Year	Total Change (ft)	Period of Record (Years)
25D1	Careaga Sand	721.05	1977	646.28	2016	(60.38)	42
14L1	Careaga Sand	311.13	1981	259.49	2021	(48.41)	41
16G3	Careaga Sand	280.44	1976	243.85	2015	(35.04)	43

Notes

Parentheses around a value, such as (60.38), indicate a negative value

ft amsl = feet above mean sea level   ft = feet   yrs = years

3.2.1.3 Well Impact Analysis

A well impact analysis was performed to aid in selecting minimum thresholds for the chronic lowering of groundwater levels sustainability indicator (see Section 4). Fall 2018 groundwater elevations were compared with top of well screen elevations for agricultural, municipal, and domestic wells screened in principal aquifers within the Basin. The percentage of wells with water levels below top of screen was calculated in 5-foot increments, starting with fall 2018 water levels.

The well impact analysis included 61 agricultural, municipal, and domestic wells in the Basin that have documented well construction and location information. The analysis was performed to help identify conditions that could result in a significant and unreasonable depletion of supply if static groundwater elevations fall below the top of well screen elevations.[18] Groundwater levels that consistently fall below the

[18] Well construction and location information were obtained from the California Department of Water Resources (DWR) Online System for Well Completion Reports, resulting in a total of 423 wells. Filtering the data set to only include wells with well construction and location information (location information required a latitude/longitude measurement with an accuracy more precise than Centroid of Section) resulted in a total of 43 wells. Agricultural wells included in the Groundwater Level Monitoring Network with known well construction information, LACSD municipal wells, and VSFB municipal wells were also included in the analysis.

top of the well screen are likely to result in increased well clogging from biological growth and mineral precipitation, cascading water, sand pumping, and reduced well yield. These conditions are considered by the SABGSA to be undesirable. The magnitude of this impact on well production differs depending on well type: agricultural, municipal, or domestic. For example, agricultural wells often are deeper and have longer well screens that can tolerate the loss of efficiency and greater drawdown that can result from water levels falling below top of screen. Municipal wells serve drinking water to citizens living in the Basin and therefore supply reduction cannot be easily addressed. Likewise, domestic wells tend to be shallower and may be more sensitive to water levels falling within the screen interval. For perspective, the average well depths for municipal, agricultural, and domestic wells included in the well impact analysis were approximately 587 ft, 684 ft, and 565 ft below ground surface, respectively.

Fall 2018 groundwater elevations measured in basin monitoring wells were used to assess how many wells have static water levels that are below the top of screen elevation as of that date and how many would be below top of screen if groundwater levels were lower.[19] The results of the analysis presented on Figure 3-23 indicate that groundwater water elevations in fall 2018 were below top of screen in 20 percent of domestic wells and 12 percent of agricultural wells in the Basin. No municipal wells had static groundwater elevations below the top of well screen. The well impact analysis was used to determine the number and type of wells in the Basin that may further be impacted (i.e., groundwater elevations below well top of screen elevation) if groundwater elevations decline further compared to fall 2018 groundwater elevations (see Figures 3-24 through 3-26).

[19] Fall 2018 groundwater elevations were selected based on recent available data with the greatest number of monitoring locations.

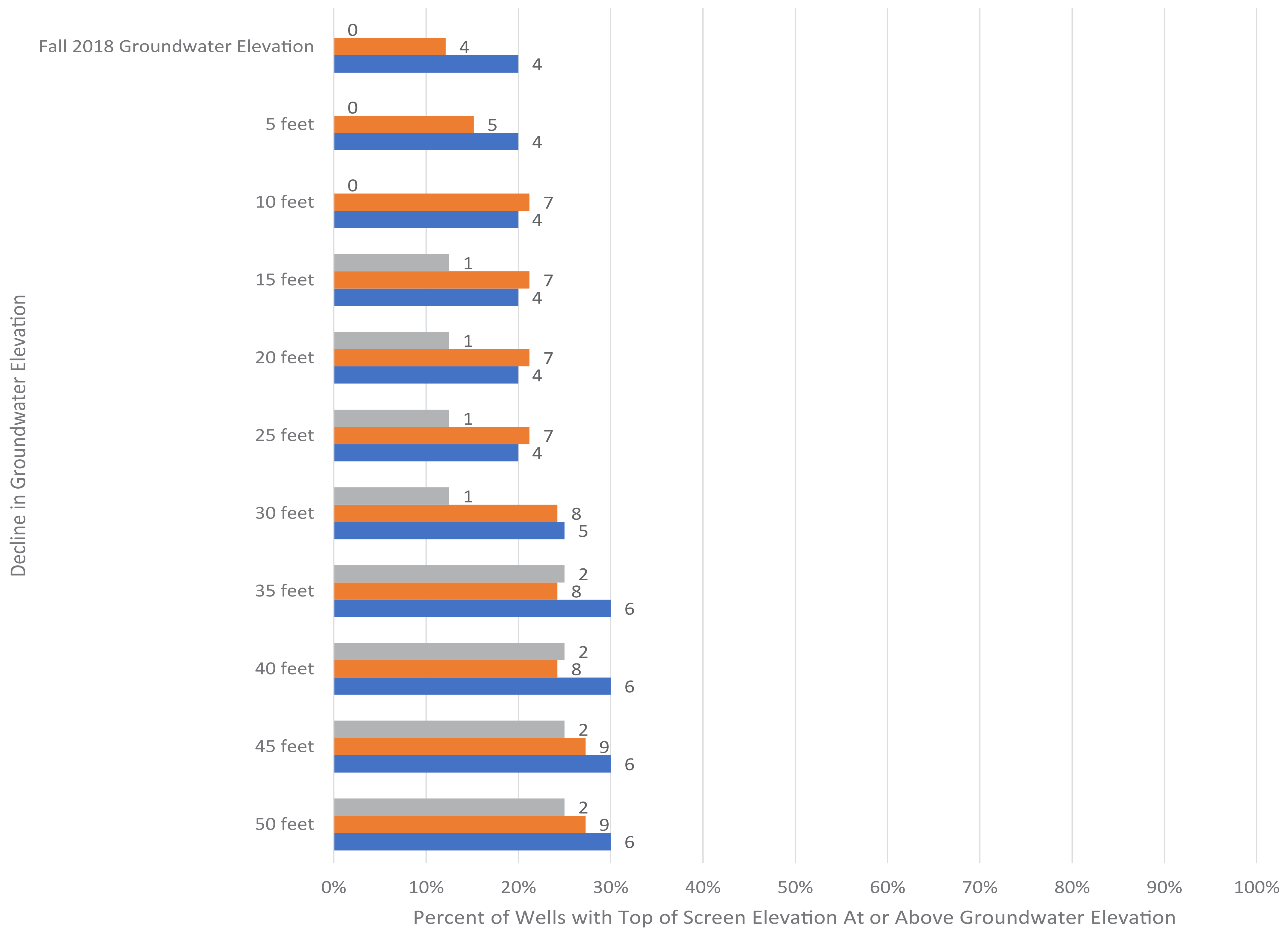

FIGURE 3-23

Well Impact Analysis, Paso Robles Formation and Careaga Sand, Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Municipal Wells (8)
- Agricultural Wells (33)
- Domestic Wells (20)

Date: September 16, 2021
Data Sources: DWR (n.d.)

GSI Water Solutions, Inc.

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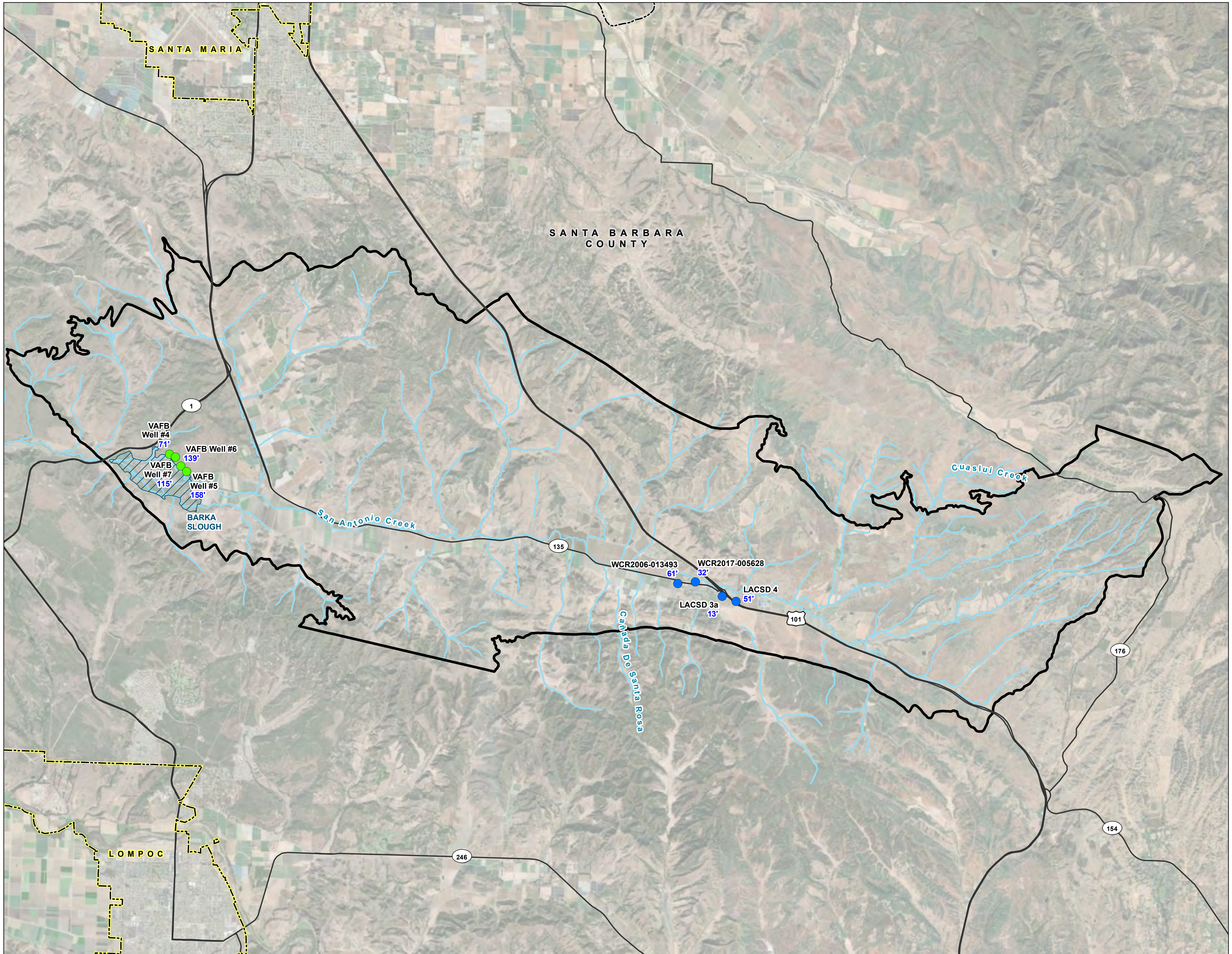

FIGURE 3-24

Well Impact Analysis for Municipal Wells Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Municipal Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand Formation
- 80' Approximate number of feet of groundwater above the reported well top of screen elevation compared to the Fall 2018 groundwater elevations in the Paso Robles Formation or Careaga Sand.

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_24_Municipal_Well_Impact_Analysis_top.mxd, abarry

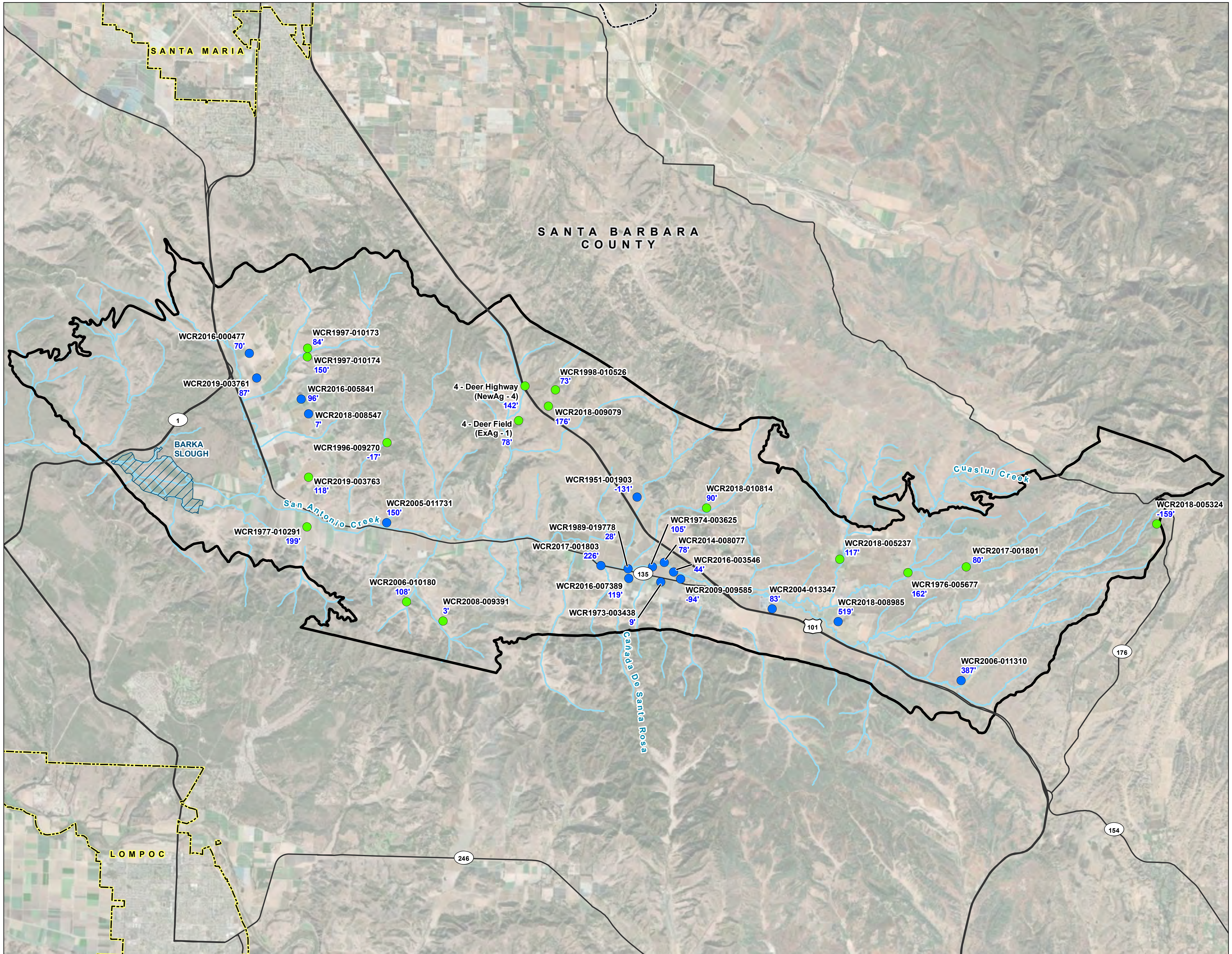

FIGURE 3-25

Well Impact Analysis for Agricultural Wells Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Agricultural Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand Formation
- 80' Approximate number of feet of groundwater above the reported well top of screen elevation compared to the Fall 2018 groundwater elevations in the Paso Robles Formation or Careaga Sand.

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

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Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_25_Agricultural_Well_Impact_Analysis_top.mxd, abarry

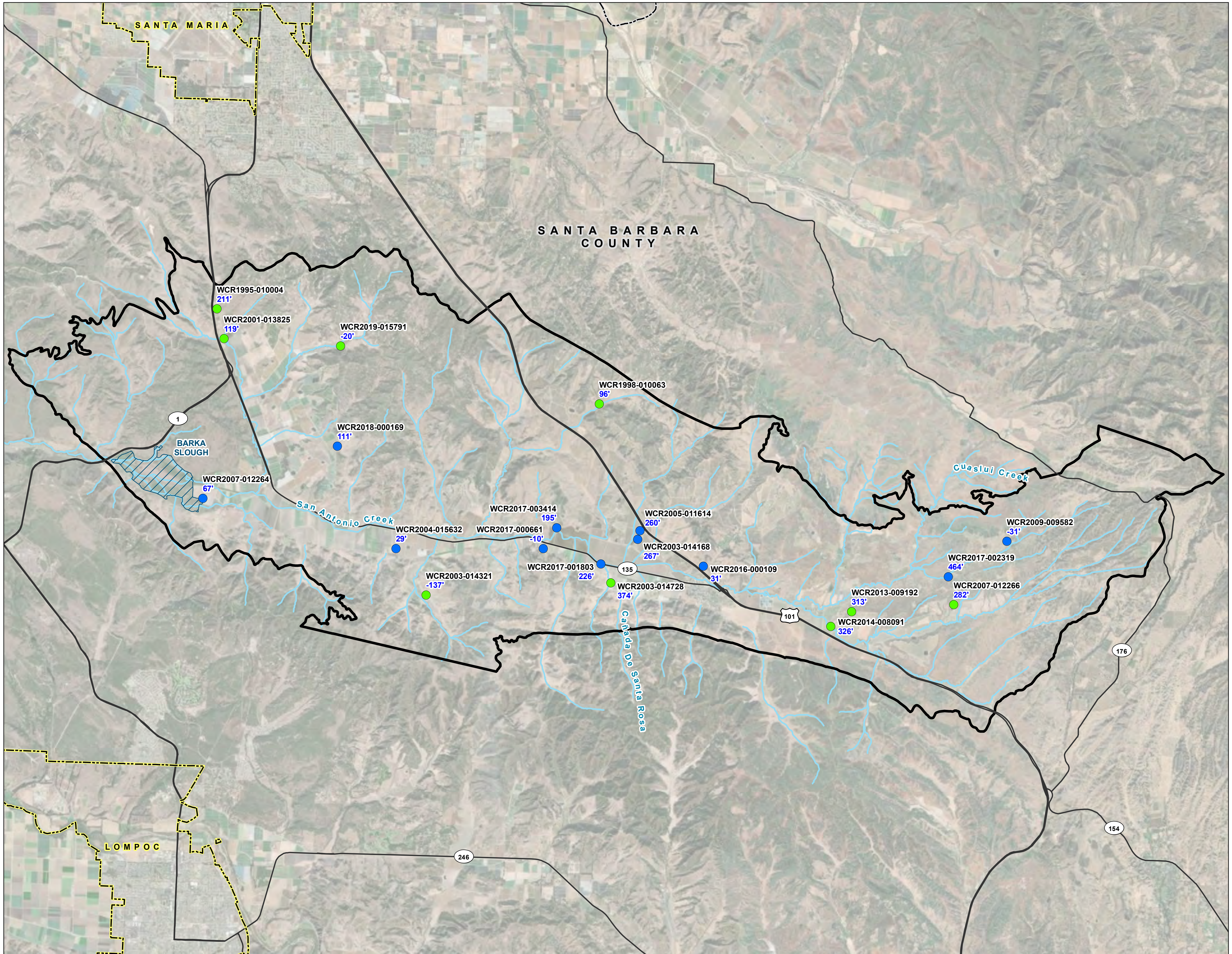

FIGURE 3-26

Well Impact Analysis for Domestic Wells Fall 2018

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Domestic Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand Formation
- **80'** Approximate number of feet of groundwater above the reported well top of screen elevation compared to the Fall 2018 groundwater elevations in the Paso Robles Formation or Careaga Sand.

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_26_Domestic_Well_Impact_Analysis_top.mxd, abarry

3.2.1.4 Vertical Groundwater Gradients

SGMA regulations require assessment of vertical gradients to evaluate the vertical direction of groundwater movement between and within aquifers. Vertical groundwater gradients can be estimated from nested or clustered wells. Currently, there four sets of nested wells in the Basin monitoring network: wells SACR 1 through SACR 5, wells SAGR and 14L1, wells 16C2 and 16C4, and wells SACC 1 through SACC 5 (see Figure 3-1 for their locations). Table 3-4 describes construction details and calculated vertical groundwater gradients for the nested wells. The wells and vertical groundwater gradient within each nested well set is ordered from deepest to shallowest. Based on the data from the four sets of nested wells, the vertical gradient of groundwater is generally downward in the eastern portion of the Basin and gradually becomes upward moving toward Barka Slough.

Table 3-4. Vertical Groundwater Gradient in Nested Wells

Well Name (From)	Aquifer	Surface Elevation (ft amsl)	Groundwater Elevation (ft amsl)	Well Depth (ft bgs)	Well Depth (ft amsl)	Well Name (To)	Vertical Gradient
SACR 1	Careaga Sand	362.45	314.78	690	(327.55)	SACR 2	0.16
SACR 2	Paso Robles Formation	362.45	291.22	540	(177.55)	SACR 3	0.21
SACR 3	Paso Robles Formation	362.45	251.54	350	12.45	SACR 4	(0.12)
SACR 4	Paso Robles Formation	362.45	267.70	220	142.45	SACR 5	0.04
SACR 5	Paso Robles Formation	362.45	262.75	110	252.45	—	—
14L1	Careaga Sand	328.72	237.92	593	(264.28)	SAGR	(0.06)
SAGR	Paso Robles Formation	329.64	266.94	90	239.64	—	—
SACC 1	Paso Robles Formation	586.08	369.53	940	(353.92)	SACC 2	(0.02)
SACC 2	Paso Robles Formation	586.08	373.08	720	(133.92)	SACC 3	0.01
SACC 3	Paso Robles Formation	586.08	371.25	530	56.08	SACC 4	(0.23)
SACC 4	Paso Robles Formation	586.08	418.00	325	261.08	SACC 5	(0.30)
SACC 5	Paso Robles Formation	586.08	478.99	120	466.08	—	—
16C4	Careaga Sand	328.59	262.14	560	(231.41)	16C2	0.02
16C2	Careaga Sand	328.59	253.99	169	159.59	—	—

Notes

Parentheses around a value, such as (327.55), indicate a negative value.

Groundwater elevation data are from the third quarter of 2020.

— = not applicable

ft amsl = feet above mean sea level

ft bgs = feet below ground surface

Wells SACR 1 through SACR 5 include wells screened in both the Paso Robles Formation (SACR 2 through SACR 5) and the Careaga Sand (SACR 1). Ordered from shallowest to deepest they are SACR 5 through SACR 1. Hydrographs for these wells are shown on Figure 3-27. Groundwater data for the set of nested wells indicate that the highest groundwater levels were recorded in SACR 1. It is apparent that there is an upward gradient within the nested wells except for the interval between SACR 3 and SACR 4, which is an approximate downward gradient of -0.12 ft/ft at this location.

SAGR and 14L1, are located adjacent to one another on the west end of the Basin and screened in the Paso Robles Formation and Careaga Sand, respectively. Hydrographs for these wells are shown on Figure 3-28. Groundwater gaging data for wells SAGR and 14L1 indicate that, prior to May 2017, groundwater levels in the Careaga Sand were higher than in the Paso Robles Formation at this location, indicating an upward vertical gradient. Declining water levels in the Careaga Sand since May of 2017 have resulted in a reversal in the direction of groundwater flow and an approximate downward gradient of -0.06 ft/ft at this location, as evident in the hydrograph for 14L1.

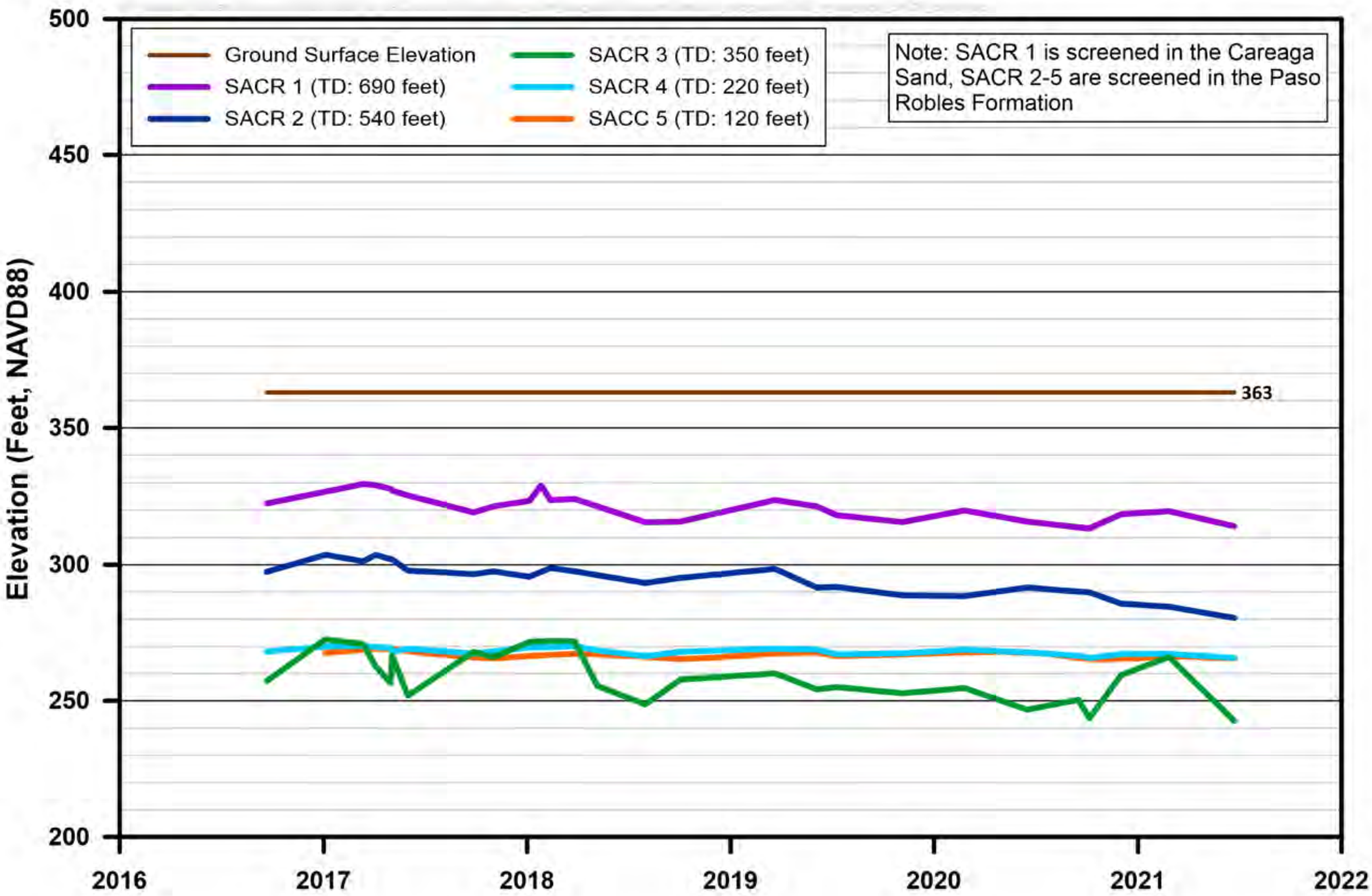

Figure 3-27. Hydrographs for SACR 1 through SACR 5

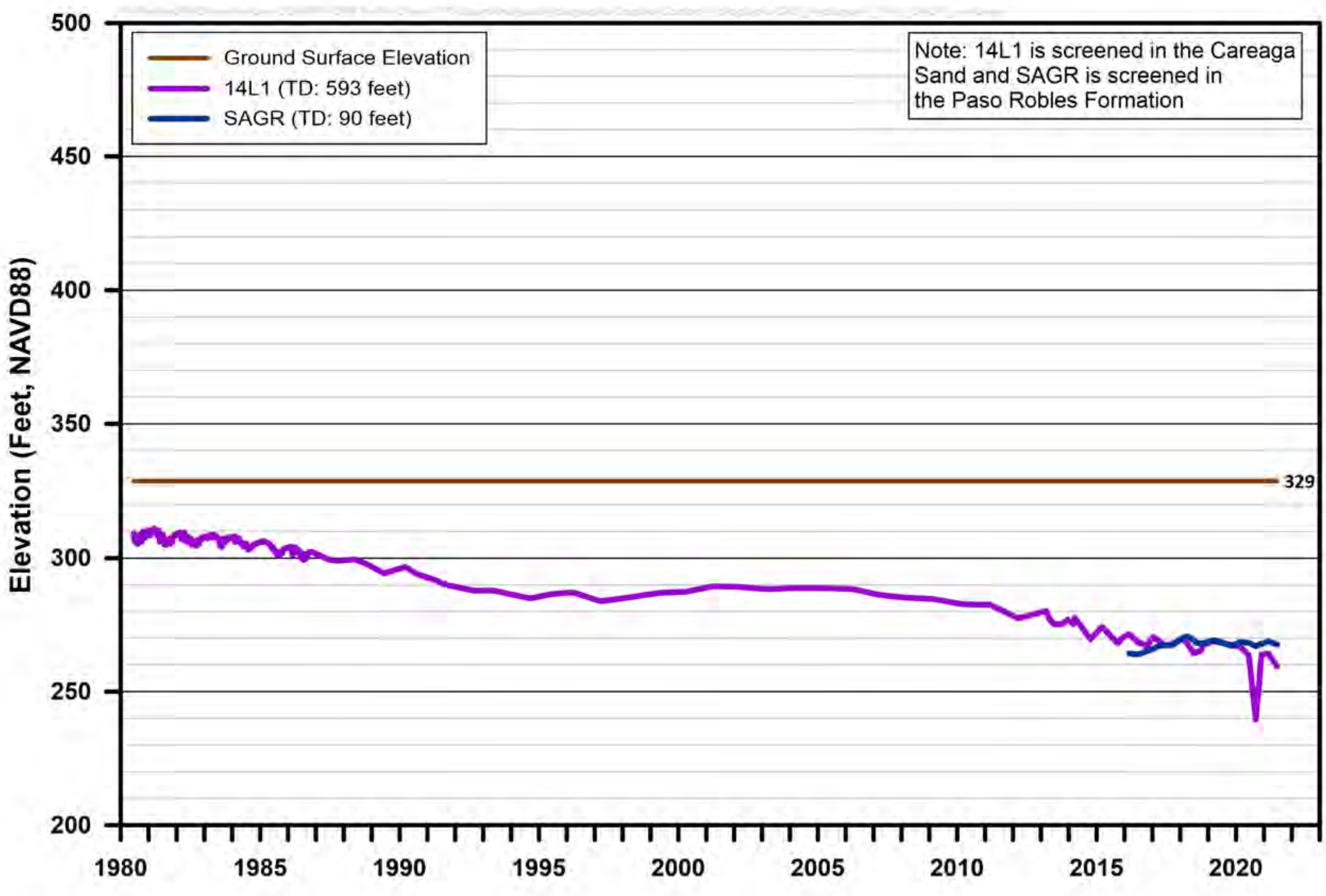

Figure 3-28. Hydrographs for 14L1 and SAGR

Nested wells, SACC 1 through SACC 5, are located near the town of Los Alamos and are all screened in the Paso Robles Formation. Ordered from shallowest to deepest they are SACC 5 through SACC 1. Hydrographs for these wells are shown on Figure 3-29. Groundwater data for the set of nested wells indicate that the highest groundwater levels were recorded in SACC 5. It is apparent that there is an overall downward gradient within the nested wells except for the interval between SACC 2 and SACC 3, which as an approximate upward gradient of 0.01 ft/ft at this location.

A pair of nested wells, 16C2 and 16C4, are located in the Barka Slough area and are both screened in the Careaga Sand. Hydrographs for these wells are shown on Figure 3-30. Well 16C4 is the deeper of the two wells and has a historically higher groundwater elevation, indicating an upward groundwater gradient. The upward flux of groundwater in this area of the Basin is suspected to be a result of the bedrock ridge underlying the western edge of the Barka Slough. The bedrock ridge forces virtually all groundwater to the surface as base flow in the Santa Ynez River or as vertical flux into the Barka Slough. Refer to Figure 3-31 The vertical gradient at this location is approximately 0.02 ft/ft.

The formation and continued existence of Barka Slough is largely due to surface water inflow and the upward flow of groundwater from the underlying Careaga Sand through Barka Slough sediments, becoming surface water or groundwater available to phreatophytes. The Careaga Sand is likely confined in this area of the Basin and therefore generates a hydraulic head that is at a higher elevation than the average ground surface elevation of Barka Slough. Wells 16C2 and 16C4 provide a long record of groundwater elevations in the Careaga Sand in the area of Barka Slough. The ground surface elevation at wells 16C2 and 16C4 is approximately 328.59 ft amsl and the approximate elevation of the average ground surface elevation of Barka Slough is 261 ft amsl. Hydrographs for wells 16C2 and 16C4 indicate artesian conditions have existed in both wells over much of the period of record (1970 through 2020). However, the hydraulic heads of 16C2 and 16C4 over the period of record have decreased by approximately 40 and 45 ft, respectively. Currently, groundwater levels in well 16C4 are equal to the elevation of the average ground surface elevation of Barka Slough. Artesian conditions have not existed at well 16C2 since 2013. A continued decrease in groundwater elevations in the Careaga Sand could result in less groundwater discharging to the Slough and may have an impact on the health of Barka Slough. Surface water is also flowing into Barka Slough. Continued periods of below-average rainfall will also have an effect on Barka Slough habitat.

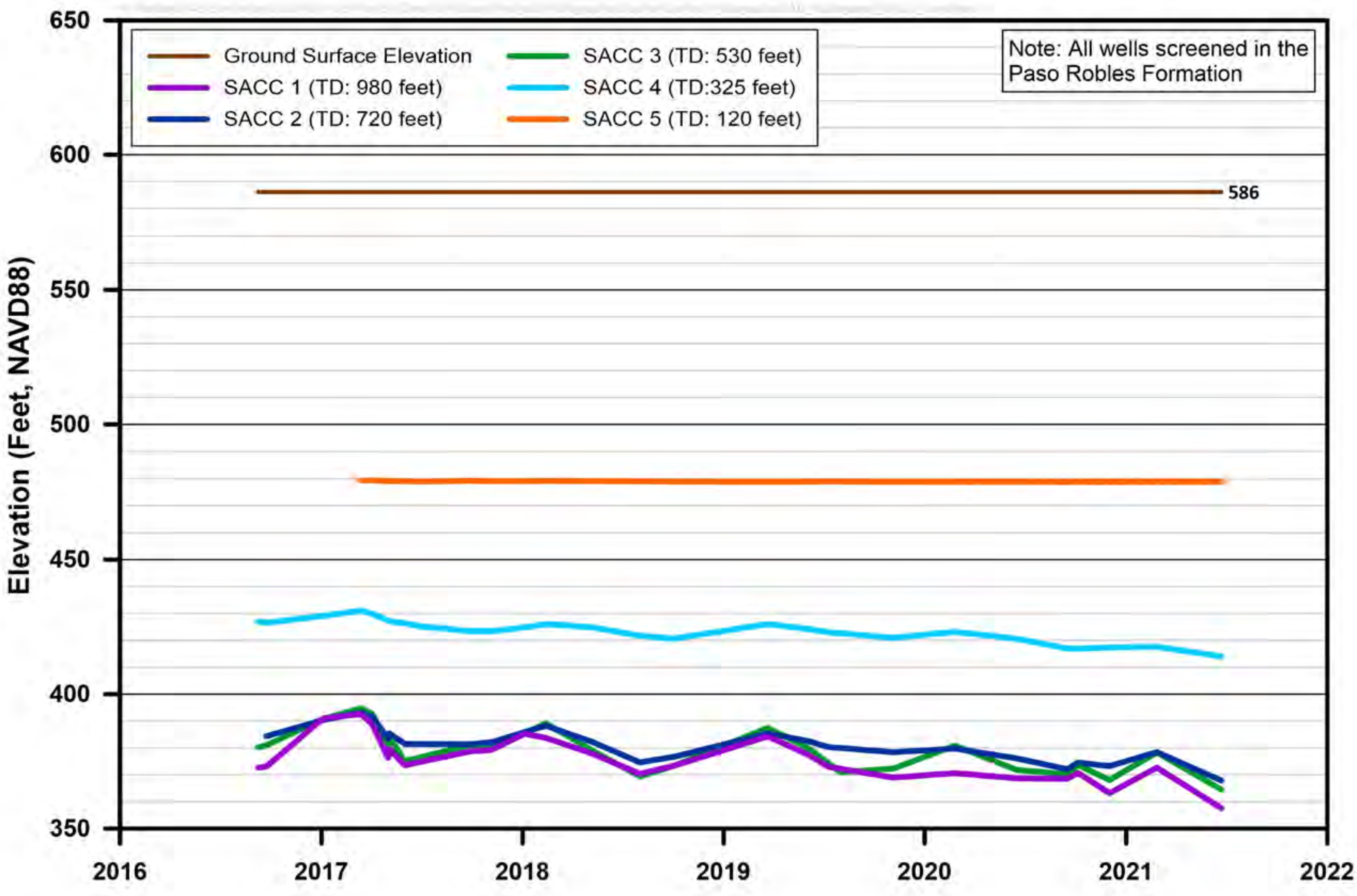

Figure 3-29. Hydrographs for SACC 1 through SACC 5

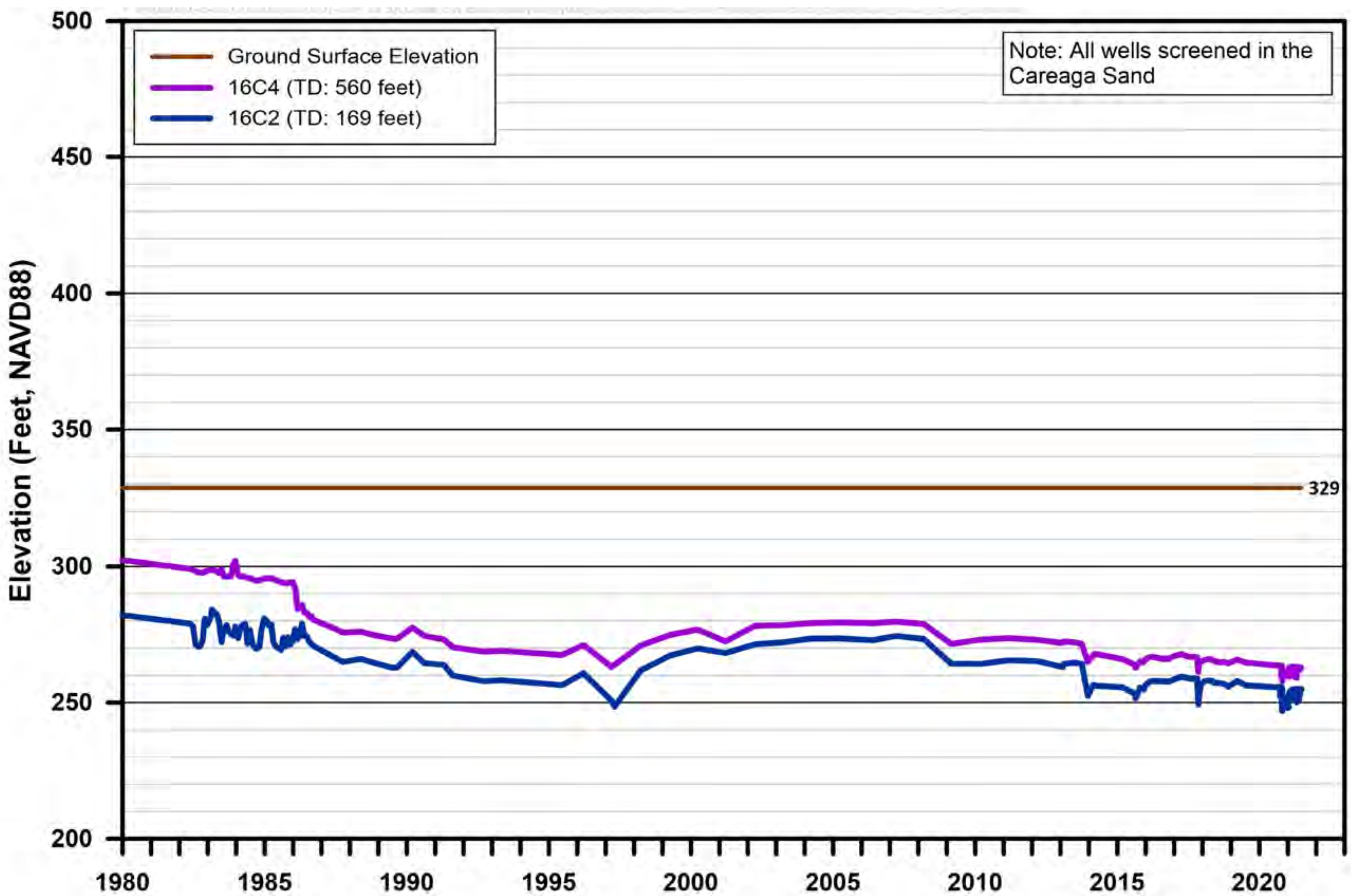

Figure 3-30. Hydrographs for 16C2 and 16C4

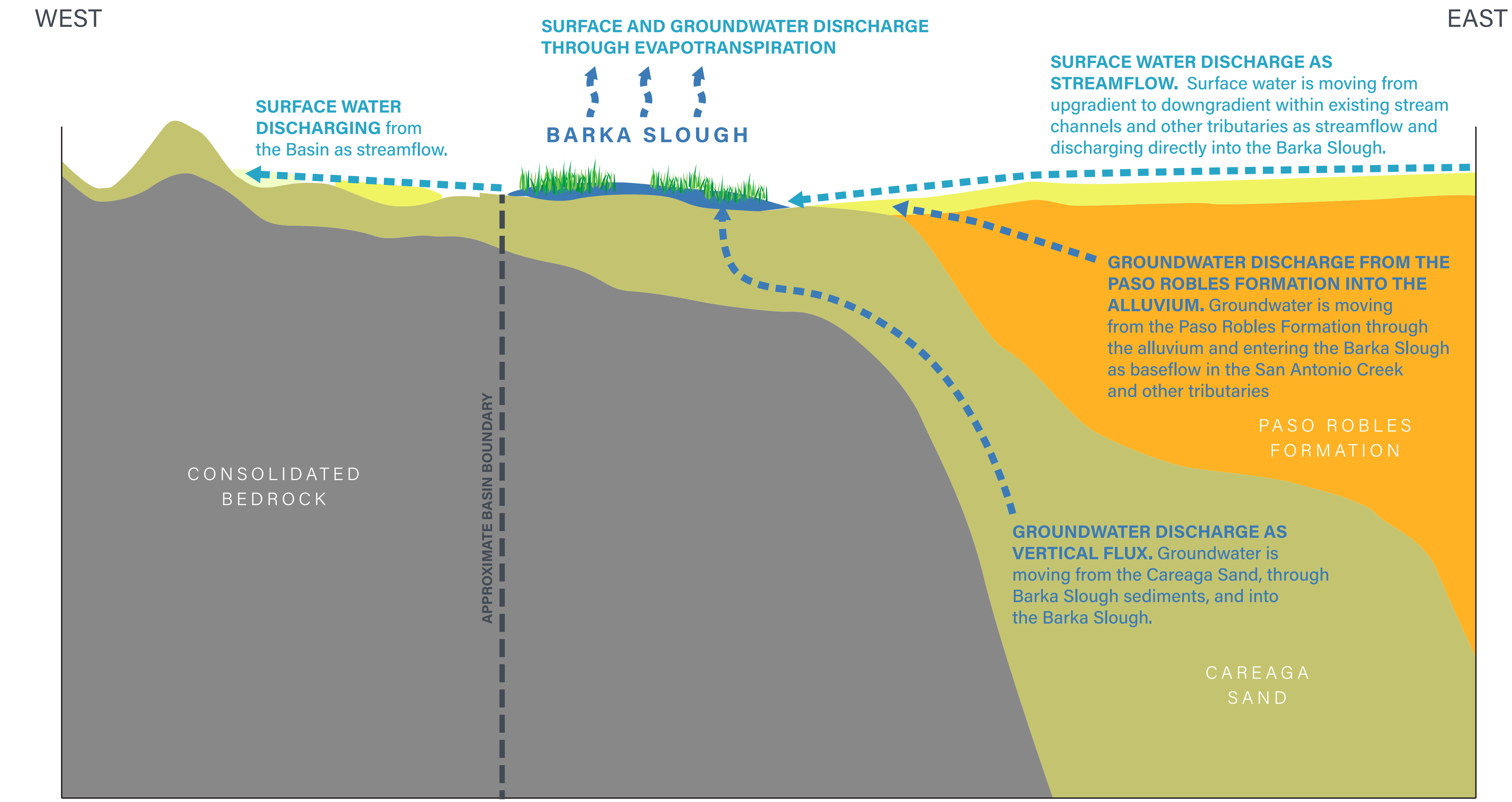

FIGURE 3-31

Conceptualized Surface Water and Groundwater Discharge into the Barka Slough

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Channel Alluvium
- Paso Robles Formation
- Careaga Sand
- Consolidated Bedrock

NOTE

View looking north

Date: September 16, 2021
Data Sources: USGS (2020c)

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3.2.2 Change of Groundwater in Storage [§ 354.16(b)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(b) A graph depicting estimates of the change in groundwater in storage, based on data, demonstrating the annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions, including the annual groundwater use and water year type.

Changes in groundwater storage for the Paso Robles Formation and the Careaga Sand are addressed in Section 3.3, Water Budget.

3.2.3 Groundwater Quality Distribution and Trends [§ 354.16(d)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(d) Groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes

This section provides a summary of the groundwater quality distribution and trends in the Basin. Water quality is presented in terms of various beneficial uses (drinking water and agricultural), point sources of groundwater contamination, and naturally occurring constituents in groundwater. Groundwater quality samples have been collected and analyzed throughout the Basin for various studies and programs. A broad survey of groundwater quality has been conducted by USGS as part of its GAMA Program. Historical groundwater quality data from NWIS and the SWRCB GeoTracker GAMA database were compiled. Water quality data were also obtained for the LACSD wells as part of the SWRCB Division of Drinking Water (DDW) public supply well water quality program.

This GSP focuses on constituents that relate to beneficial uses of groundwater that might be impacted by groundwater management activities. The constituents of concern are chosen for either or both of the following reasons:

- The constituent has a drinking water standard (MCL or SMCL).
- The constituent has a basin WQO.

3.2.3.1 Groundwater Quality Suitability for Drinking Water

Groundwater in the Basin is generally suitable for drinking water purposes. Water quality data from drinking water supply wells were analyzed to identify exceedances of drinking water standards. The data reviewed include 279 sampling events from the 13 wells in the Basin that are included in the DDW program, collected between March 1984 and November 2019. Drinking water standards are established by federal and state agencies by setting concentration thresholds for certain groundwater constituents using MCLs and SMCLs. MCLs are regulatory thresholds and SMCLs are guidelines established for nonhazardous aesthetic considerations such as taste, odor, and color. WQOs are set by the RWQCB to protect beneficial uses of groundwater.

Table 3-5 summarizes constituents with reported concentrations at or above their respective MCL, SMCL, or WQO. Concentrations of nitrate were measured above the water quality standards in one well. Concentrations of arsenic were measured above the water quality standards in another well. Concentrations of di(2-ethylhexyl)phthalate (DEHP) were detected at or above the MCL in two wells. None of the samples from LACSD wells exceed MCLs.

Iron and manganese were most frequently detected at concentrations at or above their respective SMCL. Samples analyzed for concentrations of iron from 5 of 10 wells exceeded the SMCL (0.3 milligrams per liter [mg/L]) in 83 out of 232 samples. Samples analyzed for concentrations of manganese from 6 of 10 wells exceeded the SMCL (0.05 mg/L) in 150 of 230 samples. Concentrations exceeding SMCLs may affect aesthetic qualities (taste and odor) of the water.

Table 3-5. Summary of Drinking Water and Agricultural Irrigation Water Quality Results

Constituent	MCL (mg/L)	SMCL (mg/L)	WQO (mg/L)	Number of			
				Samples at or Above WQ Standard	Samples Analyzed	Wells with Constituent Concentrations at or Above the WQ Standard	Wells Sampled
Drinking Water Quality							
Nitrate[1]	10[2]	—	5	1	67	1	11
Arsenic	0.01[2]	—	—	1	86	1	10
DEHP[3]	.004	—	—	2	32	2	5
TDS	—	1000[2]	600	0	119	0	11
Iron	—	0.3[2]	—	83	232	5	10
Manganese	—	0.05[2]	—	150	230	6	10
Agricultural Irrigation Water Quality							
Boron	—	—	0.2[2]	21	63	13	33
Chloride	—	500	150[2]	14	118	9	36
Sodium	—	—	100[2]	20	61	12	33
TDS	—	1,000	600[2]	26	116	19	35

Notes

[1] Nitrate concentration measured as nitrogen (EPA MCL)
[2] Water quality standard used to determine exceedances
[3.] State of California Division of Drinking Water MCL

— = No value
DEHP = di(2-ethylhexyl)phthalate
mg/L = milligram per liter
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level
TDS = total dissolved solids
EPA = U.S. Environmental Protection Agency
WQO = water quality objective
WQ = water quality

References

California State Water Resources Control Board. (2019). California Code of Regulations, Title 22. April 16.
Central Coast Regional Water Quality Control Board. (2019). Water Quality Control Plan for the Central Coastal Basin, June 2019 Edition. California Environmental Protection Agency.

Historical MCL and SMCL exceedances of arsenic, iron, and manganese were detected in the VSFB wellfield in the vicinity of Barka Slough. The single exceedance of the MCL for arsenic occurred in 1990. Detected exceedances of the MCL for DEHP occurred in samples from two wells in the VSFB wellfield in 1989 and 1990. Available data indicate that these are isolated concentrations of DEHP that are not laterally continuous.

The single exceedance of the MCL for nitrate occurred in a well in Harris Canyon in 2011. Total dissolved solids (TDS), chloride, sulfate, and nitrate concentrations indicate an increasing trend in well LACSD 4 located east of Los Alamos; however, concentrations of these constituents remain below MCLs, SMCLs, and WQOs.

3.2.3.2 Groundwater Quality Suitability for Agricultural Irrigation

Groundwater in the Basin is generally suitable for agricultural purposes. The agricultural suitability of groundwater was evaluated using two metrics:

1. Salinity as indicated by concentrations of TDS
2. Specific ion toxicity as indicated by concentrations of sodium, chloride, and boron

Groundwater quality data were evaluated from the NWIS and GeoTracker GAMA data sets. The reviewed data consists of 108 sampling events from 37 wells in the Basin with known well completion records, collected between December 1969 and July 2019. Table 3-5 summarizes constituents with reported concentrations at or above their respective MCL, SMCL, or basin WQO.

Groundwater in the Basin is of widely varying quality and generally decreases in quality from east to west coincident with the groundwater flow direction. Concentrations of TDS generally increase from east to west along San Antonio Creek; and are greatest near the Barka Slough, along western San Antonio Creek, and in Harris Canyon. Measured TDS concentrations from 26 water samples collected from wells located throughout the Basin indicate that some caution should be used if irrigating salt-sensitive crops (SWRCB, 2019). Samples collected from 19 of 35 wells indicated TDS concentrations exceeding the WQO in 26 of 116 samples. A total of 16 of the 19 wells with concentrations of TDS exceeding the WQO are located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon.

Concentrations of boron, sodium, and chloride are also elevated in the Barka Slough area, along western San Antonio Creek and in Harris Canyon. Analytical results for 20 samples indicate some caution should be used if irrigating with this water, due to potential sodium ion toxicity (SWRCB, 2019). Samples analyzed for concentrations of sodium from 12 of 33 wells exceeded the WQO (100 mg/L) in 20 of 61 samples. All the analytical results that exceeded the WQO were collected from wells located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon.

Analytical results for 14 samples indicate some caution should be used if irrigating, due to potential chloride ion toxicity. Samples analyzed for concentrations of chloride from 9 of 36 wells exceeded the WQO (150 mg/L) in 14 of 118 samples. All but one of the samples with detected chloride concentrations exceeding the WQO were collected from wells located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon.

Analytical results for 21 water samples indicate some caution should be used if irrigating specifically fruit (including grapes) (Hanson, Grattan, & Fulton, 2006), due to potential boron ion toxicity (SWRCB, 2019). Samples analyzed for concentrations of boron from 13 of 33 wells exceeded the WQO (0.2 mg/L) in 21 of 63 samples. All of the samples with detected boron concentrations exceeding the WQO were collected from wells located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon.

Based on available information, the east-to-west trend of increasing TDS and salts concentrations is consistent between the Paso Robles Formation and the Careaga Sand. Analytical results from samples collected from nested monitoring wells (SACC and SACR), located near Los Alamos and along San Antonio Creek in the western portion of the Basin, indicate that concentrations of TDS decreased with depth.

3.2.3.3 Distribution and Concentrations of Point Sources of Groundwater Constituents

Potential point sources of groundwater quality degradation were identified from the SWRCB GeoTracker data management system. Waste Discharge Requirement permits from the SWRCB GeoTracker data management system were also reviewed. Table 3-6 summarizes information from these websites for open/active contaminated sites, permitted land disposal sites, and produced water facilities and underground injection control sites associated with oil and gas production. Figure 3-32 shows the locations of these potential groundwater contaminant point sources, the locations of completed/case-closed sites, the locations of permitted land disposal sites, and the locations of the produced water facilities and underground injection control sites associated with oil and gas production. Based on available information, there are no known impacts to principal aquifers associated with these cases.

Table 3-6. Potential Point Sources of Groundwater Contamination

Site ID/Site Name	Site Type	Constituent(s) of Concern (COCs)	Potential Media of Concern	Status
Escolle Lease (T10000005135)	*Cleanup Program Site*	Benzene, Ethylbenzene, Naphthalene, Polycyclic Aromatic Hydrocarbons (PAHs), Toluene, Total Petroleum Hydrocarbons (TPH), Xylene	Soil, Soil Vapor	Open - Site Assessment as of 7/5/2005
So Cal Gas PSEP SI36-1032 (T10000014573)	*Cleanup Program Site*	Crude Oil, Diesel	Soil	Open - Site Assessment as of 5/13/2020
Chevron Texaco Fugler Lease (T10000005738)	*Cleanup Program Site*	None Specified	Soil	Open - Inactive as of 3/11/2014
Chevron Texaco GWP Lease (T10000005737)	*Cleanup Program Site*	None Specified	Soil	Open - Inactive as of 3/11/2014
Chevron Texaco Los Alamos Fee Lease (T10000005735)	*Cleanup Program Site*	None Specified	Soil	Open - Inactive as of 3/11/2014
Greka Cat Canyon Williams B TB (T10000005749)	*Cleanup Program Site*	None Specified	Soil	Open - Inactive as of 3/12/2014
Texaco Cat Canyon Williams Holding (T10000005739)	*Cleanup Program Site*	None Specified	Soil	Open - Inactive as of 3/11/2014

Site ID/Site Name	Site Type	Constituent(s) of Concern (COCs)	Potential Media of Concern	Status
PACIFIC COAST ENERGY CO. LP WASTE PILE FACILITY (SL0608375179)	Land Disposal Site	Crude Oil	Other groundwater (uses other than drinking water), Soil, Surface Water	Open – Operating as of 5/11/2009
Santa Maria Energy Waste Pile Management Facility (T10000006350)	Land Disposal Site	Total Petroleum Hydrocarbons (TPH)	None Specified	Open – Operating as of 11/21/2014
Santa Maria Integrated Waste Management Facility (T10000003494)	Land Disposal Site	None Specified	None Specified	Open – Proposed as of 9/28/2012
CAREAGA CANYON OIL FIELD - PRODUCED WATER FACILITIES (T10000011257)	Other Oil and Gas Projects	Total Petroleum Hydrocarbons (TPH)	Aquifer used for drinking water supply, surface water	Open – Site Assessment as of 1/26/2018
FOUR DEER OIL FIELD - PRODUCED WATER FACILITIES (T10000011703)	Other Oil and Gas Projects	None Specified	Aquifer used for drinking water supply	Open – Inactive as of 6/6/2018
PACIFIC COAST ENERGY CO - CYCLIC STEAM - SISQUOC DIATOMITE (T10000011075)	Underground Injection Control	None Specified	None Specified	Review Complete as of 12/21/2017
PROJECT PROPOSAL FOR VAQUERO ENERGY FOUR DEER OILFIELD MONTEREY FORMATION WATER DISPOSAL (T10000010711)	Underground Injection Control	None Specified	None Specified	Review Complete as of 9/17/2018
SANTA MARIA ENERGY - ORCUTT FIELD (T10000008459)	Underground Injection Control	None Specified	None Specified	Project Complete as of 3/16/2016

Source: State Water Resources Control Board Geotracker. Retrieved from California State Water Resources Control Board website: https://geotracker.waterboards.ca.gov/. (Accessed August 5, 2021.)

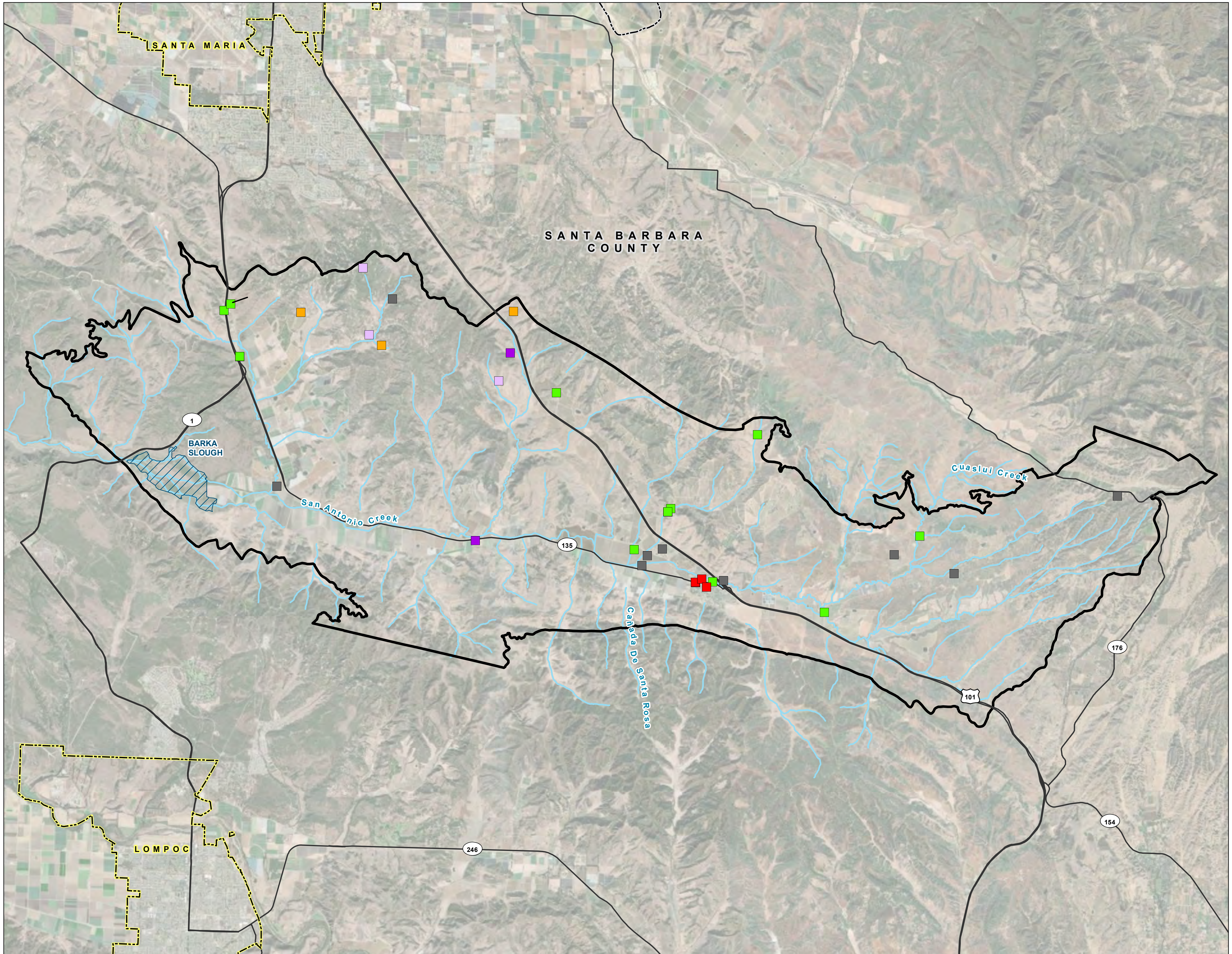

FIGURE 3-32

Locations of Potential Point Sources of Groundwater Contamination

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Potential Point Source Contamination

- Water Discharge Requirements (WDR) Site
- Underground Injection Control
- Land Disposal Site
- Other Oil and Gas Projects
- LUST Cleanup Site
- Cleanup Program Site

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

LUST: Leaking Underground Storage Tank

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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3.2.3.4 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

The distribution and concentration of naturally occurring groundwater constituents are discussed in the following subsections. Groundwater quality data from the NWIS and GeoTracker GAMA data sets were evaluated. The data reviewed consists of 108 sampling events from 37 wells in the Basin with known well completion records, collected between December 1969 and July 2019. These wells are also included in the basin groundwater level monitoring network. Each constituent is compared with its MCL, SMCL, and WQO. The following subsections focus on constituents that have the potential to be affected by any groundwater management activities.

Total Dissolved Solids

TDS is defined as the total amount of mobile charged ions—including minerals, salts or metals—dissolved in a given volume of water. TDS concentrations in groundwater have been detected above the WQO of 600 mg/L in the Basin. The SMCL for TDS has been established for color, odor and taste, rather than for human health effects. This SMCL includes a recommended standard of 500 mg/L, an upper limit of 1,000 mg/L and a short-term limit of 1,500 mg/L (SWRCB, 2020b).

Salts enter groundwater through dissolution of soil, rock, and organic material. Salinity will increase with time, as more minerals in contact with groundwater dissolve. The concentration of salts in surface and groundwater can increase in several ways. Evaporative enrichment is the process of increasing salinity levels in surface or groundwater by removing water via evaporation. For example, irrigation water is often applied to crops during the summer when evaporation rates are highest. As water molecules evaporate into the atmosphere, salts remain in the irrigation water. This irrigation water can percolate into the underlying groundwater. If the groundwater is later pumped and used for additional irrigation, the evaporation cycle is repeated, and salinity levels can increase. Water uptake by plants can also increase soil salinity. Water percolating through the ground has salts dissolved in it. Plant roots take in water while excluding salts and other non-nutrients. The excluded salts will gradually build up around the roots and must be periodically "flushed" from the root zone to maintain plant health. In natural systems, the types of plants found in a specific environment are adapted for naturally occurring soil salinities. In many agricultural areas, salts are flushed from the soil by applying irrigation water. The salts that are flushed from the soil either enter groundwater or are discharged to surficial drains. Human activities can also affect salinity levels in ground and surface water. The application of synthetic fertilizers, manures, and wastewater treatment facilities can all contribute salt to surface and groundwater. Nitrogen is a necessary nutrient for plant growth and nitrogen fertilizers are typically in the form of the salt nitrate. If excess nitrate fertilizer is applied to a field, the nitrate not used by plants can dissolve and move to groundwater. Manure from confined animal facilities is enriched in nutrients and other salts and can also increase salinity levels in receiving waters. Domestic wastewater is typically enriched in salts, including sodium and chloride, due to household activities such as washing and water softening. Most water treatment facilities cannot remove salt. As a result, discharges from these facilities can increase surface and groundwater salinity (SWRCB, 2017a).

Sample analytical results of TDS concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-33 and 3-34, respectively. TDS concentrations range from 40 mg/L to 1,410 mg/L with a mean of 465 mg/L in the Paso Robles Formation and range from 188 mg/L to 3,900 mg/L with a mean of 827 mg/L in the Careaga Sand. Removing the three highest concentrations from the analysis of the Careaga Sand data set, the mean TDS concentration is 550 mg/L.

Based on the available data, TDS concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in Harris Canyon. The east-to-west trend of increasing TDS concentrations is consistent between the Paso Robles Formation and the Careaga Sand. Analytical results from samples collected from nested monitoring wells (SACC and SACR) located near

Los Alamos and along San Antonio Creek, in the western portion of the Basin, indicate TDS concentrations generally decrease with depth. Increasing TDS concentrations have been detected in a public supply well (LACSD 4) east of Los Alamos. However, TDS concentrations have not exceeded the MCL or WQO in this well.

Based on analytical results from 20 sampling events between May 1978 and February 2017, TDS concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events do not indicate any long-term trends. TDS concentrations in surface water range from 138 mg/L to 1,280 mg/L with a mean of 433 mg/L. There is no clear correlation between streamflow rates and measured TDS concentrations.

While there are some wells that have concentrations of TDS that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated TDS concentrations are often associated with the rocks of marine origin that are present in the Basin.

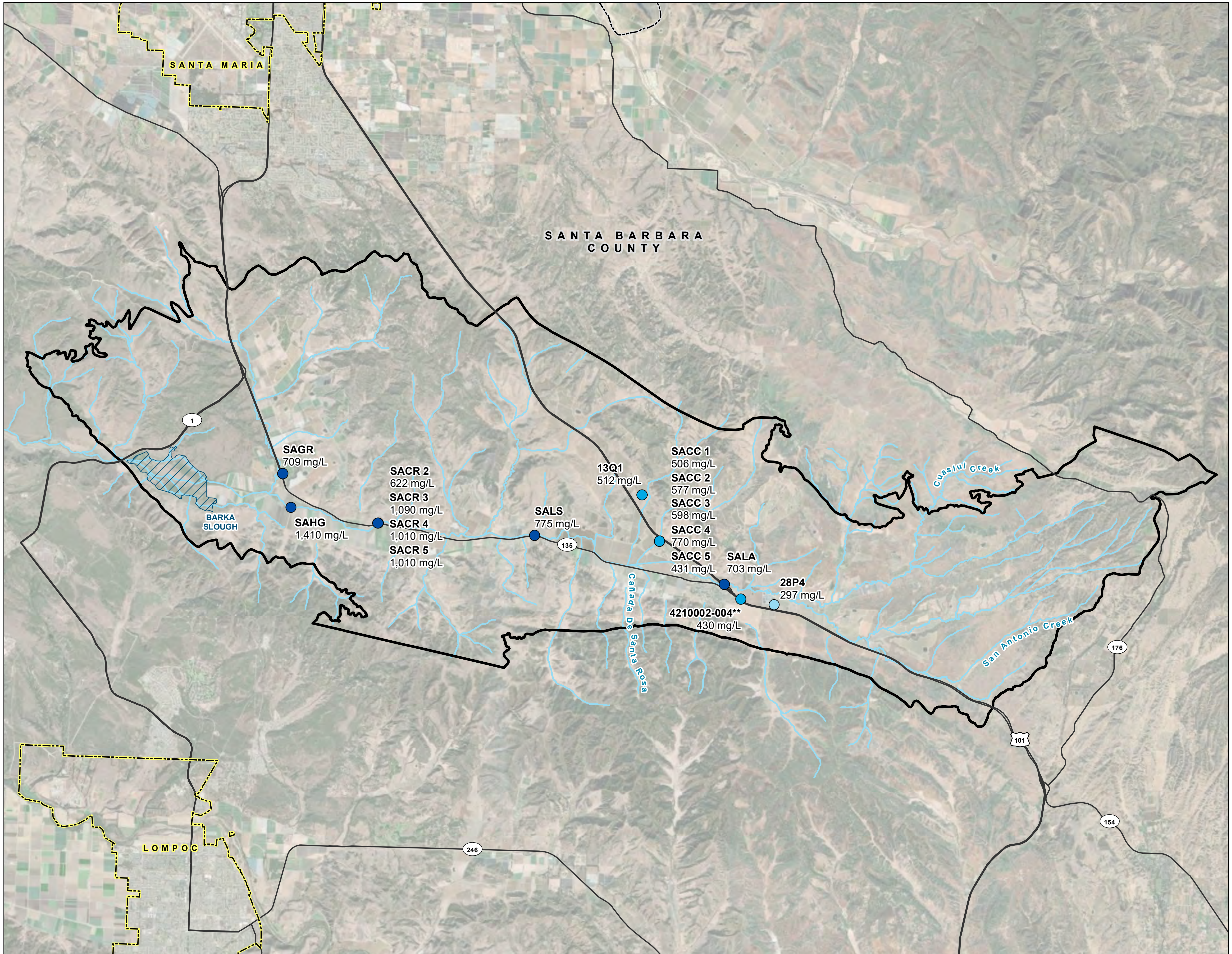

FIGURE 3-33

Total Dissolved Solids, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Total Dissolved Solids

- < 300 mg/L
- 300 - 600 mg/L
- > 600 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Total Dissolved Solids is 600 mg/L.
**4210002-004 is the well identification name for LACSD 4 in the U.S. Geological Survey Groundwater Ambient Monitoring and Assessment Program.

1. The recommended Secondary Maximum Contamination Level is 500 mg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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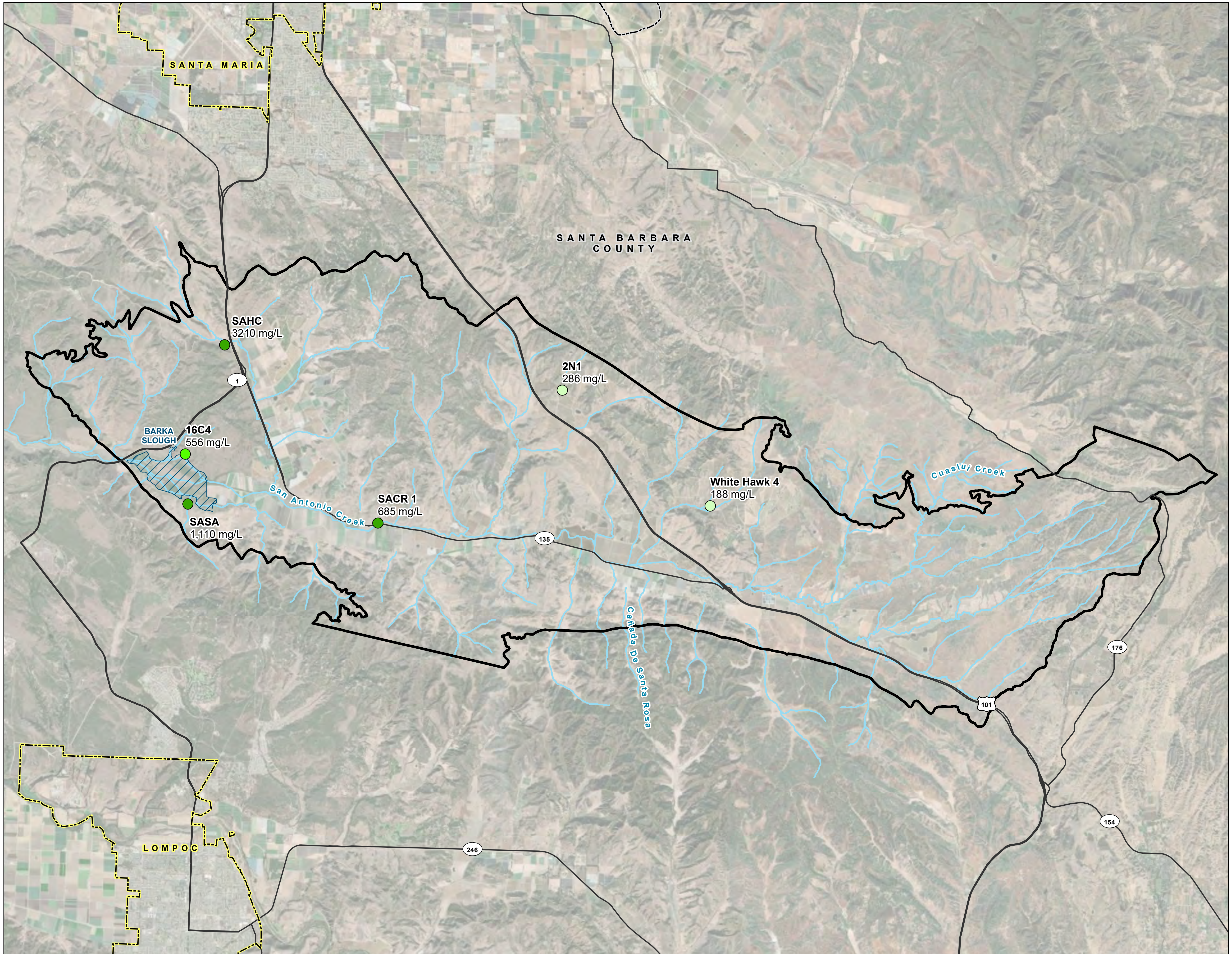

FIGURE 3-34

Total Dissolved Solids, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Total Dissolved Solids

- < 300 mg/L
- 300 - 600 mg/L
- > 600 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Total Dissolved Solids is 600 mg/L.

1. The recommended Secondary Maximum Contamination Level is 500 mg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Sodium

Sodium is an unregulated constituent and therefore does not have an established federal or state regulatory threshold. However, elevated sodium concentrations in water can damage crops and affect plant growth (SWRCB, 2019).

Sample analytical results of sodium concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-35 and 3-36.

Sodium has been detected at concentrations exceeding the WQO of 100 mg/L in the Basin. Sodium concentrations ranged from 38 mg/L to 180 mg/L with a mean of 93 mg/L in the Paso Robles Formation and ranged from 30 mg/L to 1,300 mg/L with a mean of 133 mg/L in the Careaga Sand. The two highest reported concentrations of sodium were detected in samples collected in 1976 from wells located in the Barka Slough area. The third-highest concentration measured is from a sample collected in 2017 from a well in Harris Canyon. Removing these samples from the available data set, sodium concentrations in the Careaga Sand range from 30 mg/L to 132 mg/L with a mean of 75 mg/L.

Based on available information, sodium concentrations in the Paso Robles Formation and the Careaga Sand have remained relatively stable throughout the period of record. Sodium concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in Harris Canyon. The east-to-west trend of increasing sodium concentrations is consistent between the Paso Robles Formation and the Careaga Sand. Analytical results from samples collected from nested monitoring wells (SACC and SACR) located near Los Alamos and along San Antonio Creek, in the western portion of the Basin, indicate sodium concentrations generally decrease with depth.

Based on analytical results from seven sampling events between May 1978 and February 2017, sodium concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events, do not indicate any long-term trends. Analytical results for the water samples indicated sodium concentrations ranging from 16.7 mg/L to 71 mg/L with a mean of 39.4 mg/L.

While there are some wells that have concentrations of sodium that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated sodium concentrations are often associated with rocks of marine origin that are present in the Basin.

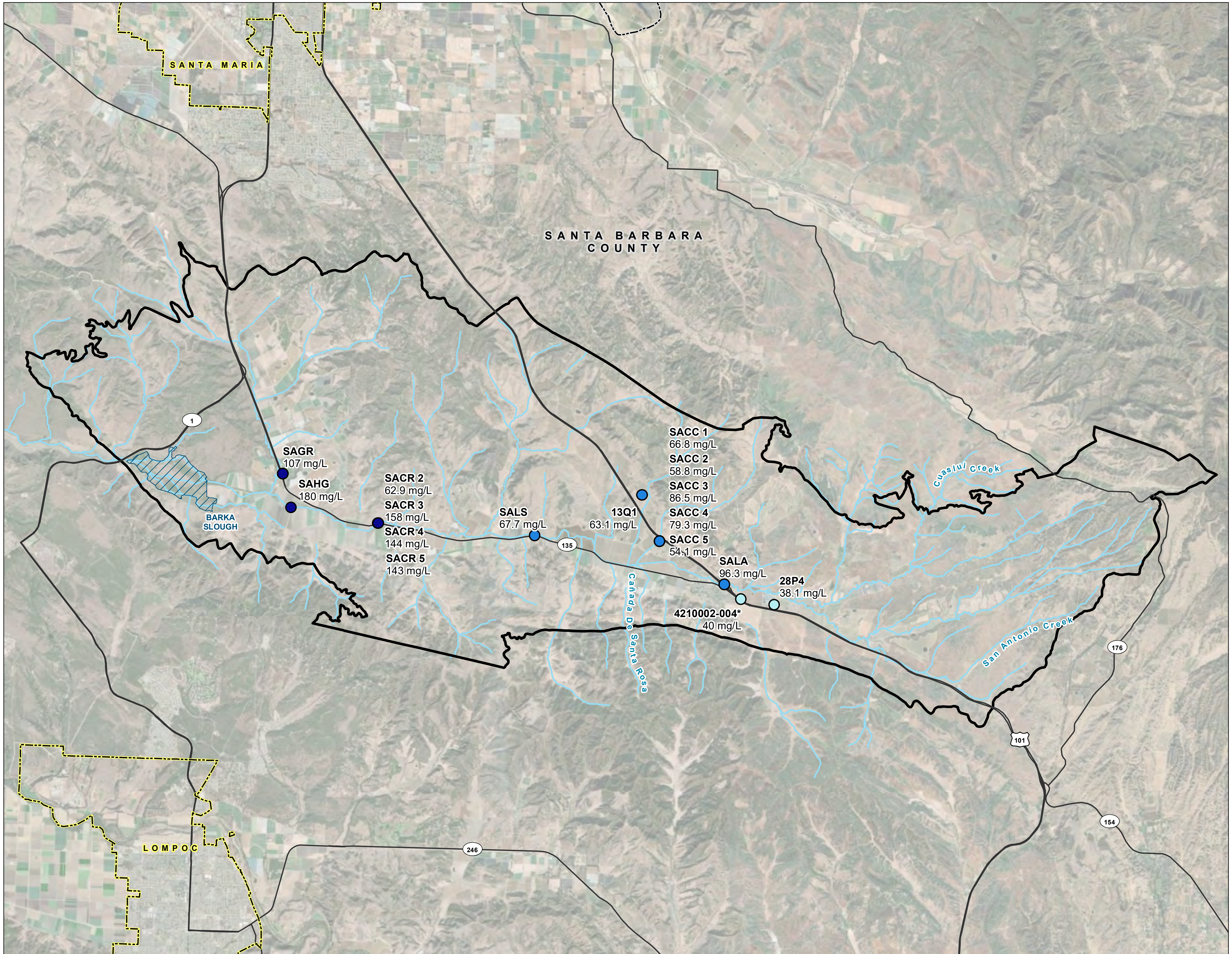

FIGURE 3-35

Sodium, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Sodium

- < 50 mg/L
- 50 - 100 mg/L
- > 100 mg/L

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*4210002-004 is the well identification name for LACSD 4 in the U.S. Geological Survey Groundwater Ambient Monitoring and Assessment Program.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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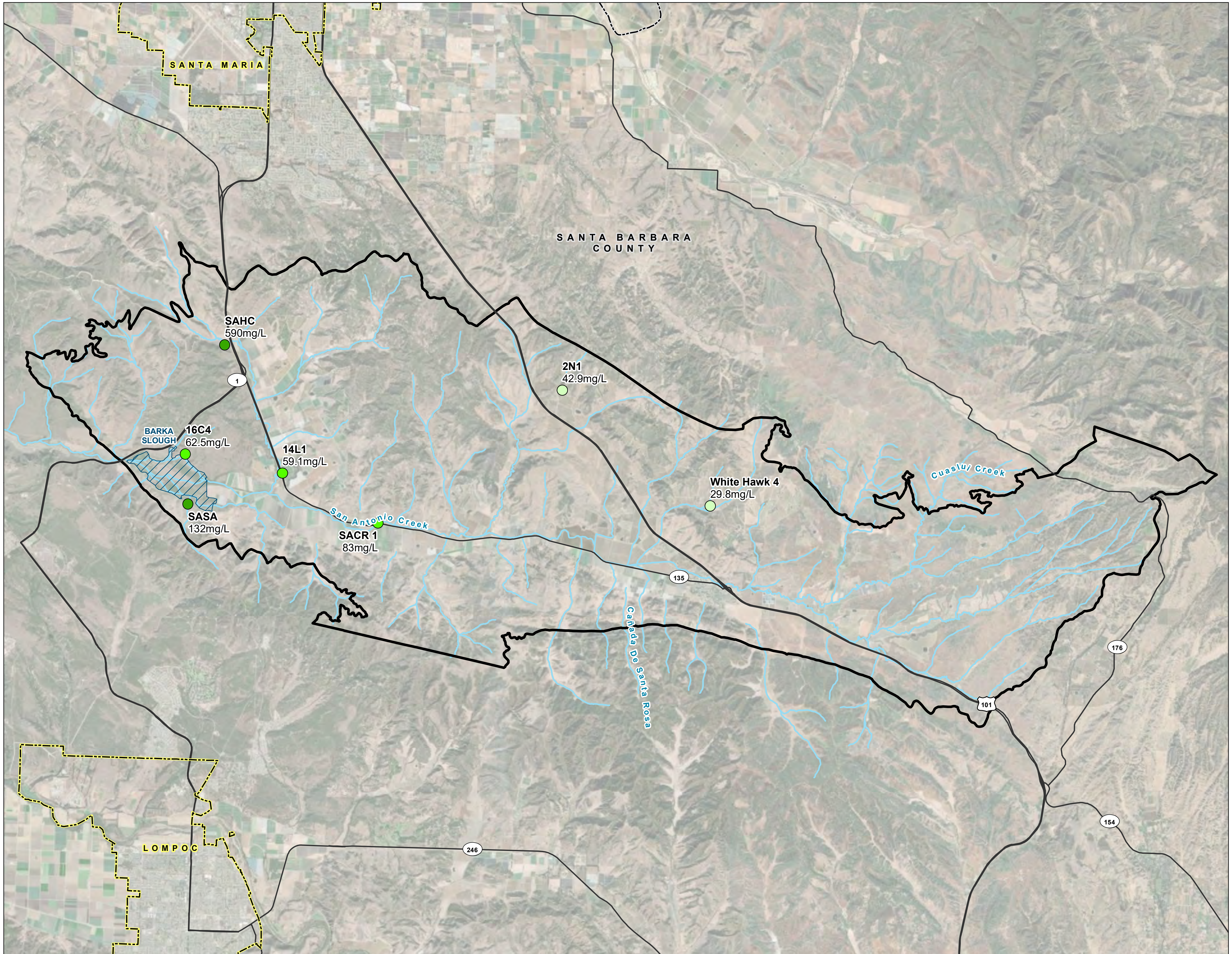

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FIGURE 3-36

Sodium, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Sodium

- < 50 mg/L
- 50 - 100 mg/L
- > 100 mg/L

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

GSI Water Solutions, Inc.

Chloride

Chloride concentrations in groundwater have been detected at concentrations greater than the WQO of 150 mg/L in the Basin. The SMCL for chloride has been established for taste, rather than for human health effects. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018). Chloride concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-37 and 3-38, respectively.

Analytical results indicate chloride concentrations range from 51 mg/L to 618 mg/L, with a mean of 88 mg/L, in the Paso Robles Formation and from 28 mg/L to 1,400 mg/L, with a mean of 191 mg/L, in the Careaga Sand. The two highest reported concentrations of chloride were detected in samples collected in 1976 from wells located in the Barka Slough area. The third highest concentration measured is from a sample collected in 2017 from a well in Harris Canyon. Removing these samples from the available data set, chloride concentrations in the Careaga Sand range from 28 mg/L to 276 mg/L with a mean of 95 mg/L.

Based on the available data, chloride concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in Harris Canyon. The east-to-west trend of increasing chloride concentrations is consistent between the Paso Robles Formation and the Careaga Sand. Analytical results from samples collected from a nested monitoring well (SACR) along San Antonio Creek, in the western portion of the Basin, indicate chloride concentrations generally decrease with depth. Increasing chloride concentrations have been detected in a public supply well (LACSD 4 [sample location 4210002-004]) east of Los Alamos. However, chloride concentrations have not exceeded the WQO in this well.

Based on analytical results from seven sampling events between May 1978 and February 2017, chloride concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events, do not indicate any long-term trends. Analytical results for the water samples indicated chloride concentrations ranging from 16 mg/L to 58 mg/L with a mean of 37.6 mg/L.

While there are some wells that have concentrations of chloride that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated chloride concentrations are often associated with rocks of marine origin that are present in the Basin.

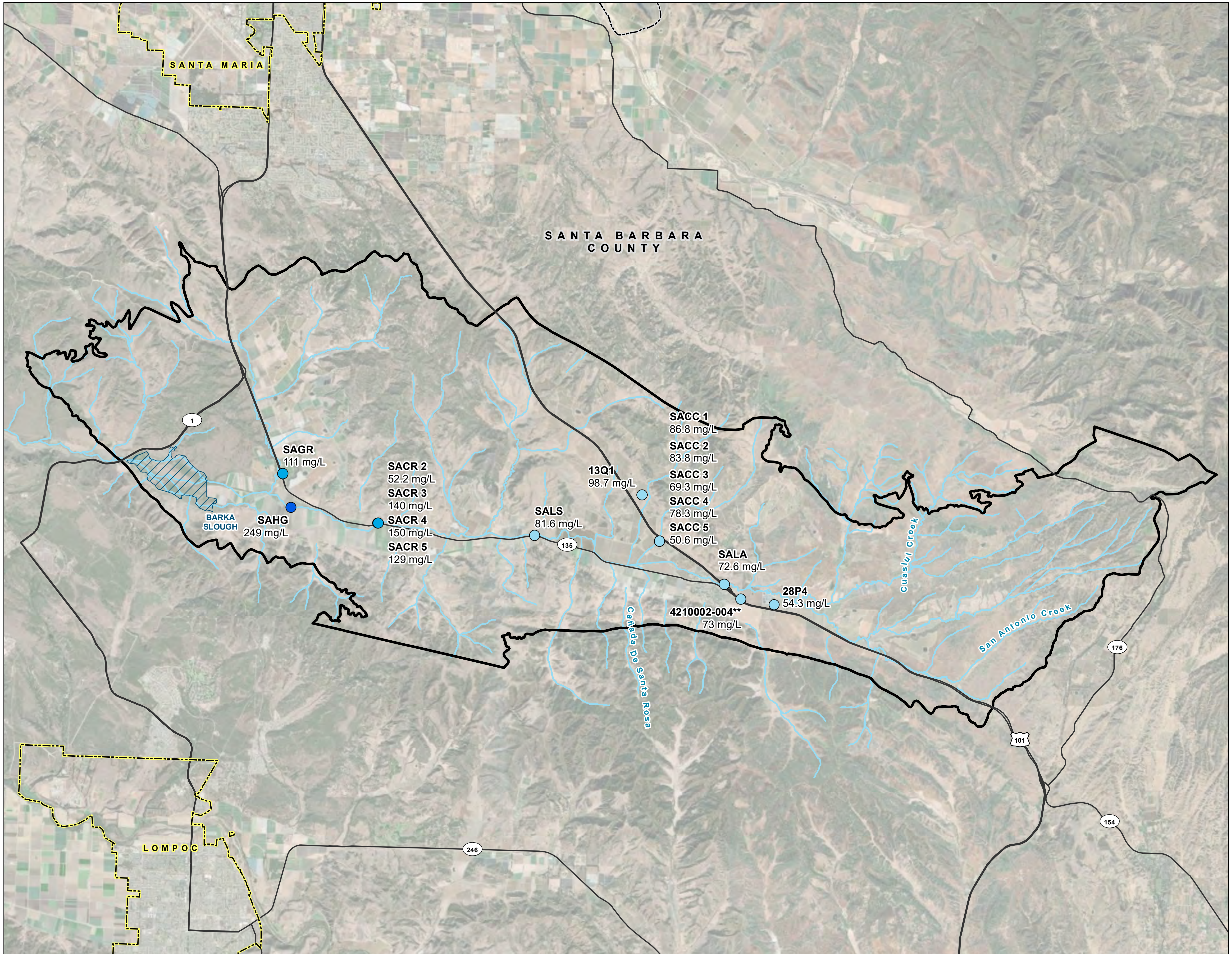

FIGURE 3-37

Chloride, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Chloride

- < 100 mg/L
- 100 - 150 mg/L
- > 150 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Chloride is 150 mg/L.
**4210002-004 is the well identification name for LACSD 4 in the U.S. Geological Survey Groundwater Ambient Monitoring and Assessment Program.

1. The recommended Secondary Maximum Contamination Level is 250 mg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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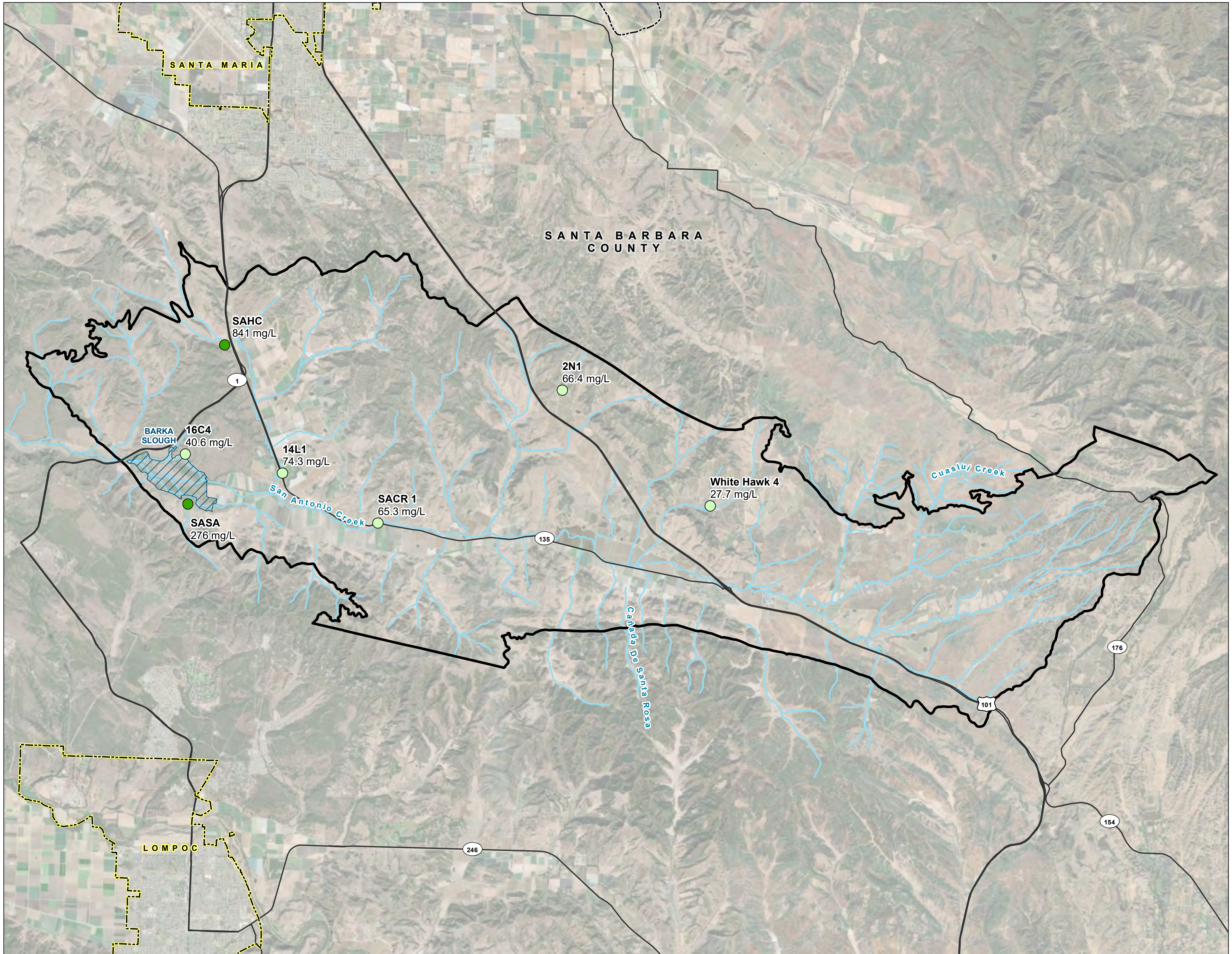

FIGURE 3-38

Chloride, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Chloride

- < 100 mg/L
- 100 - 150 mg/L
- > 150 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Chloride is 150 mg/L.

1. The recommended Secondary Maximum Contamination Level is 250 mg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Sulfate

Sulfate concentrations in groundwater have been detected at concentrations greater than the WQO of 150 mg/L in the Basin. The SMCL for sulfate was established to avoid causing digestive problems in humans. The SMCL includes a recommended standard of 250 mg/L, an upper limit of 500 mg/L and a short-term limit of 600 mg/L (SWRCB, 2018). Sulfate concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-39 and 3-40, respectively.

Analytical results indicate sulfate concentrations range from 25 mg/L to 362 mg/L, with a mean of 121 mg/L, in the Paso Robles Formation, and from 7.1 mg/L to 1050 mg/L, with a mean of 133 mg/L, in the Careaga Sand. The highest concentration measured is from a sample collected in 2017 from a well in Harris Canyon. Removing this sample from the available data set, sulfate concentrations in the Careaga Sand range from 7 mg/L to 400 mg/L with a mean of 107 mg/L.

Based on the available data, sulfate concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in Harris Canyon. The east-to-west trend of increasing sulfate concentrations is consistent between the Paso Robles Formation and the Careaga Sand.

Increasing sulfate concentrations have been detected in a public supply well (LACSD 4 [sample location 4210002-004]) east of Los Alamos. However, sulfate concentrations have not exceeded the WQO in this well.

Based on analytical results from seven sampling events between May 1978 and February 2017, sulfate concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events, do not indicate any long-term trends. Analytical results for the water samples indicated sulfate concentrations ranging from 30.4 mg/L to 210 mg/L with a mean of 30.4 mg/L.

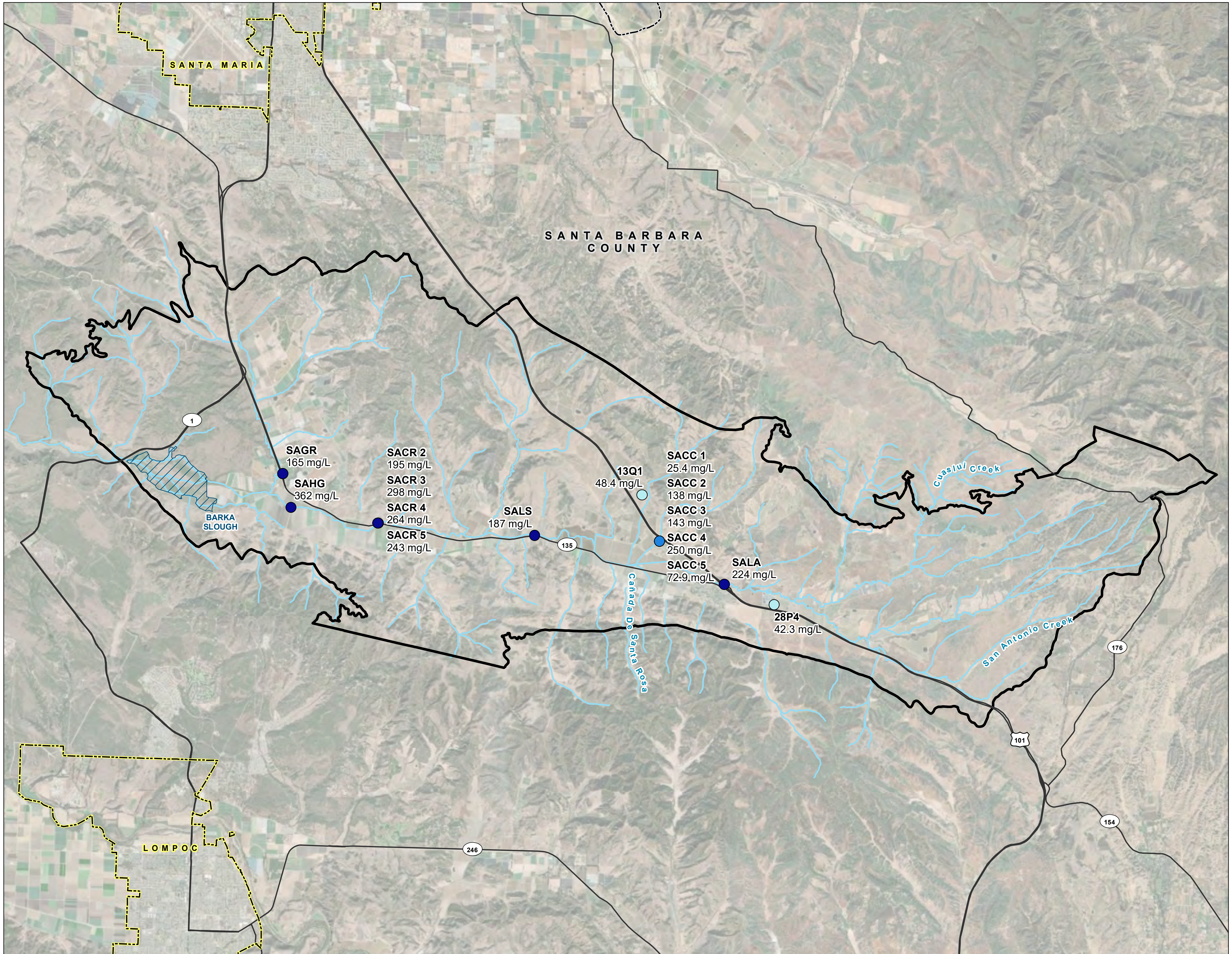

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FIGURE 3-39

Sulfate, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentration

Sulfate

- < 50 mg/L
- 50 - 150 mg/L
- > 150 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Sulfate is 150 mg/L.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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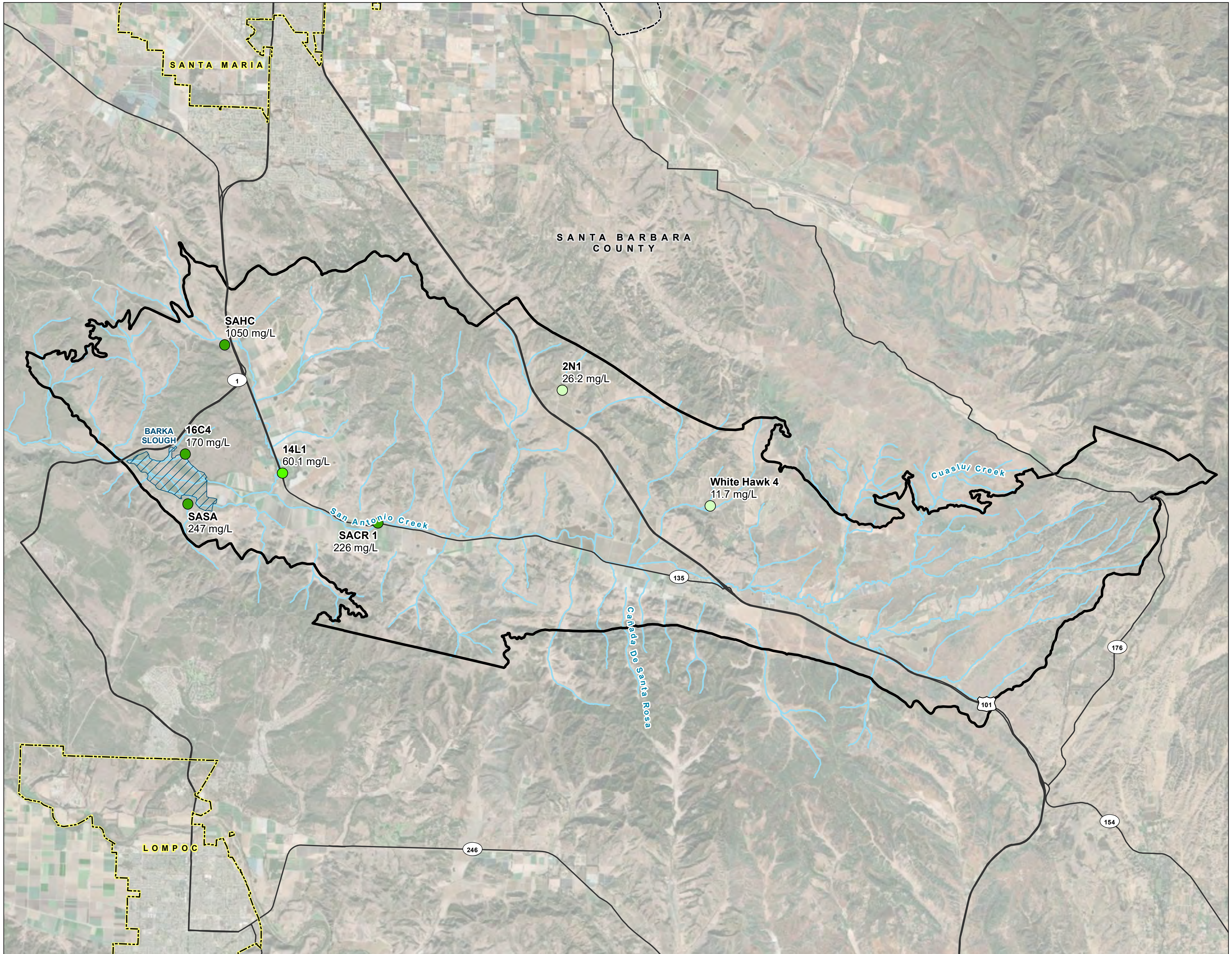

FIGURE 3-40

Sulfate, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentration

Sulfate

- < 50 mg/L
- 50 - 150 mg/L
- > 150 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Sulfate is 150 mg/L.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Arsenic

Arsenic is a regulated trace element with an MCL in drinking water of 10 microgram per liter (µg/L). Arsenic is a semi-metal element that occurs naturally in the environment but can also be released to the environment by human activities. The primary source of arsenic in the environment is from the weathering of arsenic-containing rocks. Arsenic mobility in groundwater is dependent on the physical and chemical properties of the aquifer, although two types of processes generally control its movement: adsorption/desorption reactions and precipitation/dissolution reactions. During adsorption reactions, dissolved arsenic adheres to the surface of solid aquifer materials. Desorption removes the arsenic from aquifer materials and releases it into the surrounding groundwater. The mobility of arsenate is low in acidic soils that have a high content of oxides and clays (SWRCB, 2017b).

Arsenic concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-41 and 3-42, respectively. Analytical results indicate arsenic concentrations range from 0.2 µg/L to 36.4 µg/L, with a mean of 6.3 µg/L, in the Paso Robles Formation, and from less than 0.05 to 17 µg/L, with a mean of 7.6 µg/L, in the Careaga Sand. Based on the available data, arsenic concentrations increase from east to west along San Antonio Creek and are greatest along western San Antonio Creek. The east-to-west trend of increasing arsenic concentrations is primarily observed in the Paso Robles Formation.

Arsenic concentrations were measured at 9.3 µg/L for the single surface water sample available, collected in February 2017 from San Antonio Creek near Los Alamos (Station 11135800).

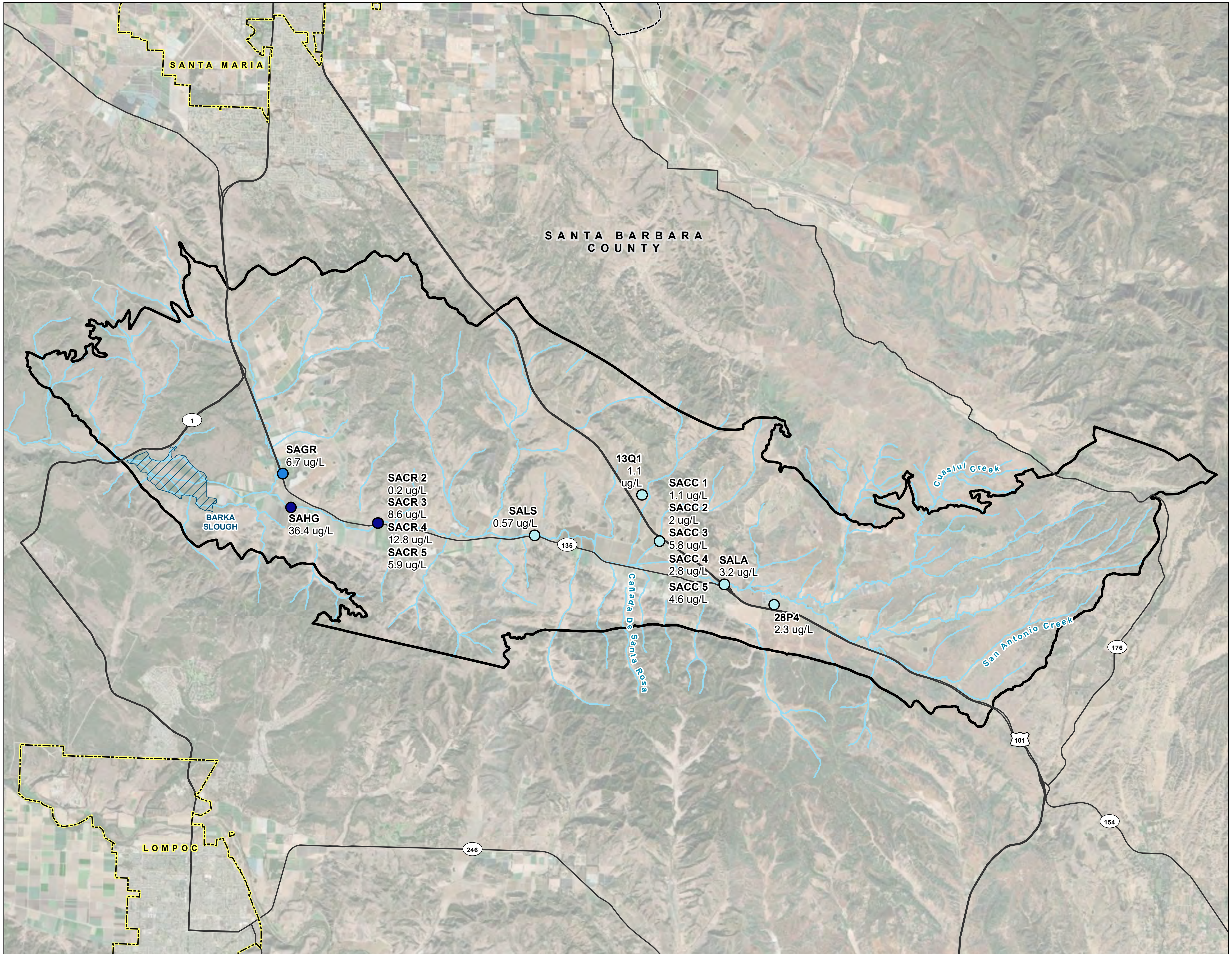

FIGURE 3-41

Arsenic, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentration

Arsenic

- < 5 μg/L
- 5 - 10 μg/L
- > 10 μg/L

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

1. The recommended Secondary Maximum Contamination Level is 10 μg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

μg/L: micrograms per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

GSI Water Solutions, Inc.

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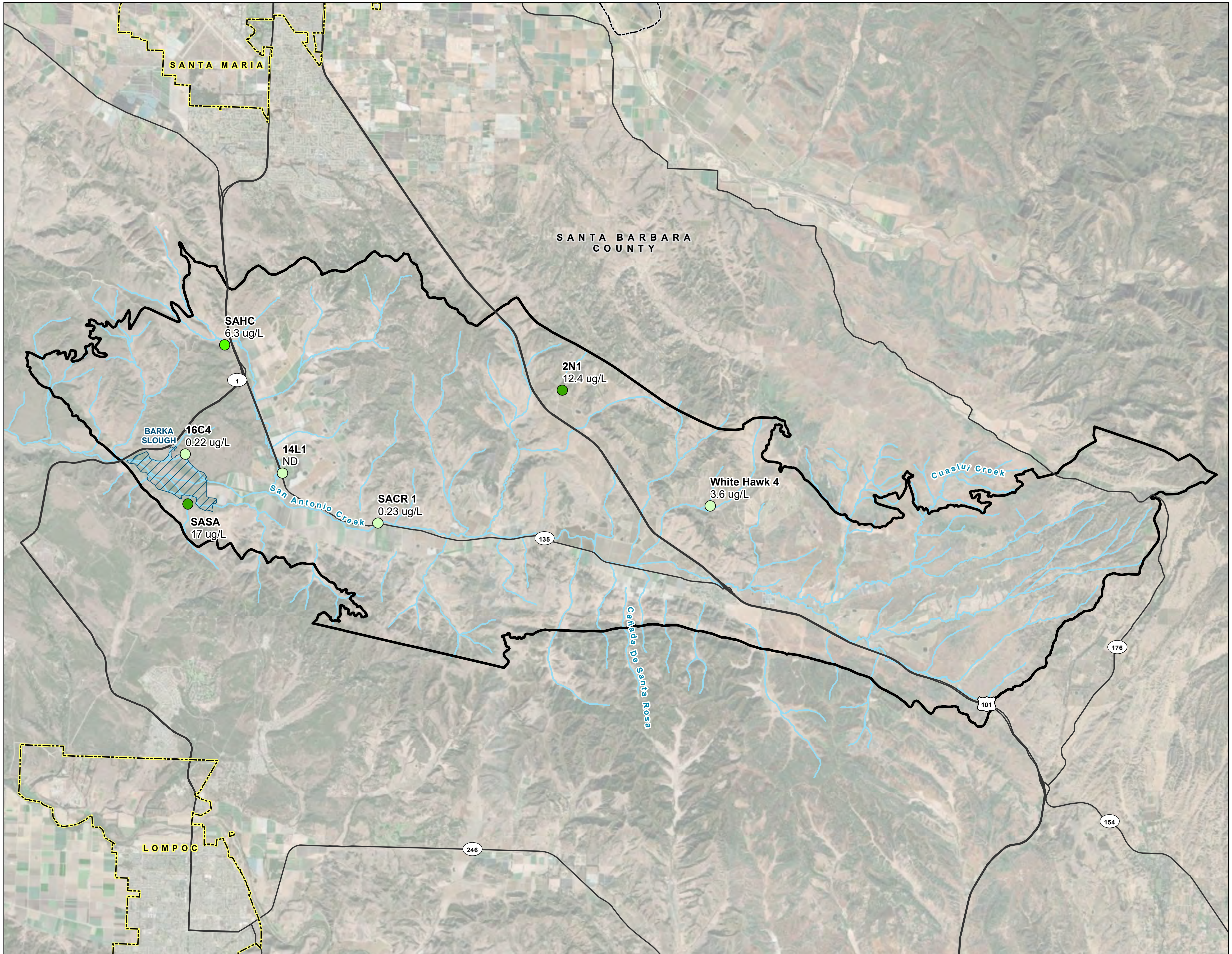

FIGURE 3-42

Arsenic, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentration

Arsenic

- < 5 µg/L
- 5 - 10 µg/L
- > 10 µg/L

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

1. The recommended Secondary Maximum Contamination Level is 10 µg/L.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

µg/L: micrograms per liter
ND: non-detect

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

GSI Water Solutions, Inc.

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Nitrate

Nitrate is a widespread constituent in California groundwater (California Department of Public Health, 2014). Elevated concentrations of nitrate in groundwater can be associated with agricultural activities, septic systems, confined animal facilities, landscape fertilizers, and wastewater treatment facilities. Nitrate is the primary form of nitrogen detected in groundwater. It is soluble in water and can easily pass through soil to the groundwater table. Nitrate can persist in groundwater for decades and accumulate to increased concentrations as more nitrogen is applied to the land surface each year (California Department of Public Health, 2014).

Sample analytical results of nitrate concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-43 and 3-44, respectively. Nitrate concentrations in groundwater have been detected above the WQO of 5 mg/L in the Basin. The MCL for nitrate has been established at 10 mg/L (SWRCB, 2020b). Nitrate concentrations ranged from less than 0.04 to 36.5 mg/L (with a mean of 3 mg/L) in the Paso Robles Formation and ranged from less than 0.04 to 6.02 mg/L (with a mean of 1.7 mg/L) in the Careaga Sand.

Based on available data, nitrate concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in western Harris Canyon. The east-to-west trend of increasing nitrate concentrations is primarily observed in the Paso Robles Formation. Increasing nitrate concentrations were detected in a public supply well (LACSD 4) east of Los Alamos. However, nitrate concentrations have not exceeded the WQO or MCL in this well.

Based on analytical results from six sampling events between April 2006 and February 2017, nitrate concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events, do not indicate any long-term trends. Analytical results for the water samples indicate nitrate concentrations ranging from 0.8 mg/L to 13.8 mg/L, with a mean of 4.3 mg/L.

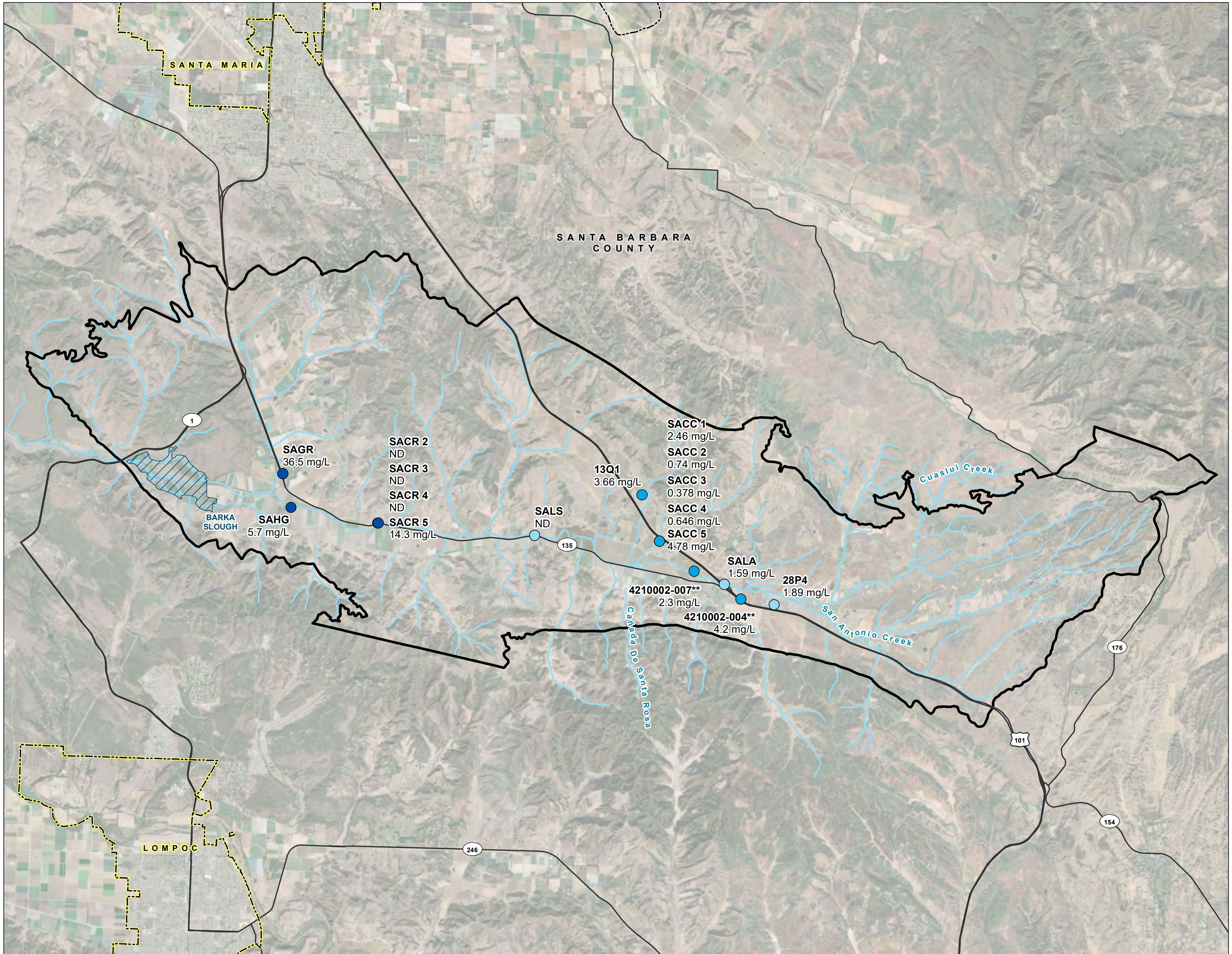

FIGURE 3-43

Nitrate, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Nitrate

- < 2 mg/L
- 2 - 5 mg/L
- > 5 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Nirate is 5 mg/L measured as Nitrogen.
**4210002-004 and 4210002-007 are the well identification names for LACSD 4 in the U.S. Geological Survey Groundwater Ambient Monitoring and Assessment Program.

1. The Maximum Contamination Level is 10 mg/L measured as Nitrogen.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter
ND: non-detect

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_43_Nitrate_Paso_Robles_Aquifer.mxd, abarry

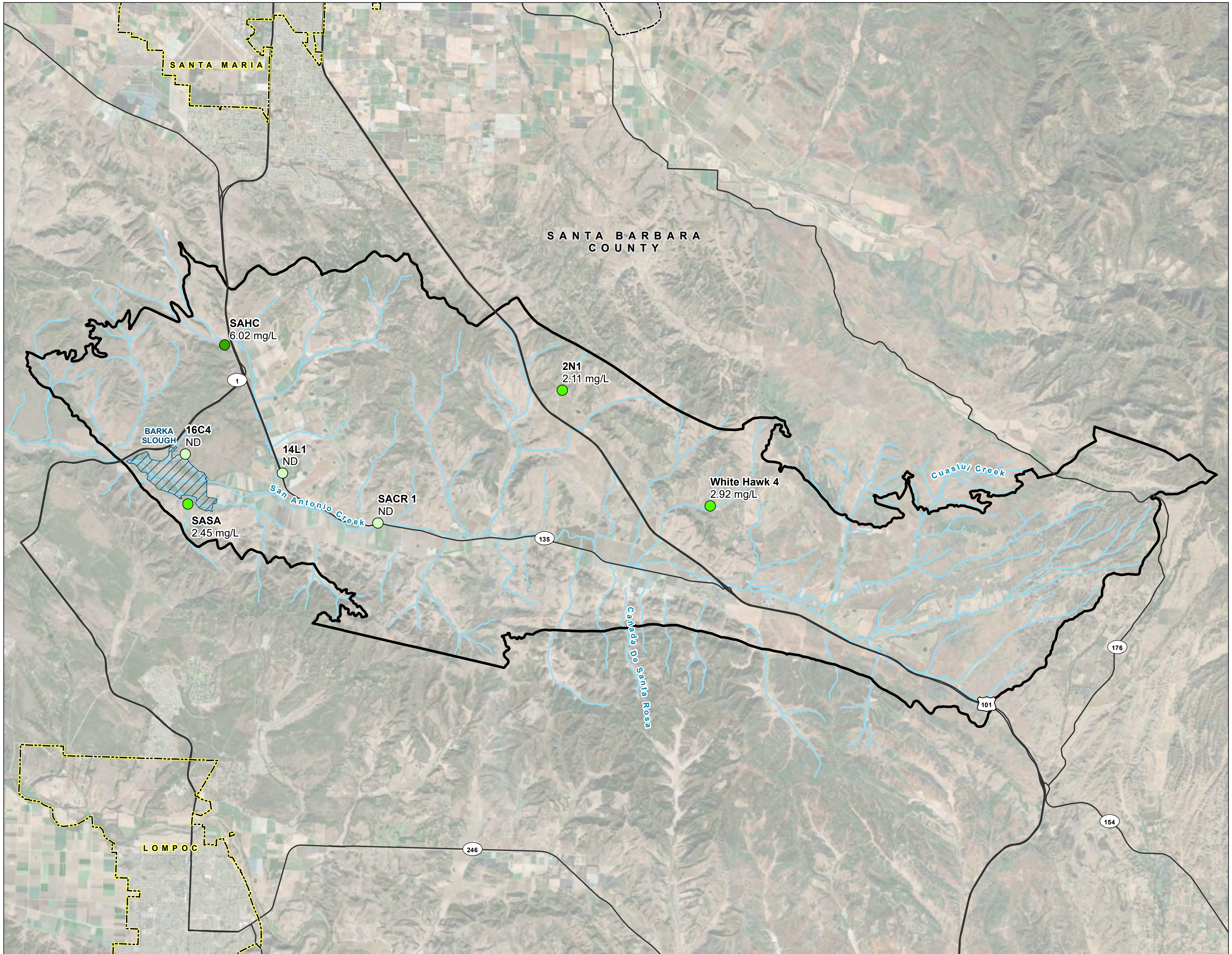

FIGURE 3-44

Nitrate, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Nitrate

- < 2 mg/L
- 2 - 5 mg/L
- > 5 mg/L

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Nitrate is 5 mg/L measured as Nitrogen.

1. The Maximum Contamination Level is 10 mg/L measured as Nitrogen.
2. San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter
ND: non-detect

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_44_Nitrate_Careaga_Aquifer.mxd, abarry

Boron

Boron is an unregulated constituent and therefore does not have an MCL or SMCL but does have a WQO. Elevated boron concentrations in water can damage crops and affect plant growth (SWRCB, 2019). Sample analytical results of boron concentrations in the Paso Robles Formation and the Careaga Sand for 2017 are shown on Figures 3-45 and 3-46, respectively. Boron has been detected at concentrations exceeding the WQO of 0.2 mg/L in 13 of 33 wells sampled. Boron concentrations ranged from 0.078 mg/L to 0.379 mg/L with a mean of 0.191 mg/L in the Paso Robles Formation and ranged from 0.041 mg/L to 14 mg/L with a mean of 0.785 mg/L in the Careaga Sand. The two highest reported concentrations of boron were detected in samples collected in 1976 from wells located in the Barka Slough area. The third-highest concentration measured is from a sample collected in 2017 from a well in Harris Canyon. Removing these samples from the available data set, boron concentrations in the Careaga Sand range from 0.041 mg/L to 0.55 mg/L with a mean of 0.161 mg/L.

Based on available data, boron concentrations increase from east to west along San Antonio Creek and are greatest near Barka Slough, along western San Antonio Creek, and in western Harris Canyon. The east to west trend of increasing nitrate concentrations is consistent between in the Paso Robles Formation and the Careaga Sand.

Based on analytical results from seven sampling events between May 1978 and February 2017, boron concentrations in surface water samples collected from San Antonio Creek near Los Alamos (Station 11135800) during flow events, do not indicate any long-term trends. Analytical results for the water samples indicate boron concentrations ranging from 0.058 mg/L to 0.200 mg/L, with a mean of 0.101 mg/L.

While there are some wells that have concentrations of boron that exceed regulatory standards, it is possible that these exceedances are a result of natural conditions and not caused by land use activities. Elevated boron concentrations are naturally occurring in many central coast basins.

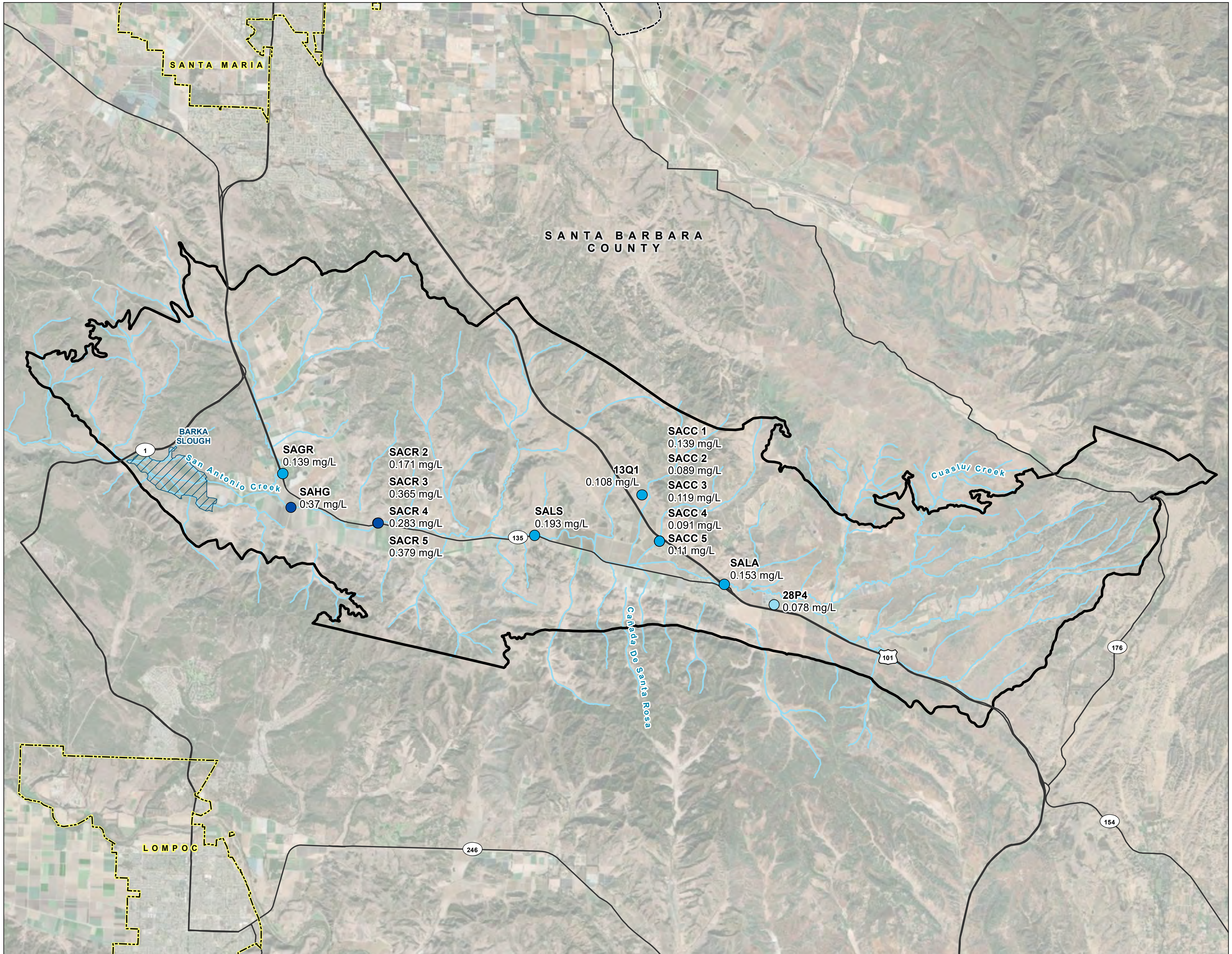

FIGURE 3-45

Boron, 2017
Paso Robles Formation

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Boron

- < 0.1 mg/L
- 0.1 - 0.2 mg/L
- > 0.2 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Boron is 0.2 mg/L.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_45_Boron_Paso_Robles_Aquifer.mxd, abarry

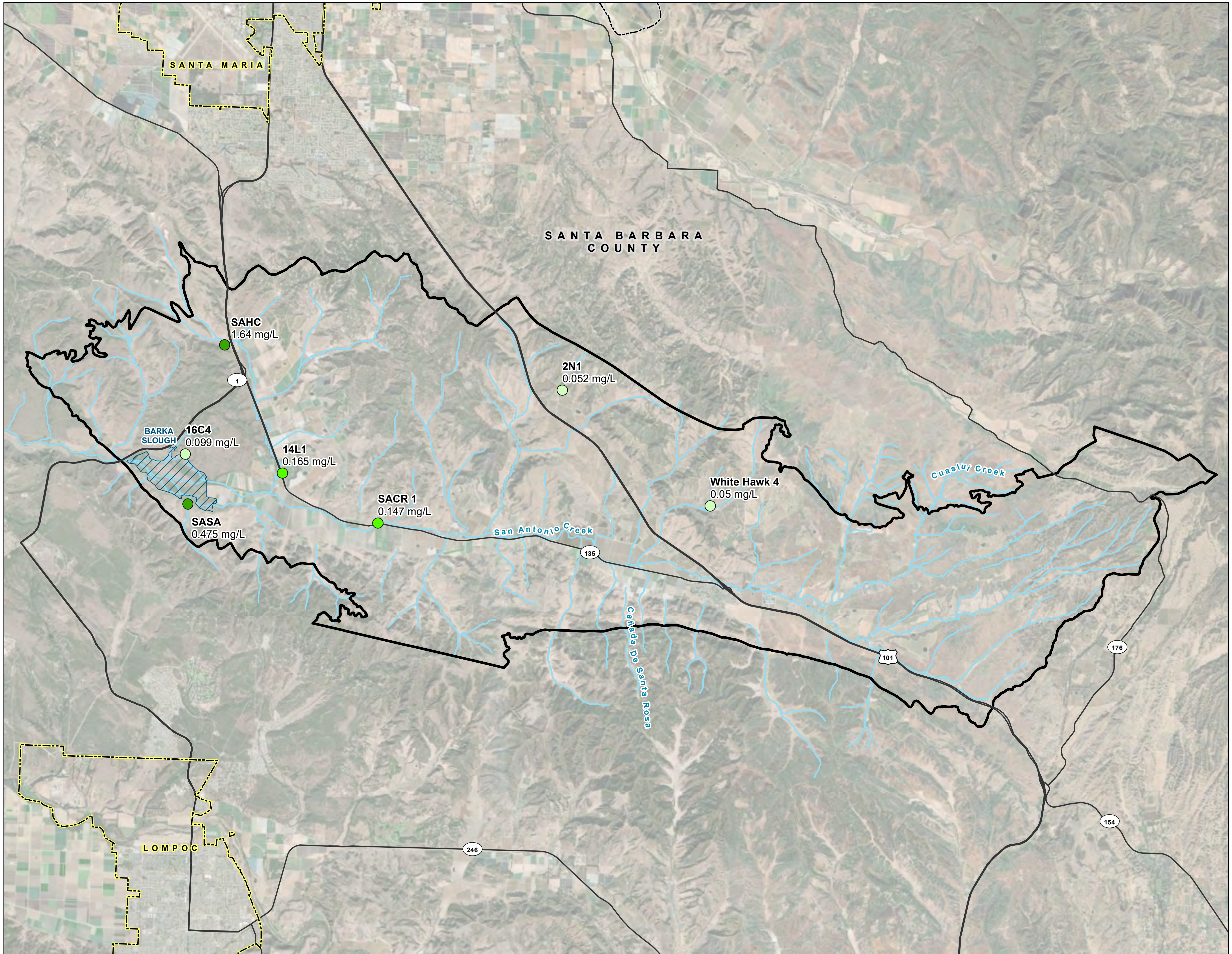

FIGURE 3-46

Boron, 2017
Careaga Sand

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Concentrations

Boron

- < 0.1 mg/L
- 0.1 - 0.2 mg/L
- > 0.2 mg/L*

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTES

*The Water Quality Objective for Boron is 0.2 mg/L.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

mg/L: milligrams per liter

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020).
Water Quality data: GAMA (2021), USGS (2020g)

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Other Constituents

Other constituents detected at concentrations at or above their respective thresholds include iron, manganese, and molybdenum. SMCL exceedances of manganese and iron have been detected throughout the Basin; concentrations for these constituents appear stable. Exceedances of the Federal Health Advisory Level (EPA, 2018) for molybdenum have also been detected throughout the Basin.

Detected exceedances of the action level for lead (EPA, 1991) occurred in samples from two wells in the VSFB wellfield in 2007. Available data indicate that these are isolated concentrations that are not laterally continuous.

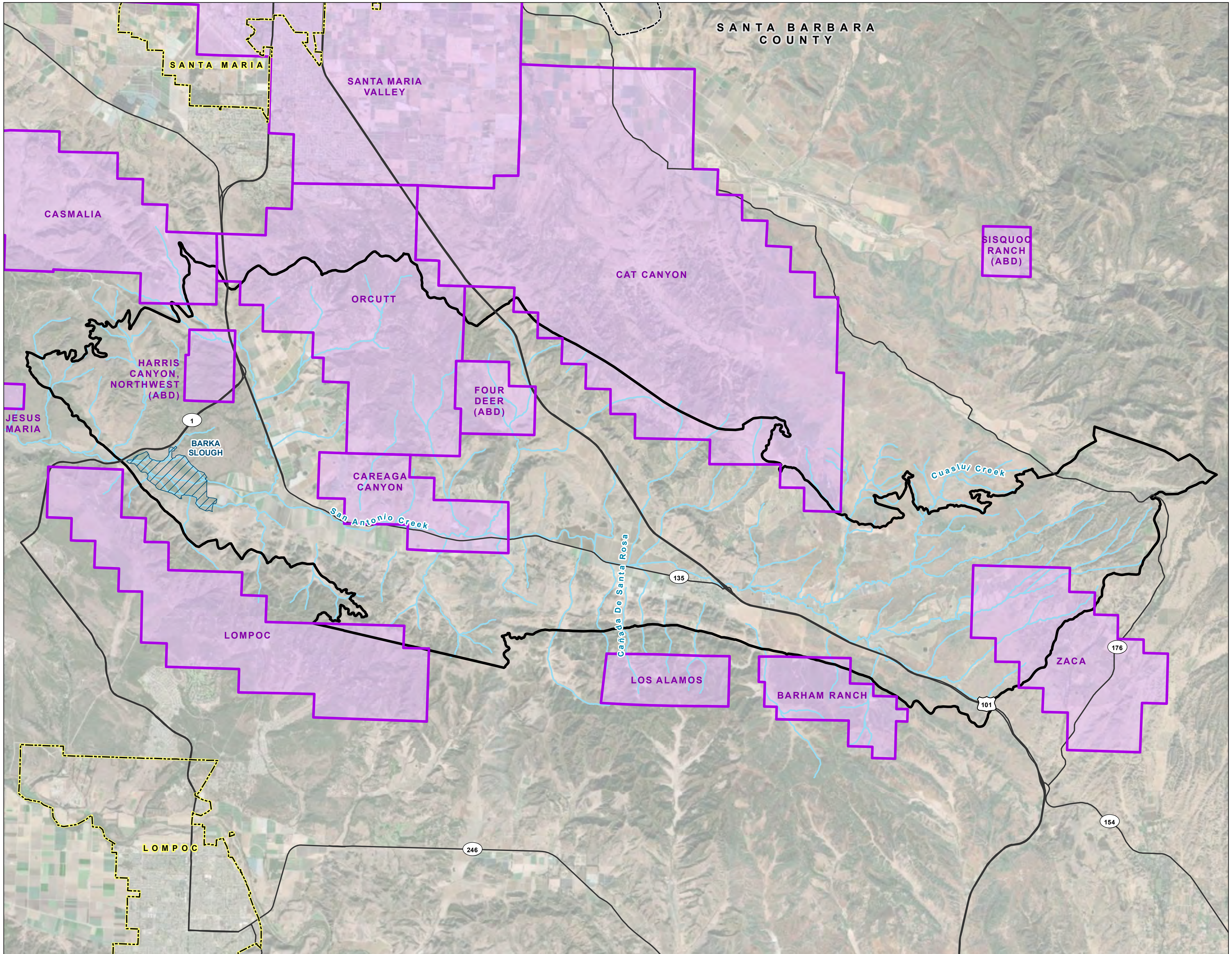
3.2.3.5 Impacts to Groundwater Quality from Oil and Gas Development Activities

According to the California Department of Conservation, Geologic Energy Management Division online Well Finder, or WellSTAR, tool, nine named oil and gas fields are located within or adjacent to the Basin: Cat Canyon, Zaca, Barham Ranch, Los Alamos, Lompoc, Harris Canyon (abandoned), Careaga Canyon, Orcutt, and Four Deer (abandoned) (see Figure 3-47).

FIGURE 3-47

Regional Oil and Gas Fields

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



LEGEND

- Oil and Gas Field
- San Antonio Creek or Adjacent Tributary
- Barka Slough
- San Antonio Creek Valley Groundwater Basin

All Other Features

- County Boundary
- City Boundary
- Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020), Department of Conservation (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_47_Oil_and_Gas_Fields.mxd, abarry

The USGS, in cooperation with the SWRCB, initiated the California Oil, Gas, and Groundwater (COGG) Program in 2015. The objective of the COGG Program is to determine where and to what extent groundwater quality may be adversely impacted by proximal oil and gas development activities (Davis, et al., 2018).

The 487 onshore oil and gas fields in California were prioritized based on potential risk to groundwater from oil and gas development. The USGS developed a criteria-based approach to prioritize the oil and gas fields, the criteria include petroleum-well density, volume of water injected in oil fields, vertical proximity of groundwater resources to oil and gas resource development, and water-well density (Davis et al., 2018).

The priority classifications for the oil and gas fields previously mentioned are shown on Figure 3-48, in Table 3-7, and are summarized below.

- High Priority – Cat Canyon, Zaca, Lompoc, and Orcutt
- Moderate Priority – Careaga Canyon
- Low Priority – Barham Ranch, Los Alamos, Harris Canyon, and Four Deer

Results and interpretations from the COGG Program are not yet available for review. If results and interpretations become available during the implementation period of this GSP, the SABGSA will consider these findings during GSP review periods.

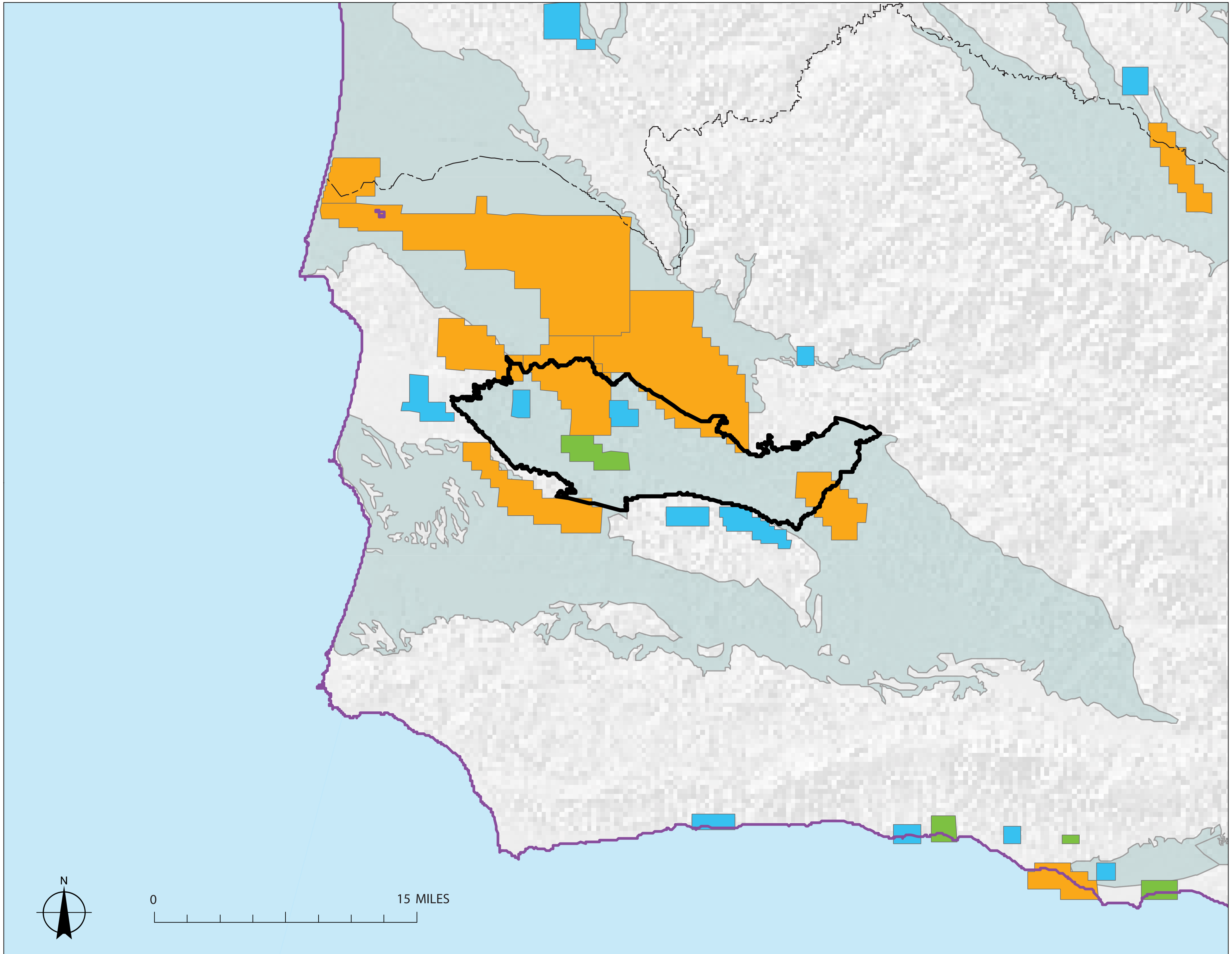


FIGURE 3-48

Prioritization of Oil and Gas Field Regional Groundwater Monitoring

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Priority classifications
- High
- Moderate
- Low

- SAC Basin
- DWR groundwater basins
- DOGGR district boundary
- County

NOTE
DOGGR: California Division of Oil, Gas, and Geothermal Resources

Date: September 16, 2021
Data Sources: Davis et al. (2018), DWR (2018a)

GSI Water Solutions, Inc.

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Table 3-7. Calculated Priority Classification for Oil and Gas Fields

Oil and Gas Field	Field Code	DOGGR District	Field Area (mi²)	Petroleum Well Density				Volume of Water Injection 1977–2015			Vertical Proximity		Water-Well Density		
				Factor Ranking	Density of all Petroleum Wells (wells/mi²)	Density of Injection Wells (wells/mi²)	Density of Waste-Disposal Wells (wells/mi²)	Factor Ranking	Total Volume of Water or Steam Injection (MMB)	Total Volume of Water Injection for Waste-Disposal (MMB)	Factor Ranking	Vertical Separation Distance (ft)	Factor Ranking	Density of Overlying Water Wells (wells/mi²)	Density of Adjacent Water Wells (wells/mi²)
High/Close Range					>70	>6	>2		>140	>25		<1,000		>8	>4
Moderate Range					10–70	0.02–6	0.02–2		10–140	2.5–25		1,000–3,000		1–8	2–4
Low/Far Range					<10	<0.02	<0.02		<10	<2.5		>3,000		<1	<2
District 3—Central Coast															
High Priority															
Cat Canyon	128	3	41.3	High	55.10	6.32	2.49	High	578.76	334.18	Moderate	1,742	Moderate	1.50	1.51
Lompoc	410	3	13.4	Moderate	16.25	1.04	0.97	High	762.62	762.62	Moderate	2,637	Low	0.82	0.48
Orcutt	524	3	17.2	Moderate	41.11	5.93	0.52	High	1015.61	59.19	Moderate	2,191	Low	0.35	1.77
Zaca	860	3	8.8	Moderate	9.38	1.47	1.47	High	287.57	287.56	Far	3,519	Moderate	1.58	0.75
Moderate Priority															
Careaga Canyon	116	3	4.6	Moderate	3.26	0.43	0.43	Low	1.79	1.79	—	—	Moderate	2.60	0.93
Low Priority															
Four Deer	250	3	2.0	Moderate	14.83	0.99	0.00	Low	0.35	0.00	—	—	Low	0.00	1.12
Harris Canyon, NW	295	3	1.4	Low	3.62	0.00	0.00	Low	0.00	0.00	—	—	Low	0.00	0.53
Los Alamos	420	3	2.5	Low	5.25	0.00	0.00	Low	0.00	0.00	—	—	Low	0.81	0.97

Notes

Fields are listed alphabetically by California Division of Oil, Gas, and Geothermal Resources (DOGGR) district. Fields were ranked by each variable into high, moderate, or low categories using the range of values listed in this table; fields were ranked as close, moderate, and far for vertical proximity. The ranking for petroleum-well density was determined by the highest ranking of the three well density calculations: density of all petroleum wells, density of injection wells, or density of waste-disposal wells. The ranking for volume of injection was the higher ranking of total water injection or water injection for waste disposal. Fields that had high water-well density overlying the field or moderate water-well density overlying field and high water-well density adjacent to field were ranked high for water-well density; fields that had low overlying and adjacent water-well density were ranked low; all other fields were ranked moderate. Petroleum-well density, volume of injection, vertical proximity, and water-well density were combined for each field into an overall priority classification. This table includes only fields that were classified as high priority.

— = not available
DOGGR = California Division of Oil, Gas, and Geothermal Resources
ft = foot
mi² = square mile
MMB = million barrel (about 42 gallons per barrel)
NW = northwest
wells/mi² = wells per square mile

Reference

Davis, T.A., Landon, M.K., and Bennett, G.L. 2018. *Prioritization of Oil and Gas Fields for Regional Groundwater Monitoring Based on a Preliminary Assessment of Petroleum Resource Development and Proximity to California's Groundwater Resources: U.S. Geological Survey Scientific Investigations Report 2018–5065*. Available at https://doi.org/10.3133/sir20185065. (Accessed November 6, 2020.)

3.2.4 Land Subsidence [§ 354.16(e)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

Land subsidence can be caused by a number of factors, including (1) lowering of groundwater levels due to pumping if the subsurface geology is prone to subsidence (that is, contains substantial clay beds), (2) oil and gas production, and (3) tectonic activity. For subsidence to occur as a result of groundwater extraction, water levels would need to drop below historical levels for extended periods of time. The DWR data sets reviewed during preparation of the GSP are presented below.

3.2.4.1 NASA-JPL InSAR Data Set, TRE ALTAMIRA Data Set, and UNAVCO CGPS Data Set

The web-based DWR SGMA Data Viewer geographic information system (GIS) (DWR, 2020a) records land surface elevation data for the Basin. Reviewed data include the following:

- Estimated land surface elevation data using Interferometric Synthetic Aperture Radar (InSAR) data that are collected by the European Space Agency Sentinel-1A satellite and processed by TRE ALTAMIRA Inc. (TRE) for the period from June 13, 2015, to September 19, 2019 (TRE ALTAMIRA, Inc., 2020).
- Estimated land surface elevation data using InSAR data collected by the European Space Agency Sentinel-1A satellite and processed by the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL) for the period between spring of 2015 and summer of 2017 (NASA JPL, 2018).
- Measured land surface elevation data collected by a network of Continuous Global Positioning System (CGPS) stations operated by University NAVSTAR Consortium (UNAVCO). Measured land surface elevation data collected by CGPSs located in Los Alamos were reviewed for the Basin (UNAVCO, 2020a).

Figure 3-49 shows the InSAR measured land surface elevation changes in the Basin. The dark blue areas are areas with measured ground surface rise of between 0 and 0.25 ft. The lighter teal areas are areas with measured ground surface drop of 0 to 0.25 ft. Random sampling of the 100-meter by 100-meter (328-ft by 328-ft) calculation grid cells indicates the greatest decrease in land surface elevation has occurred near the town of Los Alamos. Total measured elevation decrease in the Los Alamos area is approximately 0.1 ft, or 0.025 ft per year between the years 2015 and 2019. (Figure 3-50). This is a minor rate of land surface elevation change that is relatively insignificant and not a major concern for the Basin. However, ongoing subsidence over many years could add up to a more significant ground surface drop.

The data accuracy report for the InSAR data (Towill, Inc., 2020) states that "InSAR data accurately models change in ground elevation to an accuracy tested to be 16 mm at 95% confidence." Based on this, the InSAR-based annual subsidence rate of 4.6 mm (0.18 inches) is below the accuracy range of 16 mm (0.63 inches). Thus, the reported subsidence is within the range of uncertainty of the InSAR data, indicating that no significant subsidence within the Basin has been recorded.

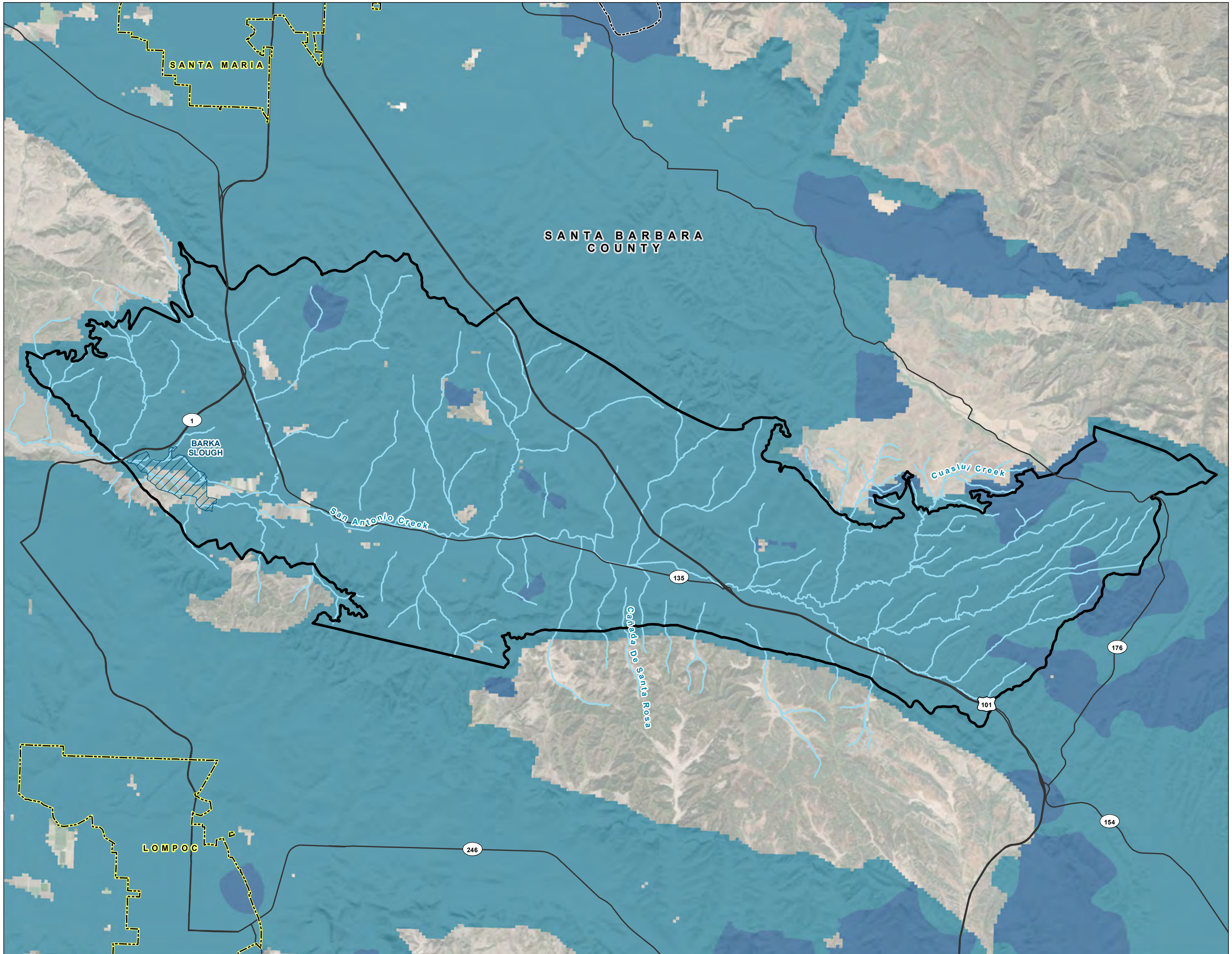

FIGURE 3-49

Total Land Surface Elevation Change (2015-2019), InSAR Data Map

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Land Subsidence

Vertical Displacement

- -0.25 to 0 ft
- 0 to 0.25 ft

All Other Features

- San Antonio Creek or Adjacent Tributary
- Barka Slough
- B118 San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a, 2020a), Maxar imagery (2020)

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TRE ALTAMIRA Vertical Displacement at Latitude: 34.73869 Longitude: -120.27521

Interpolated Displacement (ft): -0.181
Latitude: 34.73869
Longitude: -120.27521

Vertical Displacement

Date: (hover to see values)
— TRE Altamira Interpolated Vertical Displacement

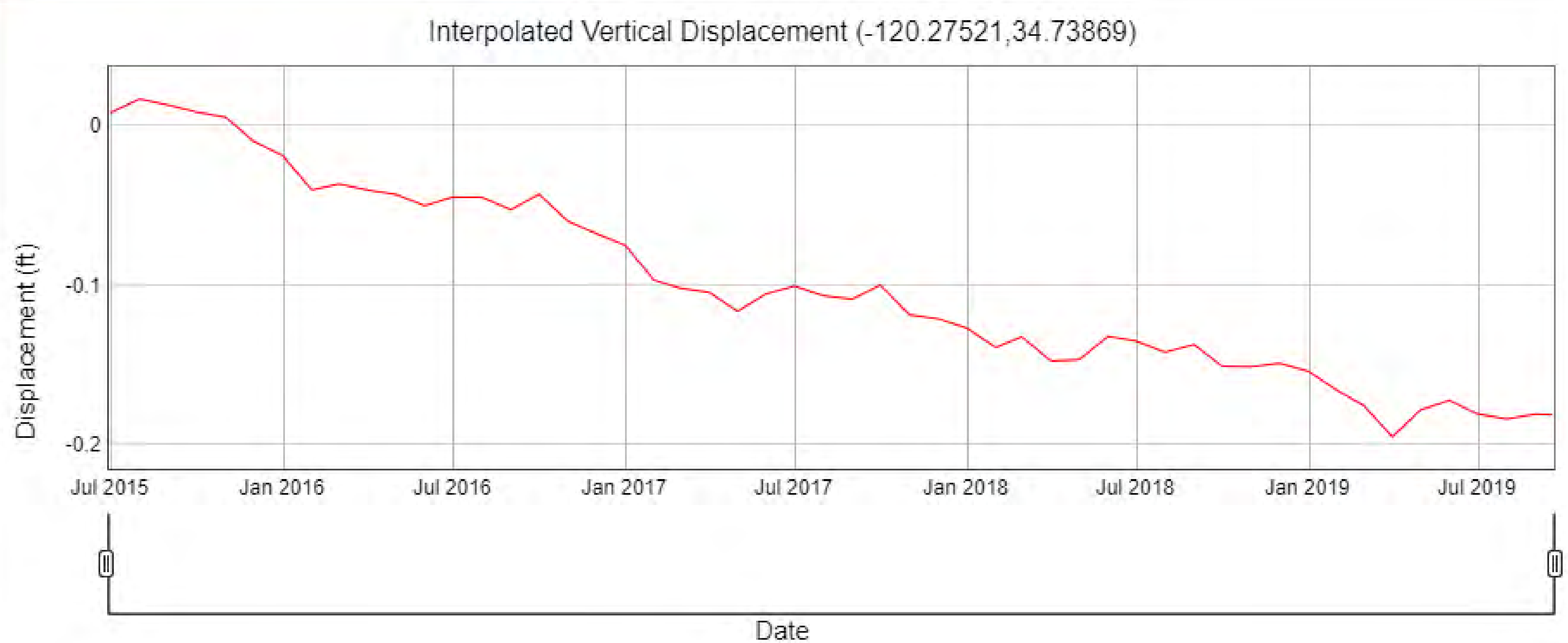

FIGURE 3-50

Land Surface Elevation Change, TRE Point Source, Los Alamos

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Date: September 16, 2021
Data Sources: DWR (2020a)

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3.2.4.2 UNAVCO Continuous Global Positioning System Sites

Figure 3-51 is a time-series plot of land surface elevation change generated from data recorded from the UNAVCO CGPS Station ORES, located in the town of Los Alamos, near Los Alamos Park. Total land surface change recorded by the station during the 20-year period of record (2000 to 2020) is approximately 250 millimeters, or 0.82 ft. Based on these data, the decrease in land surface elevation is occurring at a rate of approximately 0.49 inch per year. The plot indicates an accelerated subsidence rate beginning in 2014–2015. This is a minor rate of subsidence and is relatively insignificant and not a major concern for the Basin. However, ongoing subsidence over many years could add up to a more significant ground surface drop. The SABGSA will continue to monitor annual subsidence as part of its GSP monitoring program.

The Basin is located near the intersection of the Coastal Ranges and Transverse Ranges California Geomorphic Provinces. Consequently, the Basin is in a very tectonically active region. The 0.82 ft of vertical displacement measured at the UNAVCO station could be due to tectonic activity, groundwater extraction, oil and gas extraction, or a combination of the three. In addition, InSAR data provided by DWR show that significant land subsidence did not occur during the period between June 2015 and June 2019 (available InSAR data period of record) in the Basin.

3.2.4.3 Preliminary Subsidence Evaluation

To supplement the InSAR and UNAVCO data and assess the general susceptibility of the Basin to experience subsidence as a result of lowering groundwater levels below historical levels, a preliminary subsidence evaluation was completed. The preliminary evaluation was based on review of subsurface geologic information and groundwater level data for key wells and included estimating ranges of possible long-term subsidence that might be expected in the future. The evaluation, which is included in Appendix D, included the following key conclusions:

- There have been no reports from landowners or public agencies of impacts resulting from subsidence.
- The analysis was completed at two representative well locations and showed an estimated total potential subsidence on the order of 1 to 2 ft over the historical period resulting from the changes in groundwater elevation reported in the hydrographs.
- Historical subsidence on the order of 1 to 2 ft appears relatively consistent with the estimated subsidence rate of 0.5 inches per year reported for the UNAVCO CGPS Station ORES (see Section 3.2.4.2).

The well logs used in the evaluations include relatively thick sections of clayey materials (which would be where compaction and inelastic subsidence may occur), which are not necessarily representative of the entire Basin. The Paso Robles Formation contains relatively thin, often discontinuous sand and gravel layers interbedded with thicker layers of silt and clay; however, the fine-grained materials that may be subject to subsidence are not laterally continuous. The lack of lateral continuity tends to reduce the likelihood for significant subsidence. The Careaga Sand consists of fine-grained to medium-grained, uniform, massive, marine sand with some gravel and limestone; therefore, lacking laterally continuous fine-grained material susceptible to significant subsidence. Based on the result of this analysis, it is unlikely that the full measure of estimated subsidence (of 1 to 2 ft) would be observed unless groundwater elevations declined significantly below what has been observed historically and did not recover for an extended period.

There has been no reported historical or anecdotal information regarding land subsidence in the Basin as a result of groundwater extractions. There may be, and likely has been, some subsidence as a result of groundwater extraction, but the effects, to date, have not been documented to affect surface features. With groundwater declines of as much as 70 to 143 ft in the Basin (see Section 3.2.1.2), some subsidence may have occurred prior to the initiation of SGMA (January 2015), but there is no readily available information to document that. Due to the limited data available and the fact that factors other than groundwater extraction (e.g., tectonic activity and oil and gas extraction) must be considered, it is unknown how much subsidence has occurred, or how it relates to the maximum amount that may occur in the future. For these reasons, the SABGSA intends to continue to monitor for subsidence.

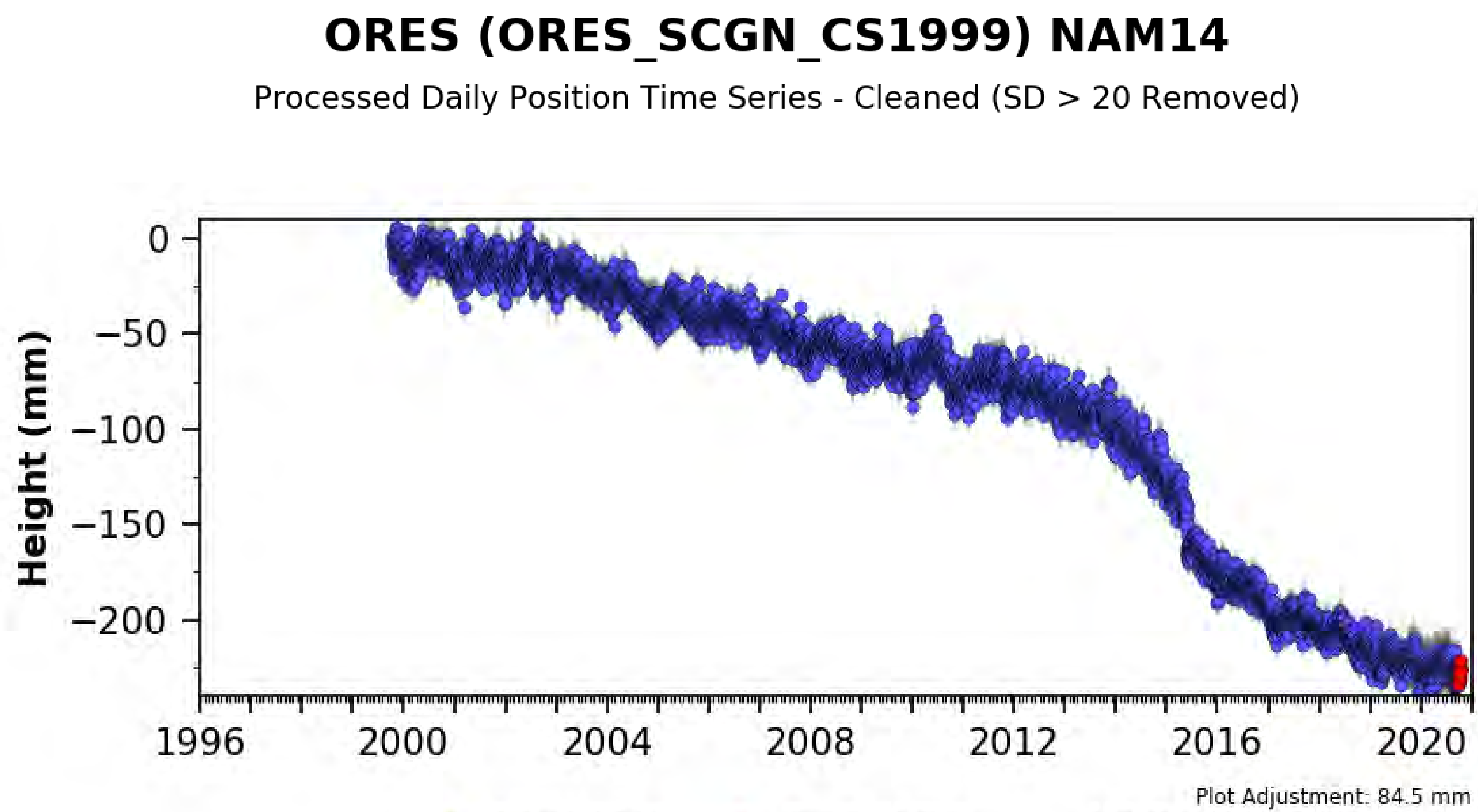

FIGURE 3-51

Time Series Plot of Land Surface Elevation Change from UNAVCO CGPS Station ORES

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Final Solution
- Rapid Solution
- Standard Deviation

Date: September 16, 2021
Data Sources: UNAVCO (2020b)

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3.2.5 Interconnected Surface Water Systems [§ 354.16(f)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(f) Identification of interconnected surface water systems within the basin and an estimate of the quantity and timing of depletions of those systems, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

Surface water systems interact with groundwater in three basic ways, as follows:

- Surface water systems gain water from inflow of groundwater through the stream bed.
  - Requires the elevation of the water table in the vicinity of the surface water body to be higher than the elevation of the surface water body surface
- Surface water systems lose water to groundwater by outflow through the stream bed.
  - Requires the elevation of the water table in the vicinity of the surface water body to be lower than the elevation of the surface water body surface
- Surface water systems gain water in some reaches of the surface water body and lose water in others.

Figure 3-52 is a drawing of gaining and losing stream conditions.

The connection of surface and groundwater systems can be affected by natural processes such as heavy rain events and periods of drought, as well as anthropogenic processes, such as land development, stream alteration, and pumping of surface water and groundwater. In addition to affecting the direction of water movement and volume of water exchanged between surface and groundwater systems, these processes can also affect water quality.

Figure 3-53 is a stream classification map of the Basin as defined by the USGS NHD (USGS, 2020b). Based on the USGS NHD, all the streams in the Basin are classified as intermittent and likely to be losing streams. The stream channels located in Barka Slough are classified as perennial and likely to be gaining streams.

Ephemeral surface water flows in the Basin make it difficult to assess the interconnectivity of surface water and groundwater and to quantify the degree to which surface water depletion has occurred. According to the USGS NHD, three springs or seeps were identified in the Basin (see Figure 3-9). Based on the location of three springs or seeps, they appear to be overlying the Paso Robles Formation. Two additional springs or seeps were identified by basin stakeholders and are located northeast of Los Alamos on Price Ranch within a tributary to San Antonio Creek and in the Las Flores watershed, a tributary to San Antonio Creek, in the low-lying grassland areas immediately west of U.S. Highway 101 (CRCD, 2003) (see Figure 3-9). Based on location, the spring or seep in the Las Flores watershed overlies the Paso Robles Formation and the Price Ranch spring or seep is located near the contact between the Paso Robles Formation and the Careaga Sand. Without additional analysis, it is unknown whether the groundwater source of these springs or seeps is from the underlying principal aquifer or from perched water within the channel alluvium. As discussed in Section 3.1.3.1, artesian conditions exist in the Basin and are due to localized confining layers created by the synclinal structure of the Basin, the presence of overlying fine-grained deposits, and or faults present within the Basin (Carlson, 2019) (USGS, 2021a). Planned additional analysis of these areas are described in Section 6.

Interconnected surface water and groundwater within the Paso Robles Formation and Careaga Sand is indicated by the Barka Slough and perennial classification of streams in that area. Figure 3-31 is a conceptual model of groundwater flow as it reaches Barka Slough. The results for volume calculations of groundwater discharged annually to Barka Slough are presented in Table 3-8. Refer to Section 3.3 and Appendix D for groundwater discharge calculations.

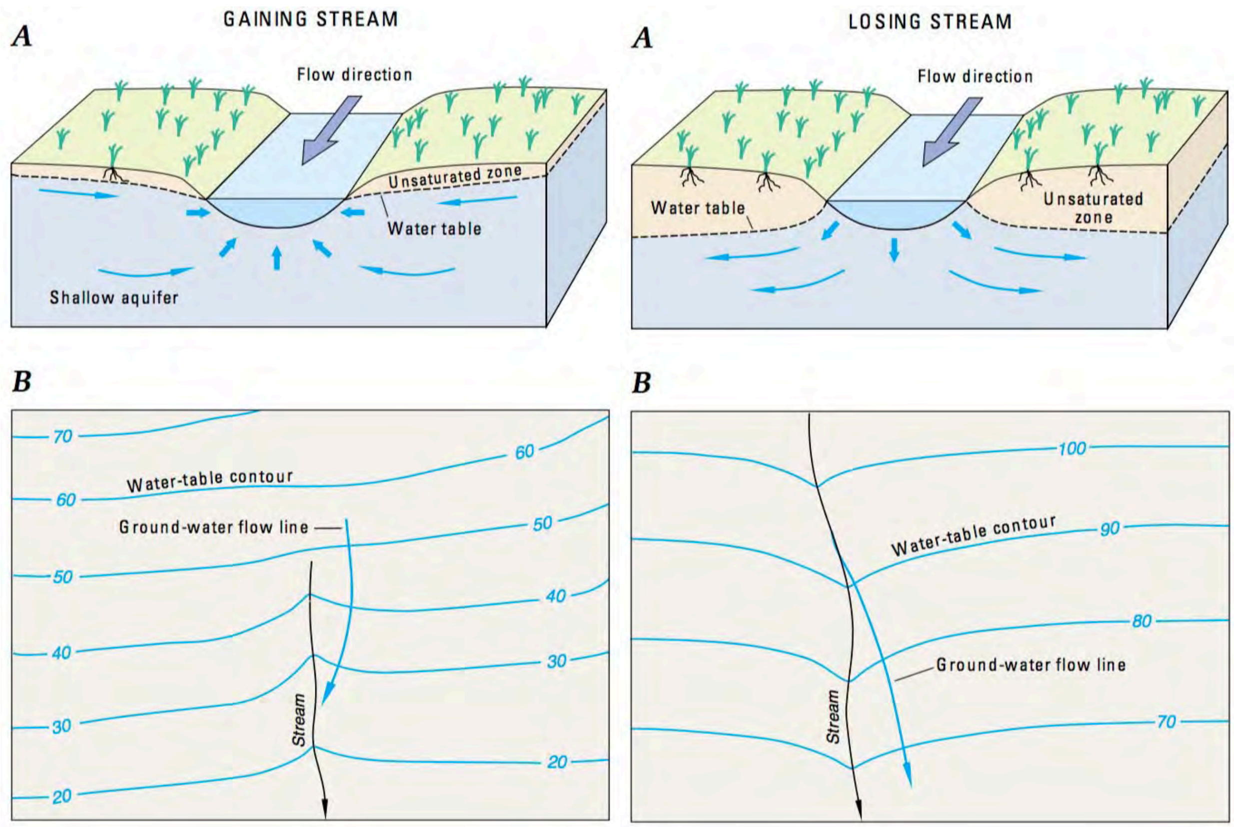

Figure 3-52. Gaining and Losing Streams (USGS, 2020d)

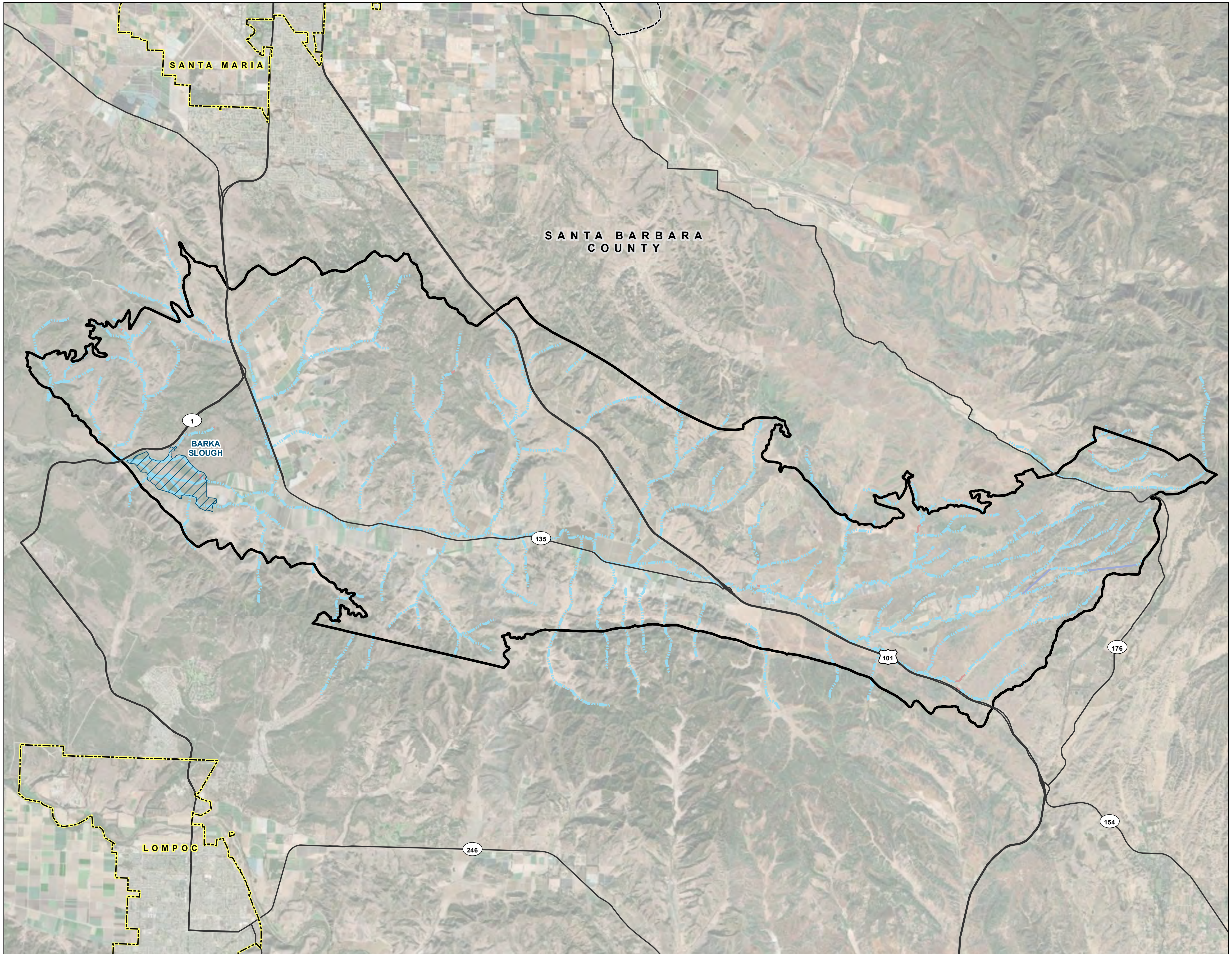

FIGURE 3-53

USGS National Hydrography Dataset (NHD) Stream Classification

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

USGS NHD Stream Classification

- Intermittent
- Perennial
- Connector
- Artificial Path

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_53_USGS_NHD_Stream_Classification.mxd, abarry

Table 3-8. Average Annual Surface and Groundwater Discharge to Barka Slough[1]

Water Type	Discharge Type	Discharge Volume (AFY)
Surface Water	Streamflow	2,100
Groundwater	Vertical Flux[2]	4,900
Total		**7,000**

Notes

[1] See Section 3.3 and Appendix D for explanation of calculations.

[2] Vertical flux includes discharge of groundwater into the alluvium from the Paso Robles Formation and through Barka Slough sediments from the Careaga Sand (see Figure 3-31 for conceptual model of surface and groundwater flow as it reaches Barka Slough).

AFY = acre-feet per year

Figure 3-54 shows the locations of active and inactive stream gages along San Antonio Creek and its tributaries. The gages are as follows:

- Stream gage 11135800 is active, located along San Antonio Creek near Los Alamos, and has a period of record of water years 1971 through 2018.
- Stream gage 11136000 is inactive, was located along San Antonio Creek at Harris Canyon and had a period of record of water years 1948 through 1954.
- Stream gage 11136050 is inactive, was located along San Antonio Creek above Barka Slough, and had a period of record of water year 1985.
- Stream gage 11136040 is inactive, was located along Harris Canyon Creek upgradient of the confluence with San Antonio Creek and had a period of record of water year 2018.
- Stream gage 11136100 (referred to as the Casmalia gage) is active, located west of the Basin along San Antonio Creek and has a period of record of water years 1956 through 2018.

Due to the placement of the gages and limited period of record, the recorded flow data cannot be used to accurately quantify stream gains or losses. However, seasonal flow data shown on Figure 3-45 are consistent with the stream classifications on Figure 3-53.

Overview Map

San Antonio Creek Daily Stream Gage Data

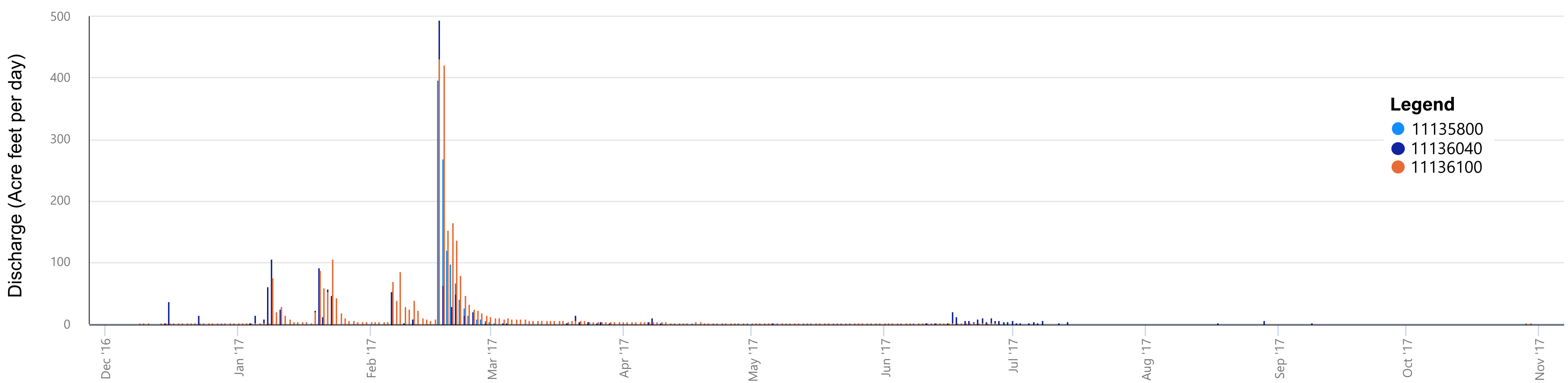

FIGURE 3-54

Daily Stream Gage Data

Groundwater Sustainability Plan
San Antonio Creek Valley Groundwater Basin

Date: September 16, 2021
Data Sources: USGS (2020f), PowerBI

Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3

3.2.6 Groundwater-Dependent Ecosystems [§ 354.16(g)]

§ 354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following:

(g) Identification of groundwater dependent ecosystems within the basin, utilizing data available from the Department, as specified in Section 353.2, or the best available information.

SGMA and DWR's GSP regulations establish requirements for the identification of GDEs, and if present, identification of impacts on GDEs from management actions in the Basin. GDEs are defined in the SGMA regulations as "ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface." Determination of whether an area within a groundwater basin includes GDEs is the responsibility of the GSA. DWR created the NCCAG data set to assist GSAs with identification of potential GDEs. NCCAG data are presented on Figure 3-10.

The NCCAG data set is a compilation of 48 publicly available state and federal agency data sets that map vegetation, wetlands, springs, and seeps in California. A working group that includes DWR, California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC) reviewed the compiled data set and conducted a screening process to exclude vegetation and wetland types less likely to be associated with groundwater and to retain types commonly associated with groundwater as described in Klausmeyer et al. (2018). Two habitat classes are included in the NCCAG data set statewide:

- Wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions
- Vegetation types commonly associated with the subsurface presence of groundwater (phreatophytes)

The data included in the NCCAG data set do not represent the determination of a GDE by DWR, only the potential existence of a GDE. However, the NCCAG data set can be used by GSAs as a starting point when approaching the task of identifying GDEs within a groundwater basin that are both classified as potential GDEs and connected to groundwater (DWR, 2020b).

3.2.6.1 Identification of Potential GDEs

TNC developed a guidance document based on best available science to assist agencies, consultants, and stakeholders to efficiently incorporate GDEs analysis into GSPs. In the guidance, five steps were outlined to inform the GSP process (Rohde et al., 2018):

Step 1 – Identify potential GDEs

Step 1.1 – Map GDEs

Step 1.2 – Characterize GDE Condition

Step 2 – Determine Potential Effects of Groundwater Management on GDEs

Step 3 – Consider GDEs when Establishing Sustainable Management Criteria

Step 4 – Incorporate GDEs into the Monitoring Network

Step 5 – Identify Projects and Management Actions to Maintain or Improve GDEs

The two objectives within Step 1, to map (Step 1a) and characterize (Step 1b) GDEs in the Basin, are the focus of this section. The remaining steps are considered in later sections of the GSP, specifically in

Sustainable Management Criteria (Section 4), Monitoring Network (Section 5), and Projects and Management Actions (Section 6).

Based on review of the NCCAG data set, several wetland features, three mapped springs, and four types of vegetation communities are present in the Basin. The four Natural Communities vegetation types are:

- Coast Live Oak
- Valley Oak
- Riparian Mixed Harwood
- Willow

Wetland classifications recorded in the Natural Communities data set (DWR, 2020b) for the Basin include the following:

- Palustrine, Emergent, Persistent, Seasonally Flooded
- Palustrine, Emergent, Persistent, Semipermanently Flooded
- Palustrine, Forested, Seasonally Flooded
- Palustrine, Scrub-Shrub, Seasonally Flooded
- Palustrine, Unconsolidated Bottom, Permanently Flooded
- Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded
- Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded

Generally, wetlands were recorded along the San Antonio Creek tributary channels as well as Barka Slough. There are a few small areas outside of these locations that may be associated with springs.

The four Natural Communities vegetation classifications are presented as polygons on Figure 3-10 as they occur throughout the Basin. Each of the vegetation classifications are described in detail below. The Natural Communities wetland classifications are also presented on Figure 3-10 (aggregated as one “wetland area” category). The three mapped springs are also shown on Figure 3-10.

Potential GDE Vegetation Classifications

The Natural Communities vegetation classes mapped within the Basin include Coast Live Oak, Valley Oak, Riparian Mixed Hardwood, Riversidean Alluvial Scrub, and Willow. These NCCAG vegetation classifications are a collection of multiple vegetation species. The classifications named after a specific species (e.g., Willow) are generally the predominant species in the classification (Klausmeyer et al, 2018). A summary of each of the classifications is provided below.

The **Coast Live Oak** Natural Communities classification occurs throughout the Basin, covering an area of 2,686 acres, as shown in orange on Figure 3-10. Coast live oak (*Quercus agrifolia*) dominates this type that occurs primarily on protected north-facing ravines within the river channel. Coast live oak is considered the most fire-resistant California tree oak and does not tolerate extended flooding (USDA, 2009). It has evergreen leaves, thick bark, and an ability to sprout from the trunk and roots, given its food reserves stored in an extensive root system (USDA, 2009). Associated species include toyon (*Heteromeles arbutifolia*) and elderberry (*Sambucus mexicana*) (SWRCB, 2011). Reported maximum rooting depths for the coast live oak range from 24 to 35 ft (TNC, 2020).

The **Valley Oak** Natural Communities classification occurs primarily in the eastern portion of the Basin, covering an area of 495 acres as shown in red on Figure 3-10. Valley oak (*Q. lobata*) savanna and woodlands normally occur at elevations below 2,000 ft in valley bottoms on deep, well-drained soils

(Meridian Consultants, 2012). Understory vegetation in relatively undisturbed areas may be constituted of native perennial bunchgrasses. This community may also contain scattered coast live oaks and blue oaks. Reported maximum rooting depth for valley oak is 80 ft (Lewis and Burgy, 1964).

The **Riparian Mixed Hardwoods** Natural Communities classification occurs in several isolated stands within the Basin, covering an area of 171 acres as shown in purple on Figure 3-10. Riparian Mixed Hardwood is found along perennial and intermittent streams in areas that are less frequently and less intensely disturbed by flood events than areas dominated by riparian scrub. The dominant tree species include Fremont or black cottonwood (*Populus fremontii*, *P. balsamifera ssp. trichocarpa*), California sycamore (*Platanus racemosa*), willow (either arroyo, red, or yellow), California walnut (*Juglans californica*), white alder (*Alnus rhombifolia*), and coast live oak (*Q. agrifolia*) (Meridian Consultants, 2012). Understory species, when present, include California mugwort (*Artemisia douglasiana*), California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversilobum*), Pacific blackberry (*Rubus ursinus*), wild cucumber (*Marah macrocarpa*), and non-native plants such as periwinkle (*Vinca minor*) and nasturtium (*Tropaeolum majus*) (Meridian Consultants, 2012). Apart from coast live oak, only a few of this category's primary plant species (willow, Fremont cottonwood, and black cottonwood) have rooting depth information in the GDE Database (TNC, 2020), with ranges from 1 to 7 ft.

The **Willow** Natural Communities classification occurs within Barka Slough, totaling 268 acres as shown in green on Figure 3-10. The Willow CALVEG alliance is defined by the dominance of a single or a combination of deciduous willow tree species including black (*Salix gooddingii*), red (*S. laevigata*), arroyo (*S. lasiolepis*), and/or shining (*S. lucida*) willows (USDA, 2009). A biological assessment prepared for the Vandenberg Dunes Golf Courses Project indicates the presence of arroyo willow in the area (AECOM, 2019). Willows are found on the edge of active channels and floodplain terraces where they have access to shallow groundwater. Other riparian species found within this CALVEG alliance include the Fremont cottonwood (*P. fremontii*) and California sycamore (*P. racemosa*) and a variety of perennial and annual forbs. No information about rooting depths of the specific willow species listed above is provided in the GDE Rooting Depths Database. However, other willow species in the same genus have reported maximum rooting depths ranging up to 8 ft (TNC, 2020).

A complete biological survey of Barka Slough has not been completed nor made available for review. Table 3-9 lists plant species that likely occur in Barka Slough based on the plant species identified during surveys completed as part of the biological assessment for the Vandenberg Dunes Golf Courses Project (AECOM, 2019) and plant species identified during an unpublished survey that was completed after the Harris Fire (2000) (ManTech, 2010). Due to a redirection in funding, the post-fire assessment habitat study was not completed.

Table 3-9. Rooting Depths of Plant Species Likely Present in Barka Slough[1]

Common Name	Species Name	Maximum Rooting Depth (feet)[2]
Arroyo Willow	*Salix lasiolepis*	3 (*S.* spp.)
Black Elderberry	*Sambucus nigra*	3 (*S. Mexicana*)
Basket Rush	*Juncus textilis*	1 (*J. arcticus*)
Deerweed	*Lotus scoparius*	4
California Bulrush	*Schoenoplectus californicus*	2 (*S. americanus*)
Cattail	*Typha* spp.	1 (*T. domingensis*)
Spiny Rush	*Juncus acutus*	1 (*J. arcticus*)
California Sawgrass	*Cladium californicum*	—
Bur-reed	*Sparganium eurycarpum*	0.4

Notes

[1] Plant species listed were identified during surveys completed as part of the biological assessment for the Vandenberg Dunes Golf Courses Project (AECOM, 2019) and post-Harris Fire assessment habitat study completed in 2004 and 2005 (ManTech, 2010).
[2] Rooting depths as described in the California Plant Rooting Depth Database compiled by The Nature Conservancy in California and published on April 19, 2018. A species name in parentheses following the maximum rooting depth indicates no maximum rooting depth was indicated in the database for the specific species listed in the preceding column and the parenthesized species maximum rooting depth is listed.

— = data are unavailable

Screening of Potential GDEs

To confirm whether the Natural Community vegetation and wetland polygons are connected to groundwater, local hydrologic information may be used to confirm a groundwater connection to the potential GDE. TNC guidance (Rohde et al., 2018) provides a list of questions to assess whether Natural Community polygons (potential GDEs) are connected to groundwater. These questions include the following from Worksheet 1 of the guidance:

1. Is the Natural Community polygon underlain by a shallow unconfined or perched aquifer that has been delineated as being part of a Bulletin 118 principal aquifer in the basin?
2. Is the depth to groundwater under the Natural Community polygon less than 30 feet?
3. Is the Natural Community polygon located in an area known to discharge groundwater (e.g., springs/seeps)?

If the answer is yes to any of these three questions, per TNC guidance, it is likely a GDE. As a part of the process, some Natural Community polygons are removed and other GDE polygons may be added, where appropriate. TNC recommends that Natural Community polygons with insufficient hydrologic data also be considered GDEs but be flagged for further investigation.

Contoured groundwater elevation data for spring 2015 were used to determine areas where the Natural Communities polygons were within 30 ft depth to groundwater. Spring 2015 groundwater elevations were chosen for this analysis because this marked a period of the greatest recent data availability.[20] These data are considered representative of average spring-summer conditions within the last 5 years.[21] Areas with

[20] The spatial distribution and density of spring 2015 groundwater elevation data satisfies the TNC recommendation for using wells that are located within 5 kilometers (3.1 miles) of the Natural Communities polygons (TNC, 2019).
[21] Groundwater elevations are generally the highest in the spring, following recharge from winter rains. Spring-time groundwater elevations in 2015, a relatively dry year, are considered representative of average modern conditions as measured throughout the spring-summer months, during the period of maximum annual evapotranspiration.

spring 2015 depth to groundwater of 30 ft or less are shown in purple on Figure 3-55 and the Natural Communities polygons associated with these areas are shown on Figure 3-56. Other than two small areas located just west of the community of Los Alamos, the area of 30 feet or less depth to groundwater is concentrated entirely around the Barka Slough area.

As discussed in Sections 3.2.1.3 and 3.2.5, Barka Slough is located in an area where there is a groundwater flow barrier and where groundwater is known to discharge from underlying aquifers into the Slough area. As a result of this, plus the results of the depth to groundwater analysis, the Barka Slough area and all intersecting Natural Communities polygons are considered GDEs. An area that is known to discharge groundwater to surface water in seeps is located northeast of Los Alamos on Price Ranch (Figure 3-56). The Price Ranch seep area is designated as a 27-acre wetland and is associated with 33-acre stand of coast live oak, according to the Natural Communities data set (DWR, 2020b). These areas are considered GDEs based on observations by a local landowner.[22] Another area known to discharge groundwater in seeps supporting La Graciosa thistle (*Cirsium loncholepis*; a special-status species; see Section 3.2.6.2) is located in the Las Flores watershed, a tributary to San Antonio Creek, in the low-lying grassland areas immediately west of U.S. Highway 101 (CRCD, 2003). This seep area is designated as a 3-acre wetland and is considered a GDE[22] (Figure 3-56).

[22] Although the Price Ranch and Las Flores watershed seeps are not indicated as potential GDEs in the depth-to-groundwater analysis (i.e., having depth to groundwater of less than 30 ft) they are considered GDEs because they are known to discharge groundwater based on field observation (CRCD, 2003 and local landowner Chris Wrather).

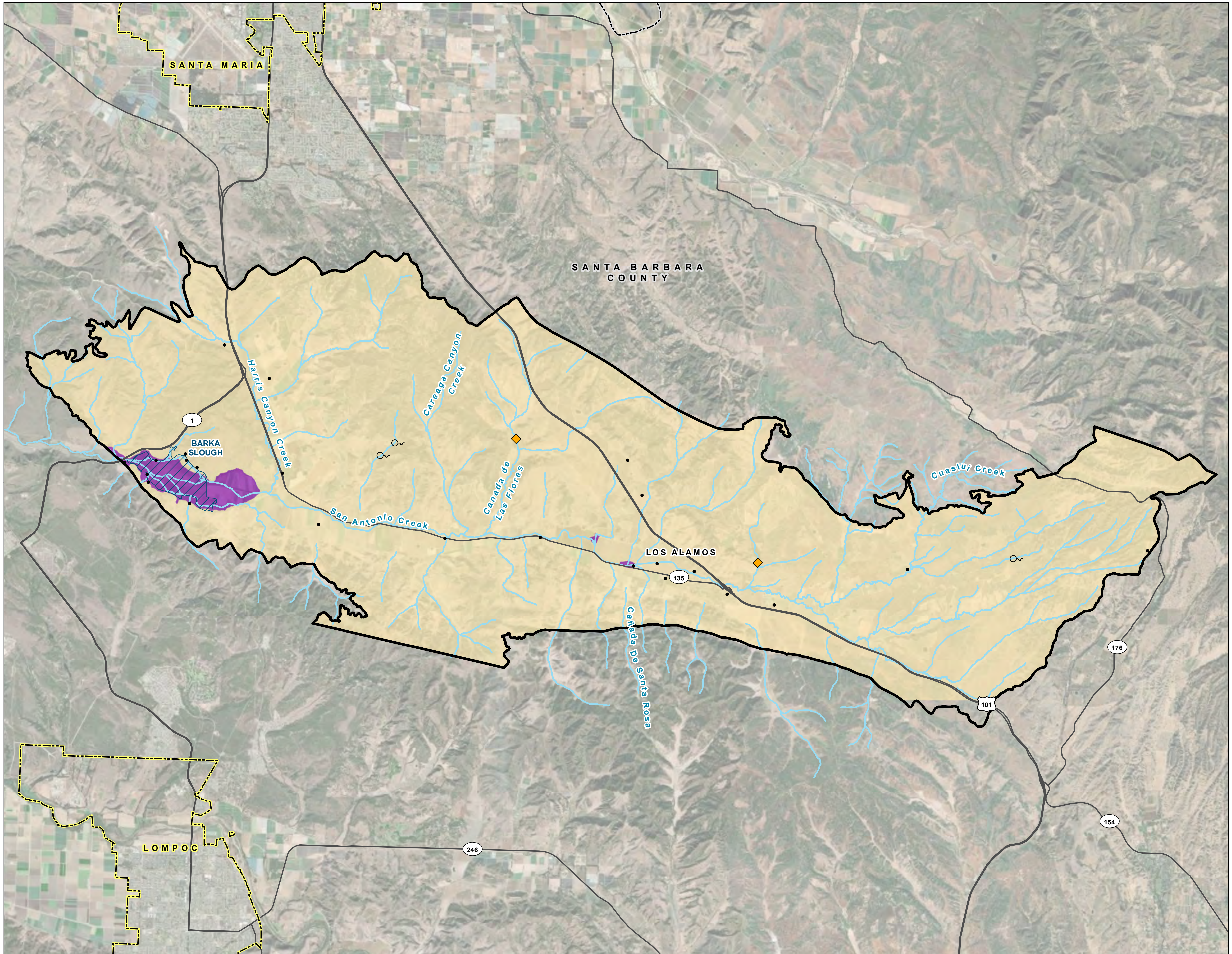

FIGURE 3-55

Groundwater-Dependent Ecosystems 30-Foot Depth to Groundwater Screening

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Spring 2015 Measured Groundwater Elevation

Spring 2015 Depth to Groundwater

- <= 30 ft Depth To Water
- > 30 ft Depth To Water

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- Major Road
- City Boundary
- USGS Spring
- Reported Seep

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a, 2020b), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_55_GDEs_30ft_Depth_to_GW_Screening.mxd, abarry

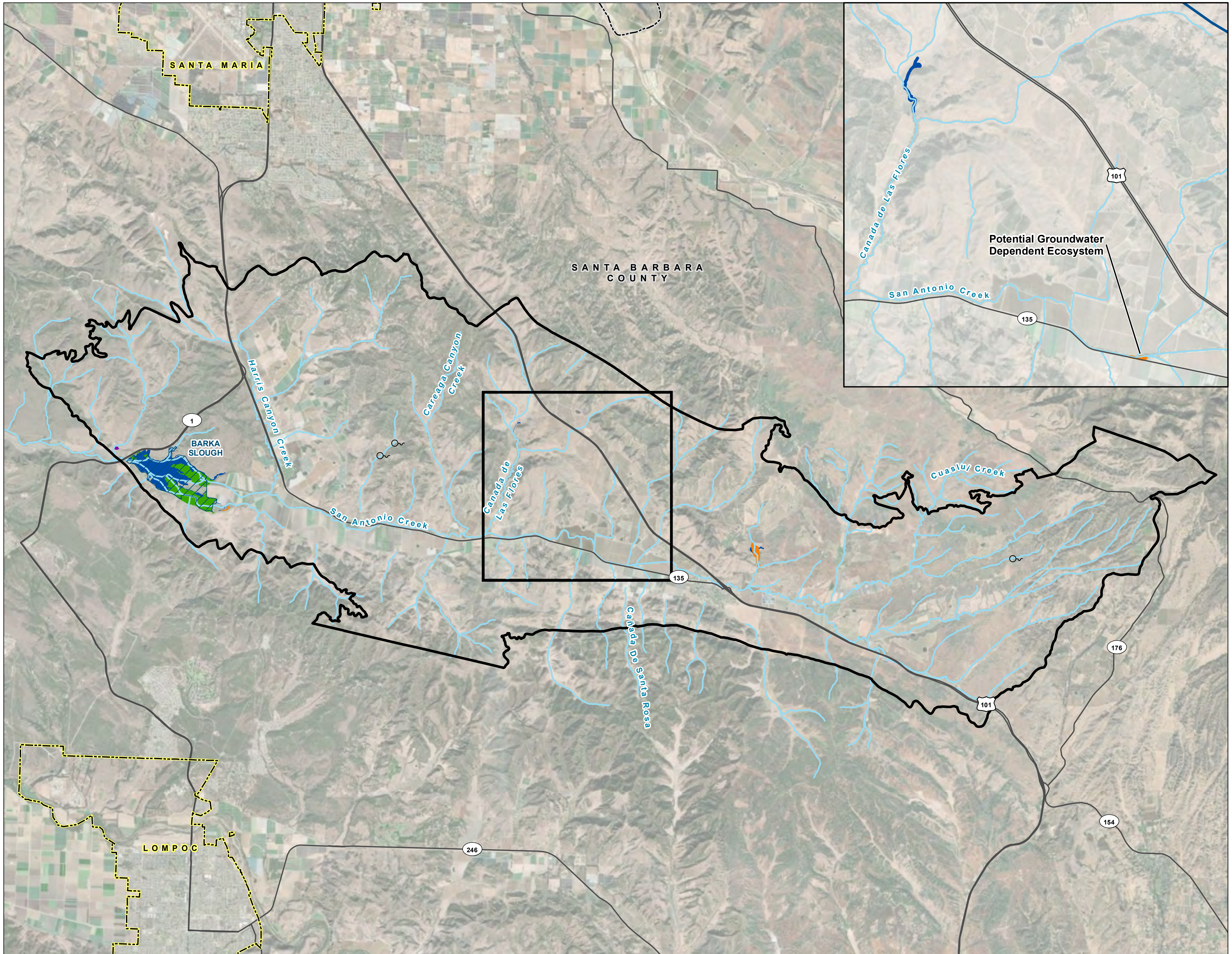

FIGURE 3-56

Groundwater-Dependent Ecosystems

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Natural Communities Commonly Associated with Groundwater (NCCAG)

- Wetland Area

VEGETATION

- Coast Live Oak
- Riparian Mixed Hardwood
- Willow

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- Major Road
- City Boundary
- USGS Spring

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b, 2020h), ESRI, DWR (2018a, 2020b), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_56_GDEs.mxd, abarry

One small stand of coast live oak (1 acre) located just west of Los Alamos is considered a potential GDE, based on the depth-to-groundwater analysis (see Figure 3-56). The presence of a GDE in this area will be verified during GSP implementation. The vegetation and wetland GDEs (and potential GDE) identified within the Basin are summarized in Tables 3-10 and 3-11.

Table 3-10. Vegetation GDEs (and Potential GDEs)

Natural Communities Vegetation Classification	GDE Acres[1]	Potential GDE acres[2]
Coast Live Oak	36	1
Riparian Mixed Hardwood	3	
Willow	268	
Total	**307**	**1**

Notes

[1] GDE acreage associated with Barka Slough and Price Ranch seeps (33 acres of coast live oak)

[2] Potential GDE acreage located just west of Los Alamos

Table 3-11. Wetland GDEs

Natural Communities Wetland Classification	Acres
Palustrine, Emergent, Persistent, Seasonally Flooded	53
Palustrine, Emergent, Persistent, Semipermanently Flooded	3
Palustrine, Forested, Seasonally Flooded	504
Palustrine, Scrub-Shrub, Seasonally Flooded	15
Palustrine, Unconsolidated Bottom, Permanently Flooded	5
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	1
Riverine, Unknown Perennial, Unconsolidated Bottom, Semipermanently Flooded	1
Total	**582**[1]

Note

[1] The potential wetland GDE acres overlap in many areas with potential vegetation type GDEs. Therefore, the total potential GDE acreage in the EMA is less than the sum of the potential wetland GDE and the potential vegetation type GDE acres.

Three USGS mapped springs are located within the Basin as shown on Figure 3-10. Coast Live Oak Natural Communities polygons intersect with two of these mapped springs; however, a brief aerial imagery review reveals little evidence to support or refute the continued presence of springs at these locations. The presence of these springs and any associated GDEs will be verified during GSP implementation.

3.2.6.2 Terrestrial and Aquatic Special-Status Species Occurrence

A literature review was completed to determine the terrestrial and aquatic special-status species that may be associated with GDEs in the Basin. The documents reviewed include the biological assessment that evaluated the potential environmental effects from development of the Vandenberg Dunes Golf Courses Project (AECOM, 2019) and the San Antonio Creek Coordinated Resource Management Plan (CRCD, 2003).

The U.S. Fish and Wildlife Service Critical Habitat Mapper[23] was also consulted. No original work was done for the special status species review of the Basin.

For the purposes of this GSP, special-status species are defined as those meeting the following criteria:

- Listed, proposed, or under review as endangered or threatened under the federal Endangered Species Act or the California Endangered Species Act
- Designated by CDFW as a Species of Special Concern
- Designated by CDFW as Fully Protected under the California Fish and Game Code (§§ 3511, 4700, 5050, and 5515)

[23] Available at https://ecos.fws.gov/ecp/report/table/critical-habitat.html.

Table 3-12 lists the special-status species that are documented to occur within the Basin or are supported by resources originating in the Basin (i.e., groundwater discharge to surface water in the Barka Slough) based on review of the documents listed above. Wildlife species were evaluated for potential groundwater dependence using the Critical Species Lookbook (Rohde et al., 2019). This potential groundwater dependence rating is indicative of the species' general documented reliance on groundwater and should not be considered a statement of specific groundwater reliance occurring within the Basin.

Table 3-12. Special-Status Species that May be Located within the Basin or are Supported by Resources Originating from within the Basin

Common Name	Scientific Name	Status	Potential Dependence on GW[1]
California Red-Legged Frog	*Rana draytonii*	Federally listed (Threatened)	Direct
Tidewater Goby[2]	*Eucyclogobius newberryi*	Federally listed (Endangered)	Direct
Unarmored Threespine Stickleback	*Gasterosteus aculeatus williamsoni*	Federally and State listed (Endangered)	Direct
La Graciosa Thistle	*Cirsium scariosum var. loncholepis*	Federally listed (Endangered) and State listed (Threatened)	Direct
California Tiger Salamander	*Ambystoma californiense*	Federally and State listed (Threatened)	Unknown
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Federally and State listed (Endangered)	Indirect
Least Bell's Vireo	*Vireo bellii pusillus*	Federally and State listed (Endangered)	Indirect
Tricolored Blackbird	*Agelaius tricolor*	Federally not listed (Bird of Conservation Concern) and State Listed (Threatened)	Direct
Arroyo Chub	*Gila orcuttii*	Not Listed (Species of Special Concern)	Unknown
Southern California Steelhead	*Oncorhynchus mykiss*	Federally listed (Endangered)	Direct

Notes

[1] General reliance on groundwater is determined from the Critical Species Lookbook (Rohde et al., 2019) and is not an indication of specific groundwater reliance within the Basin

[2] Tidewater goby do not occur within the Basin; however, potential reductions in San Antonio Creek streamflow leaving the Basin could adversely affect critical habitat downstream (AECOM, 2019).

GW = groundwater

California Red-Legged Frog

Barka Slough provides optimal habitat for California red-legged frogs (AECOM, 2019). However, California red-legged frogs have the potential to occur in a variety of wetland and upland habitats, including ephemeral ponds, intermittent streams, springs, seeps, seasonal wetlands, permanent ponds, perennial streams, marshes, riparian corridors, annual grassland, and oak savannas (CRCD, 2003). Dense, shrubby, or emergent vegetation closely associated with deep-water pools with fringes of cattails and dense stands of overhanging vegetation, such as willows, are considered optimal breeding habitat (AECOM, 2019).

Tidewater Goby

Although usually associated with lagoons, the tidewater goby has been documented in ponded freshwater habitats as far as 4.6 miles upstream from the ocean in San Antonio Creek (Swift et al. 1997). Although tidewater goby do not occur within the Basin, potential reductions of San Antonio Creek streamflow leaving the Basin could adversely affect critical habitat downstream (AECOM, 2019).

Unarmored Threespine Stickleback

Constituent elements of essential habitat for unarmored threespine stickleback (UTS) include permanent streamflow, slow currents, low turbidity, and lack of pollution (AECOM, 2019). Habitat for UTS occurs in the lower 8.4 miles of San Antonio Creek, from the mouth of the creek at the Pacific Ocean upstream to Barka Slough (AECOM, 2019) (Figure 3-57). UTS were not detected in Barka Slough during surveys conducted in 2004–2005 according to unpublished data (ManTech, 2010). However, UTS occurring both within and downstream of Barka Slough are highly reliant on surface water flows originating in Barka Slough (CRCD, 2003).

La Graciosa Thistle

La Graciosa thistle has only been found near the coast of southern San Luis Obispo and northern Santa Barbara counties, growing in riparian habitat, often around seeps or in marshes (CDFW, 2013). Occurrences of La Graciosa thistle were mapped in the Las Flores watershed, tributary to San Antonio Creek, in the low-lying grassland areas immediately west of Highway 101 (CRCD, 2003) (Figure 3-57). This is the most interior site for the species that is primarily found in the dune areas near the ocean. The habitat areas identified are primarily around gently sloping hillside seeps within a grassland plant community (CRCD, 2003). U.S. Fish and Wildlife Service has designated critical habitat for the La Graciosa thistle in the Las Flores watershed and in the eastern end of Barka Slough (Figure 3-57). The primary threat to La Graciosa thistle is reduced access to water, with groundwater decline as the likely major cause, along with hydrological alteration, drought, and climate change (Kofron et al., 2019).

California Tiger Salamander

California tiger salamander habitat includes vernal pools and seasonal ponds associated with coastal scrub, grassland, and oak savanna (CRCD, 2003). Known and potential California tiger salamander habitat within the Basin is shown on Figure 3-57 (CRCD, 2003). California tiger salamanders spend much of their lives in rodent burrows, leaving only to feed and breed during periods of high relative humidity and during rains (CRCD, 2003). California tiger salamanders have no known direct reliance on groundwater, unless groundwater depletion reduces the spatial and temporal availability of seasonal ponds, which could prevent larvae from completing their metamorphoses (Rohde et al., 2019).

Southwestern Willow Flycatcher

The southwestern willow flycatcher is a species in danger of extinction throughout all or a significant portion of its range. Its historical range includes much of central and southern coastal regions of California (USFWS, 2021a). Southwestern willow flycatchers breed along watercourses and canyon bottoms, as well as interior river bottoms, throughout Southern California. This species is found in bushes, willow thickets, brushy fields, and upland copses. It breeds in thickets of deciduous trees and shrubs, especially willows, or along woodland edges. Nest sites are typically located near slow-moving streams, or side channels and marshes with standing water and/or wet soils (Rohde et al., 2019).

Least Bell's Vireo

The least Bell's vireo is a species in danger of extinction throughout all or a significant portion of its range. Its historical range includes much of central and southern coastal regions of California (USFWS, 2021b). These birds require low-elevation riparian areas near water with a dense shrub understory and canopy layer. Such habitats are generated by alluvial river systems. Active river meandering and flooding are highly beneficial to this species because they support riparian vegetation succession, which creates the habitat the birds depend upon. Least Bell's vireo associate with willow (*Salix* spp.) and dense areas of riparian shrubs, trees, and vines for nesting (Rohde et al., 2019).

Tricolored Blackbird

The tricolored blackbird is a Bird of Conservation Concern through its range in the continental United States and Alaska and a State Listed Threatened species. The tricolored blackbird is nearly endemic to California and is found in remaining wetlands, including those in Southern California and along the Central Coast. This species uses semipermanent and permanent wetlands with dense tracts of tall emergent vegetation for nesting, and upland habitat for both nesting and foraging. Upland nesting habitat includes groundwater-dependent grain crops (primarily silage associated with dairies). Foraging habitat includes groundwater-dependent crops and irrigated pasture. Tricolored blackbirds are associated with cattails (*Typha latifolia*), tules (*Scirpus acutus*), bulrush (*Schoenoplectus californicus*), sandbar willow (*Salix exigua*), and mugwort (*Artemisia douglasiana*), as well as grasslands and agricultural crops for foraging (Rohde et al., 2019). The migratory bird's probability of presence in the Basin is highest in March through the first half of August (USFWS, 2021c).

Arroyo Chub

The arroyo chub is a species of special concern. The chub is found only in the streams of Southern California and generally in relatively flat stretches. It is a good indicator of a healthy riparian or stream habitat and a good indicator for other species like steelhead and the threespine stickleback, which rely on the arroyo chub as food (Arroyo Seco Foundation, 2021). Based on the USGS Nonindigenous Aquatic Species online mapping tool, the Arroyo Chub was last documented in the Basin in 1987 (USGS, 2021b). Arroyo chub have the potential to occur within the Basin would likely be adversely impacted by declining surface water levels as a result of over pumping of groundwater.

Southern California Steelhead

Steelhead trout require cold water and complex instream habitat during their freshwater juvenile residency, which generally lasts at least one year, including at least one dry season. Estuaries can provide important rearing habitat for steelhead, with opportunities for rapid growth prior to entering the marine environment. For spawning, all adult salmonids require sufficient flow and suitably cool water temperature for upstream migration to spawning grounds, and streambeds with clean gravel, free of excessive fine sediment deposition to spawn in. Some adult steelhead will survive to spawn a second or third time; thus, adequate streamflows are required for post-spawn adult steelhead to migrate downstream during spring (Rohde et al., 2019). The species historical range included California, Idaho, Oregon, Washington (USFWS, 2021d). Steelhead trout have the potential to occur in the Basin and would be adversely impacted by declining surface water levels as a result of over pumping of groundwater.

3.2.6.3 Ecological Condition of GDEs and Potential GDEs

Once GDEs and potential GDEs are mapped, they are then characterized in Step 1.2 (see list above in Section 3.2.6.1) by their hydrologic and ecological conditions. Although mapping GDEs and potential GDEs has been the primary focus of this GSP, the hydrologic and ecological importance of the Barka Slough is well documented (e.g., CRCD, 2003; AECOM, 2019). An Enhanced Vegetation Index (EVI) analysis was completed using Landsat data processed in Climate Engine[24] as a first step towards analyzing the historical and current ecological condition of the Barka Slough. EVI data provide an indicator of healthy, well-watered vegetation. EVI is calculated from the proportions of visible and near-infrared sunlight reflected by vegetation. EVI values typically range from zero to more than 0.7. Healthy, or well-watered, vegetation absorbs most of the visible light that hits it and reflects a large portion of near-infrared light, resulting in a high EVI value. Unhealthy, dry, or dormant vegetation reflects more visible light and less near-infrared light, leading to a lower EVI value. The results of EVI analyses for the Barka Slough and a subset area, referred to as West Barka Slough, are shown on Figure 3-58. Notable observations from the EVI analysis include the following:

- EVI values fluctuate throughout each year, demonstrating seasonal fluctuations in vegetative health.
- Long-term fluctuations in overall Barka Slough EVI appear to generally track with the cumulative departure from the average precipitation curve, indicating a strong relationship between annual precipitation and overall Barka Slough vegetative health.
- West Barka Slough EVI values appear less influenced by annual precipitation, suggesting a larger component of vegetative water demand satisfied by upwelling groundwater in the western portion of the Slough. The disparity between overall Barka Slough EVI and West Barka Slough EVI is most pronounced during dry years and drought periods.
- Groundwater elevations in well 16G3 declined through the early to mid-1990s during years of consistent ~3,000 acre-feet per year VSFB groundwater production in the vicinity of Barka Slough until 1997, when pumping was substantially decreased as the VSFB obtained State Water Project (SWP) water.
- 1997 marked the beginning of SWP water availability for VSFB and a subsequent decrease in VSFB groundwater production.
- Precipitation totals in water years 1998 through 2001 were all above average (especially 1998), likely contributing to increasing groundwater elevations in well 16G3 and relatively high seasonal EVI values.
- The Harris Fire burned a large portion of Barka Slough, including igniting the underlying peat, in September of 2000. The resultant decrease in vegetation or vegetative health is notable in the EVI data. The vegetative health evidently took several years to recover.
- Groundwater elevations in well 16G3 reached a high point in 2006 and then began to decline through the current drought. The groundwater elevation in 16G3 reached a low point in 2015, coincident with increased VSFB pumping due to limited availability of SWP water. Since 2015, groundwater elevations in 16G3 have remained approximately stable at 250 ft amsl.
- The EVI analysis indicates no discernible long-term trend in Barka Slough vegetative health. The EVI data suggest that vegetative health in the western Slough area continues to be supported primarily by upwelling groundwater, whereas the vegetative health in eastern portions of the Slough may be more closely related to annual precipitation and surface water inflow.

The TNC guidance recommends that the condition of each GDE unit be inventoried and documented by describing the species composition, habitat condition, and other relevant information reflected in Worksheet 2 of the guidance (Rohde et al., 2018). Then the ecological condition of the GDE unit should be characterized as having a high, moderate, or low ecological value based on criteria provided in the TNC guidance. These tasks would likely rely heavily on field surveys. This additional characterization was not conducted but may be undertaken during GSP implementation. Until the additional characterization has been conducted, Barka Slough will be characterized as having high ecological value.

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[24] Climate Engine (Huntington et al., 2017) is an online tool for cloud computing of climate and remote sensing data powered by Google Earth Engine (Gorelick et al., 2017) (https://app.climateengine.org/climateEngine)

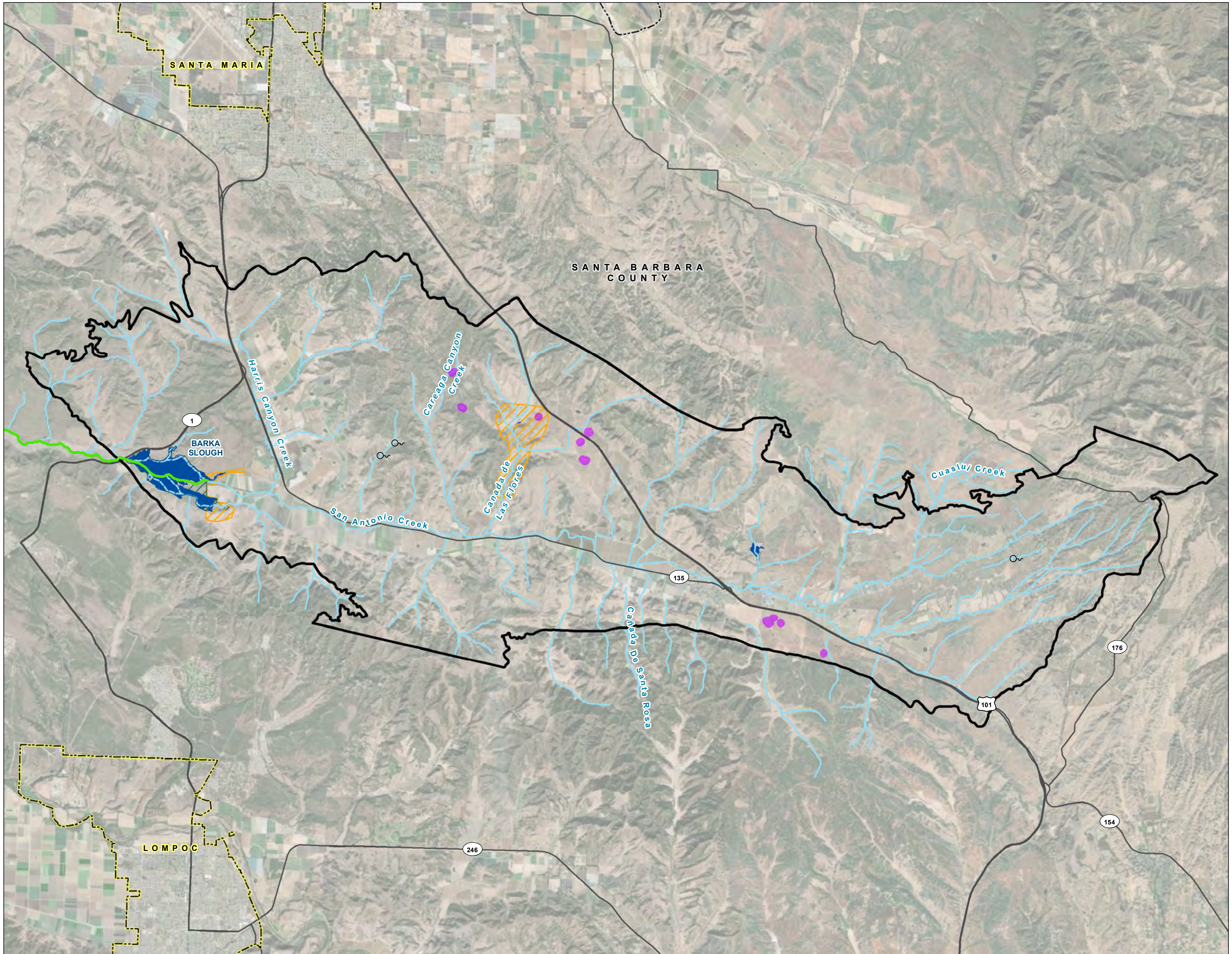

FIGURE 3-57

Special-Status Species Critical Habitat

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Unarmored Threespine Stickleback Habitat
- California Tiger Salamander Habitat
- La Gracious Thistle Habitat

Natural Communities Commonly Associated with Groundwater (NCCAG)

- Wetland Area

All Other Features

- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- Major Road
- City Boundary
- USGS Spring

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: September 16, 2021
Data Sources: USGS (2020b, 2020h), ESRI, DWR (2018a, 2020b), Maxar imagery (2020)

GSI Water Solutions, Inc.

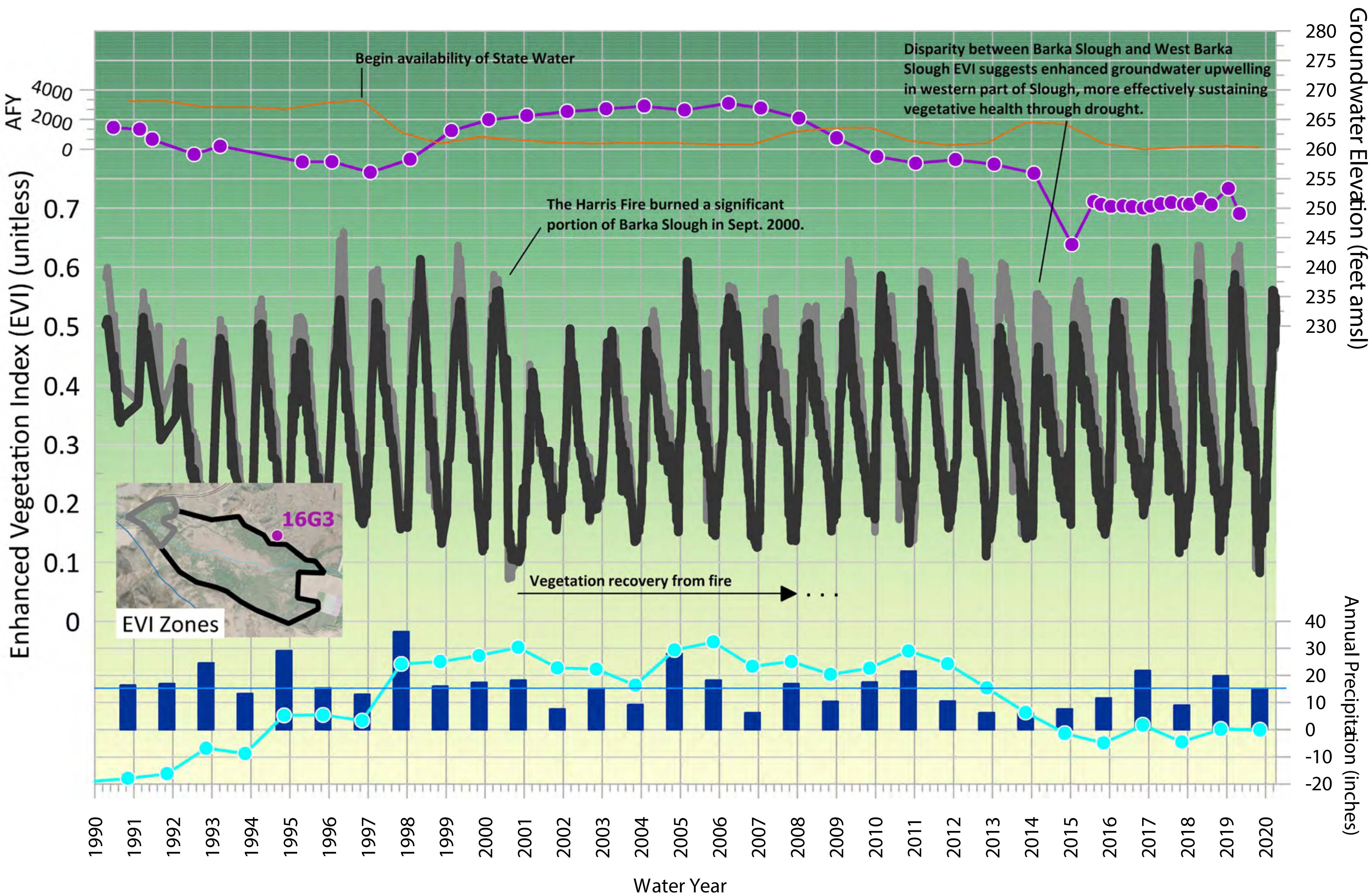

FIGURE 3-58

Enhanced Vegetation Index (EVI) of Barka Slough

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Annual Precipitation at Los Alamos Fire Dept.
- Average Annual Precipitation (15.3 in.)
- Cumulative Departure from Average Precipitation
- Barka Slough Mean EVI
- West Barka Slough Mean EVI
- Well 16G3 Groundwater Elevation (ft. amsl)
- VSFB Groundwater Production (AFY)

NOTES

AFY: acre-feet per year
ft amsl: feet above mean sea level
VSFB: Vandenberg Space Force Base

Date: September 16, 2021
Data Sources: County of Santa Barbara (n.d.), Huntington et al. (2017), VSFB (2020)

GSI Water Solutions, Inc.

3.3 Water Budget [§ 354.18]

§ 354.18 Water Budget.

(a) Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored. Water budget information shall be reported in tabular and graphical form.

(b)The water budget shall quantify the following, either through direct measurements or estimates based on data:

(1) Total surface water entering and leaving a basin by water source type.

(2) Inflow to the groundwater system by water source type, including subsurface groundwater inflow and infiltration of precipitation, applied water, and surface water systems, such as lakes, streams, rivers, canals, springs and conveyance systems.

(3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.

(4) The change in the annual volume of groundwater in storage between seasonal high conditions.

(5) 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.

(6) The water year type associated with the annual supply, demand, and change in groundwater stored.

This section summarizes the estimated historical, current, and future projected water budgets for the Basin, including information required by the SGMA regulations and information that is important for developing an effective GSP to achieve sustainability. In accordance with the SGMA regulations § 354.18, the GSP should include a water budget for the Basin that provides an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Basin—including historical, current, and projected water budget conditions—and the change in the volume of groundwater in storage. The regulations require that the water budget be reported in graphical and tabular formats, where applicable.

3.3.1 Overview of Water Budget Development

§ 354.18 Water Budget.

(d) The Agency shall utilize the following information provided, as available, by the Department pursuant to Section 353.2, or other data of comparable quality, to develop the water budget:

(1) Historical water budget information for mean annual temperature, mean annual precipitation, water year type, and land use.

(2) Current water budget information for temperature, water year type, evapotranspiration, and land use.

(3) Projected water budget information for population, population growth, climate change, and sea level rise.

(e) Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow. If a numerical groundwater and surface water model is not used to quantify and evaluate the projected water budget conditions and the potential impacts to beneficial uses and users of groundwater, the Plan shall identify and describe an equally effective method, tool, or analytical model to evaluate projected water budget conditions.

(f) The Department shall provide the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM) and the Integrated Water Flow Model (IWFM) for use by Agencies in developing the water budget. Each Agency may choose to use a different groundwater and surface water model, pursuant to Section 352.4.

The water budgets for the Basin were developed using estimated inflow and outflow terms and a spreadsheet tool. Three types of water budgets are presented here: historical water budget results (Section 3.3.3), a current water budget (Section 3.3.4), and a projected water budget (Section 3.3.5). Within each subsection, a surface water budget and groundwater budget are presented. This section includes a brief overview of the inflow and outflow terms and spreadsheet tool. Appendix E provides additional information about the inflow and outflow terms and spreadsheet tool and compares previously reported water budgets to the water budgets developed for this GSP.

Basin yield of a groundwater basin is the volume of pumping that can be extracted from the basin on a long-term basis without creating a chronic and continued lowering of groundwater levels and the volume of groundwater in storage. Basin yield is not a fixed constant value but a dynamic value that fluctuates over time as the balance of the groundwater inputs and outputs change; thus, the calculated basin yield of the Basin will be estimated and likely modified with each future update of this GSP.

Basin yield is not the same as sustainable yield. Sustainable yield is defined in SGMA as "the maximum quantity of water, calculated over a period representative of long-term conditions in the basin and including any temporary surplus that can be withdrawn annually from a groundwater supply *without causing an undesirable result*" (emphasis added). An undesirable result is one or more of the following adverse effects on the six sustainability indicators:

- Chronic lowering of groundwater levels in the aquifer(s)
- Significant and unreasonable reduction of groundwater in storage
- Significant and unreasonable degradation of water quality
- Seawater intrusion
- Significant and unreasonable land subsidence that interferes with surface land uses
- Depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial uses of surface water

Defining the basin yield provides a starting point for later establishing sustainable yield by considering each of the six sustainability indicators listed above.

Section 354.18 of the SGMA regulations requires development of water budgets for both groundwater and surface water that provide an accounting of the total volume of water entering and leaving a basin. To satisfy the requirements of the regulations, a surface water budget was prepared for the Basin and an integrated groundwater budget was developed for each water budget period for the combined inflows and outflows for the two principal aquifers—Paso Robles Formation and Careaga Sand. Groundwater is pumped from both aquifers for beneficial use. Groundwater and surface water also discharge to Barka Slough at the west end of the Basin. The Slough contains important aquatic and terrestrial plant and animal species.

Figure 3-59 presents a general schematic diagram of the hydrologic cycle. The water budgets include the components of the hydrologic cycle.

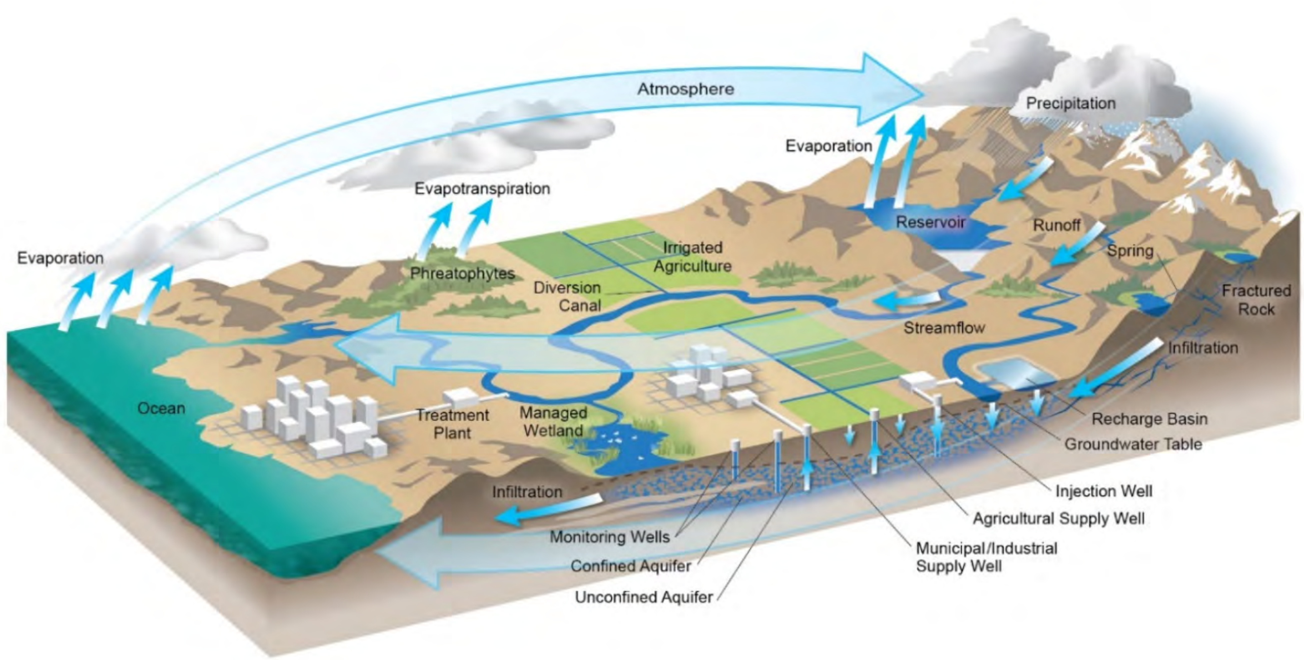

Figure 3-59. The Hydrologic Cycle

Source: DWR, 2016c

A few components of the water budget can be measured, such as streamflow at a gaging station or groundwater pumping from a metered well. Other components of the water budget are estimated, such as recharge from precipitation or unmetered groundwater pumping. For the components that cannot be measured, the best available science has been used to estimate the water budget. The water budget is an inventory and accounting of total surface water and groundwater inflows (recharge) and outflows (discharge) from the Basin, including the following:

Surface Water Inflows:

- Runoff of precipitation into streams and rivers within the watershed

Surface Water Outflows:

- Streamflow exiting the Basin from Barka Slough
- Percolation of streamflow to the groundwater system

Groundwater Inflows:

- Recharge from precipitation, including mountain front recharge
- Irrigation return flow (water not consumed by crops/landscaping)
- Percolation of streamflow to groundwater
- Percolation of treated wastewater from septic systems and LACSD Wastewater Treatment Plant (WWTP) spray irrigation

Groundwater Outflows:

- ET from crops, unirrigated land, and riparian areas
- Groundwater pumping
- Groundwater discharge to surface water

The difference between inflows and outflows is equal to the change of groundwater in storage.

The historical water budget period was selected to be between water years 1981 and 2018. The current water budget period is between water years 2011 and 2018. The projected future water budget extends to 2072 (see Figure 3-60).

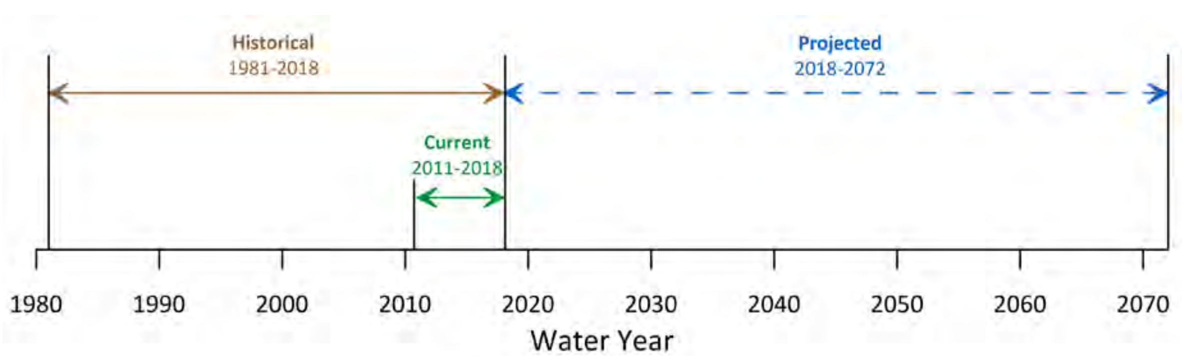

Figure 3-60. Historical, Current, and Projected Water Budget Periods

This historical period discussion refers to water years, which are defined in this GSP as between October 1 of the starting year and September 30 of the following year. For example, the period between October 1, 2017, and September 30, 2018, constitutes water year 2018.

The 38-year period between water years 1981 and 2018 (inclusive) has been selected for the historical water budget to comply with the California Department of Water Resources' (DWR's) regulatory requirement as follows:

> "a quantitative assessment of the historical water budget (be prepared) starting with the most recently available information and extending a minimum of 10 years, or as sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon."

The historical period selected also includes the most recently available information. The 38-year period selected for the historical water budget includes two wet-dry hydrologic cycles and the changes to water demand associated with irrigated land.

The historical water budget was used to define a specific period over which elements of recharge and discharge to the groundwater basin may be compared to the long-term average. This period allows for the identification of long-term trends in groundwater basin supply and demand, as well as water level trends; changes of groundwater in storage; estimates of the annual components of inflow and outflow to the zone of saturation; and basin yield estimates.

Further, SGMA regulations require that the historical water budget provide a "quantitative evaluation of the availability or reliability of historical surface water supply deliveries" and are to start "with the most recently available information … extending back a minimum of 10 years" (§ 354.18 (c)(2).

A representative base, or baseline, period (referred to as the "historical period" by SGMA) should do the following:

- Be representative of long-term hydrologic conditions (precipitation and streamflow).
- Include wet, dry, and average years of precipitation.
- Span a 20-to-30-year period (Mann, 1968).
- Have its start and end years preceded by comparatively similar rainfall quantities (DWR, 2002).
- Preferably start and end in a dry period (Mann, 1968), which minimizes water draining (in transit) through the vadose zone.
- Include recent cultural conditions (DWR, 2002).

This historical period selection also helps inform the projected water budget. The historical period selection should "utilize 50 years of historical precipitation, ET, and streamflow information as the baseline condition for estimating future hydrology" (§ 354.18 (c)(3)). Notably, the selection of both the historical water budget and current water budget are based on this requirement. The historical water budget period closely approximates the long-term hydrologic conditions based on precipitation. While historical period selection may include consideration of streamflow within this Basin, San Antonio Creek is classified as a losing stream and the flow is intermittent. Because of this, the consideration of streamflow is not as meaningful or useful for the selection of the historical period. Therefore, precipitation data are used as the principal recharge component for the selection of the historical period.

In addition to the consideration of precipitation and streamflow variability, the historical period must include high-quality, reliable data with regard to all of the principal components of the water budget. The historical period selected generally includes reliable data for most, but not all, of the water budget components. Primary information and data sources for the water budget are included as Table 3-14.

The historical period was determined based on a review of long-term precipitation records from the precipitation station located in the Basin at the Los Alamos Fire Station.[25] The period of record for the Los Alamos Fire Station precipitation station dates back to 1910.

The precipitation data for the Los Alamos Fire Station gage is presented as Figure 3-16. The average precipitation within the Basin measured at the Los Alamos Fire Station, which occurs mainly as rainfall, is 15.3 inches for the period of record (1910–2019). The upper portion of the chart shows the annual precipitation. Climatic trends (historical wet-dry cycles) were identified using DWR guidance for defining "water year type." These wet, variable, and dry periods determined from the precipitation data are presented on all hydrographs and water budget graphs in this GSP. The lower portion of the chart shows the climatic variability by showing the cumulative departure from the mean precipitation; upward trending portions (blue areas) represent wet periods of above-average rainfall, and downward trending portions (tan areas) represent drought periods of below-average rainfall.

Highly variable precipitation patterns with multi-year cycles are common to the area; multi-year cycles of drought are punctuated by shorter, intense wet periods. The climate variability within the Basin is evident on Figure 3-16, as well as on Table 3-13.

Table 3-13. Historical Hydrologic Conditions – Water Year Type

Period (Water Years)	Hydrologic Condition	Duration (No. of Years)	Precipitation Deviation (inches)	Deviation Rate (inches per year)
1910 to 1918	Wet	9	+ 26	+ 2.9
1919 to 1934	Drought	16	- 48	- 3
1935 to 1944	Wet	10	+ 35	+ 3.5
1945 to 1977	Drought	33	- 44	- 1.3
1978 to 1983	Wet	7	+ 38	+ 5.4
1984 to 1990	Drought	7	- 30	- 4.2
1991 to 1998	Wet	8	+43	+ 5.4
1999 to 2011	Variable	13	+ 4	+ 0.3
2012 to 2019	Drought	7	- 29	- 4.1

[25] Precipitation records from additional gages were considered for the determination of the historical period; however, some gages were excluded from the analysis due to being located too far from the Basin or having limited available data. Data from previously unconsidered gages will be periodically evaluated to characterize variability of precipitation in different parts of the basin in the future.

Notable aspects of the variable periods include the following:

- A wet period occurred between the beginning of the period of record in water years 1910 through 1918. During this 9-year period, the annual precipitation deviated above the long-term average by 2.9 inches per year.
- A longer drought period occurred from water years 1919 through 1934. During this 16-year drought, the annual precipitation deviated below the long-term average by 3 inches per year.
- Between 1935 and 1944, a wet period occurred during which the average precipitation was 3.5 inches above the long-term average.
- A long drought occurred from water year 1945 through 1977. During the 33-year drought, the annual precipitation deviated below the long-term average by 1.3 inches per year.
- Similar duration wet (1978 to 1983 and 1991 to 1998) and drought periods (1984 to 1990) followed this period.
- The current drought started in water year 2012. Two wet years (2017 and 2019) have occurred during the current drought; however, it remains a severe drought with an average rainfall deficit of 4.1 inches per year compared to the long-term average. The current drought has continued into water year 2021, extending the drought to 10 years (2012 through 2021 inclusive).

Based on review of precipitation data from this station, the initial year for a suitable historical period could be 1976, 1978, 1981, or 1982, all of which start in a dry year preceded by at least one dry year. The ending year of 2018 is a dry year in an overall dry period. The period between 1981 and 2018 is the most balanced period from a precipitation point of view. In consideration of the availability of high-quality data, this period will be used for the Basin historical water budget. The historical water budget is presented in Section 3.3.3.

The current water budget period was selected to be between 2011 and 2018. This period represents a very dry period overall, which—although not as hydrologically balanced as the historical period—is considered representative of the current drought conditions. Precipitation at the Los Alamos Fire Station during this period averaged 11.9 inches, which is 77 percent of the historical period. The current water budget is presented in Section 3.3.4.

The projected water budget, for the 55-year period between 2018 and 2072, extends 50 years past the 2022 submittal of this GSP. The projected water budget is presented in Section 3.3.5.

3.3.2 Water Budget Data Sources and Spreadsheet Tool

A groundwater model developed by the USGS is currently being calibrated as part of a multi-year groundwater basin study. As of this writing in 2021, the groundwater model and related information have not been made available; therefore, it is necessary to use a spreadsheet tool to develop the water budgets for the Basin and to assess projects and management actions needed to bring the Basin into sustainability. While a groundwater model would be preferred, the spreadsheet tool can be used for this purpose in accordance with § 354.18 of the SGMA regulations. The spreadsheet tool is adequate for developing the water budgets and assessing projects and management actions in this Basin. The tool relies on the best available information and the best available science to quantify the water budget for the Basin. This provides an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, groundwater and surface water interaction, and subsurface groundwater flow.

The sources used for the tool include the following:

- Information from local and regional Basin water users
- Sources/tools identified in the DWR *Draft Handbook for Water Budget Development, With or Without Models* (DWR, 2020c)
- Published technical reports
- Published hydrogeologic properties and principles
- Use of developed forecasting and interpolation tools
- Multiple calculation methodologies to determine validity of data and calculations

Water budget components for the Basin were developed using various publicly available data sets organized by water year. Table 3-14 presents a summary of the data sources used for developing the water budgets and a description of each data set's qualitative data rating. Each of these data sets are described in further detail in the following sections.

A qualitative discussion of the estimated level of uncertainty associated with each data source is described in the table below and for each water budget term. This discussion focuses on the level of uncertainty and the authors' confidence in the data, as well as the assumptions and interpretations of the information used to develop the water budgets. The level of uncertainty can significantly affect the SABGSA's ability to sustainably manage the Basin. The data associated with the Basin is adequate to estimate the surface and groundwater inflow and outflow components of the water budget. The qualitative data rankings presented in Table 3-14 acknowledge that the directly measured data—which include gaged streamflow (surface water), metered groundwater pumpage, precipitation, and groundwater levels (groundwater)—is of the highest quality and lowest uncertainty.

The calculated and modeled values are generally of medium quality. Data derived from other sources—including water duty factors for irrigated crops for the estimation of agricultural pumping and related irrigation return flow—are less certain and therefore of medium/low quality (with the highest uncertainty).

These are the best-available data available for the Basin and are similar to the quality and sources of data available in similar groundwater basins throughout the state. Importantly, these data and the resulting water budgets summarized in this section support the sustainable management of the groundwater resource. As discussed in this section and later in Section 6, the quality of many of these data will improve during GSP implementation, which will enable adaptive and sustainable groundwater management. Moreover, the sustainable management criteria (see Section 4) are based largely on groundwater elevation measurements, which are data of high quality and low uncertainty.

Any significant uncertainty in the data could limit the SABGSA's ability to effectively develop sustainable management criteria, select appropriate projects and management actions, and determine whether the Basin is being sustainably managed. These uncertainties are discussed within each water budget data source section and later within the subsequent sections. Data with significant uncertainty that may have an impact on management of the Basin are identified and will be addressed as part of the management actions associated with this GSP.

Table 3-14. Primary Information and Data Sources for the Water Budget

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating	Projected Data Set Methodology
Surface Water Inflow Components				
Native Streamflow	USGS-BCM Runoff, Stream Gage Data	USGS-BCM adjusted to local and regional meteorological station data	Adjusted Model – Medium	USGS-BCM adjusted to DWR VIC hydrology model for 2030 and 2070 climate data
Groundwater Discharge to Surface Water	USGS-BCM Runoff, Stream Gage Data, Darcian Flux Calculation, Historical Reports	Methods described in Section 3.3.2.1	Estimated – Low	
Groundwater Inflow Components				
Mountain Front Recharge	USGS-BCM Recharge	USGS-BCM adjusted to local and regional meteorological station data	Adjusted Model – Medium	USGS-BCM adjusted to DWR VIC hydrology model for 2030 and 2070 climate data
Streamflow Percolation	USGS-BCM Recharge	USGS-BCM adjusted to local and regional meteorological station data	Adjusted Model – Medium	
Deep Percolation of Direct Precipitation	USGS-BCM Recharge	USGS-BCM adjusted to local and regional meteorological station data	Adjusted Model – Medium	
Percolation of Treated Wastewater (Effluent Spray Irrigation)	LACSD, Crop water use factors	Data provided by LACSD. Published water duty factors for irrigated crop/groundcover	Metered – High Published – High	Linear projection of historical data set
Percolation from Septic Systems	Aerial Survey	Methods described in Section 3.3.2.3	Estimated Medium/Low	Linear projection based on historical data set and estimated population growth

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating	Projected Data Set Methodology
Irrigation Return Flow	Various Land Use Surveys, Crop Water Duty Factors from the SYRWCD, Aerial Survey	Methods described in Section 3.3.2.3	Estimated Medium/Low	Agricultural – 20% of Agricultural Pumping Rural Domestic – Linear projection based on historical data set and estimated population growth
Surface Water Outflow Components				
San Antonio Creek/ Barka Slough Outflow	USGS-BCM Runoff, Stream Gage Data	USGS-BCM adjusted to gage data	Adjusted Model – Medium	USGS-BCM adjusted to DWR VIC hydrology model for 2030 and 2070 climate data
Groundwater Outflow Components				
LACSD Pumping	LACSD	Data provided by LACSD	Metered – High	Linear projection based on historical data set and estimated population growth
VSFB Pumping	VSFB	Data provided by VSFB	Metered – High	
Agricultural Irrigation Pumping	Various Land Use Surveys and Crop Water Use Factors from the SYRWCD	Methods described in Section 3.3.2.4	Estimated – Medium/Low	Irrigated acreage and water demand based on 2020 land use survey. Crop water duty factors multiplied by the respective DWR VIC hydrology model ET
Rural Domestic Pumping	Aerial Survey	Methods described in Section 3.3.2.4	Estimated – Medium/Low	Linear projection based on historical data set and estimated population growth
Riparian ET	LandFire	Methods described in Section 3.3.2.4	Estimated – Medium	Linear projection of historical data set multiplied by the respective DWR VIC hydrology model ET
Discharge to Surface Water	USGS-BCM Runoff, Stream Gage Data, Darcian Flux Calculation, Historical Reports	Methods described in Section 3.3.2.4	Estimated – Low	USGS-BCM adjusted to DWR VIC hydrology model for 2030 and 2070 climate data

Water Budget Component	Data Source(s)	Comment(s)	Qualitative Data Rating	Projected Data Set Methodology
General Basin and Hydrogeologic Properties				
—	(Muir, 1964; Hutchinson, 1980; Mallory, 1980; and Martin, 1985)	Published scientific reports	High/Medium	—

Notes

— = not applicable
BCM = Basin Characterization Model developed by the USGS, (Flint and Flint, 2014). Monthly data on a uniform 885 feet (ft) × 885 ft grid across the Basin.
ET = evapotranspiration
LACSD = Los Alamos Community Services District
SYRWCD = Santa Ynez River Water Conservation District
USGS = United States Geological Survey
VSFB = Vandenberg Space Force Base
VIC = Variable Infiltration Capacity model developed by (Hamman et al., 2018) and (Liang et al., 1994)

3.3.2.1 Surface Water Inflow Components

The Basin's watershed is the headwaters for San Antonio Creek. Consequently, surface water inflows include only water native to the Basin (runoff of precipitation). The Basin does not receive imported water from the California SWP, nor does it receive reservoir releases into streams and rivers that enter the Basin from the surrounding watershed. The individual components of the surface water budgets are described below.

Native Streamflow

Native streamflow in the tributaries to San Antonio Creek were estimated using a combination of USGS Basin Characterization Model (BCM) for California (Flint and Flint, 2017) local and regional meteorological station data, and stream gage data (if available). The BCM data are provided statewide on a 270 meter (m) × 270 m grid. As a quality assurance check on the BCM data, the gridded BCM monthly precipitation data were compared to the monthly precipitation reported at meteorological stations located within and adjacent to the Basin. On average, over the 110-year period of record from 1910 through 2020, the BCM precipitation across all these stations was 1.4 percent higher than the weather station reported values. For month-to-month comparisons, however, meteorological stations reported more discrepancies between the BCM values for individual locations. As detailed in Appendix E, a correction was applied to the BCM values for each monthly timestep such that the adjusted BCM data exactly matched all recorded meteorological station monthly precipitation values. These monthly adjustments were also applied to the BCM generated runoff and recharge data sets. These adjusted BCM runoff and recharge data sets were then compared to San Antonio Creek streamflow gage data, where available, and adjusted to fit the gage data.[26]

Multiple USGS-operated stream gages exist or formerly existed in the Basin along San Antonio Creek. Therefore, the level of uncertainty of these data is low. The flow from the tributary creeks, however, is ungaged and estimated based on the USGS BCM. The uncertainty of these data is considered moderate, because the USGS BCM is adjusted to measured stream flow and precipitation data within the Basin. Most native streamflow percolates to the groundwater system (see Section 3.3.2.2). The uncertainty associated with estimated tributary flow will not limit the SABGSA's ability to manage the Basin's groundwater system because these estimated water budget terms for tributary inflow are adjusted to measured data.

Groundwater Discharge to Surface Water

Groundwater discharge to surface water flows occur at the downstream end of the Basin into Barka Slough. Average annual groundwater discharge to surface water flow values were calculated using Darcy's law[27] with hydrogeologic properties according to Muir (1964), Hutchinson (1980), and Martin (1985), or determined using groundwater levels from nested monitoring wells near the Slough to calculate vertical gradient, and surficial topography of San Antonio Creek to calculate the hydraulic gradient of the alluvium located immediately east of Barka Slough. See Appendix D for calculation details. To determine groundwater

[26] The BCM precipitation data was adjusted to regional precipitation station data (by adjusting the BCM precipitation data to honor the regional precipitation station data for the pixels where the precipitation gages are located). Initial adjustments to BCM recharge and runoff terms were based on the adjusted precipitation ratio (adjusted precipitation ÷ raw precipitation). Subsequent adjustments were made between recharge and runoff terms to match surface water flow gage data or to match general understanding of runoff to recharge relationships in the area. This was based on a simple hydrologic conceptual model (rejected recharge and streambed percolation of runoff) and related mathematical models were calibrated to the surface water gage flow data. All the BCM-generated recharge and runoff in the Basin was always accounted for, no mass was lost or removed. Rejected recharge was accounted for as surface water and all runoff generated during drier years percolated as streambed percolation.

[27] Darcy's law is an equation that describes the flow of fluid, such as groundwater, through a porous medium, such as beds of sand or gravel in the subsurface. The flow rate predicted by the law depends on several key variables, including the permeability of the medium, the cross-sectional area of the medium through which the fluid flows, the viscosity of the fluid, and gradient (change in elevation) that is present over a given distance.

discharge to surface water flow values for each year of the historical water budget period, the surface water flow data from the Casmalia stream gage, located on San Antonio Creek downstream (west) of the Slough, were used to calculate surface water outflow from the Slough.

The USGS BCM runoff model (adjusted to local regional meteorological station data) was used to estimate the annual surface water inflow to Barka Slough (SswIN). The annual surface water flow discharging from the Slough (SswOUT) was estimated by subtracting the USGS BCM runoff model flows for the watershed areas contributing flow to San Antonio Creek downstream of the Slough and upstream of the Casmalia gage (BCMds) and adding the estimated annual agricultural ET (AgET) for the crops located adjacent to San Antonio Creek between the Slough and the Casmalia gage to the annual surface water flow measured at the Casmalia gage (Cas), as shown here:

$$\boldsymbol{SswOUT = Cas - BCMds + AgET}$$

The AgET was estimated using a fixed annual water duty factor of 2.1 AF per acre per year and an assumed 20 percent irrigation return flow rate.[28] The AgET estimate is based on the assumption that crop irrigation water is derived from shallow alluvial wells in direct communication with San Antonio Creek and that irrigation return flows wind up back in direct communication with San Antonio Creek.[29]

The estimated total annual volume of groundwater discharge to surface water in the Slough (GWdis) was estimated as follows:

$$\boldsymbol{GWdis = SswOUT - SswIN + SET}$$

where, SswIN is the surface water inflows to the Slough and SET is the estimated annual Slough riparian evapotranspiration.

The uncertainty of these data is considered moderate because the USGS BCM is being used to estimate this water budget term. The authors do not have other reliable methods for estimating this term and are applying best available science. However, the authors have attempted to constrain this term by adjusting the USGS BCM to measured streamflow and precipitation data within and downgradient of the Basin. The authors do not believe that the uncertainty associated with estimates of groundwater discharge to surface water limits the SABGSA's ability to manage the Basin's groundwater system because the estimated water component was calculated using measured data from the USGS-operated Casmalia stream gage.

3.3.2.2 Surface Water Outflow Components

The data sources used for the surface water budget outflow terms are described below.

San Antonio Creek/Barka Slough Outflow

San Antonio Creek/Barka Slough surface water outflows calculations and level of uncertainty are discussed in Section 3.3.2.1.

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[28] Crop-specific water duty factors and agricultural irrigation return flow are discussed further in Sections 3.3.2.4 and 3.3.2.3, respectively. Crop type for the area located between Barka Slough and the Casmalia gage was determined based on the 2018 LandIQ data set available on SGMA Data Viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#waterbudget)
[29] This assumption is supported by geologic mapping showing that San Antonio Creek is contained within a narrow package of recent alluvium underlain by relatively impermeable bedrock between Barka Slough and the Casmalia gage (Dibblee and Ehrenspeck, 1989).

Streamflow Percolation

Streamflow percolation, or the deep percolation of surface water to groundwater through the streambed, was calculated using the adjusted USGS BCM. Portions of the adjusted BCM runoff and recharge data sets routed to San Antonio Creek and tributary streamflow percolation were determined in conjunction with comparisons to San Antonio Creek streamflow gage data as described in Section 3.3.2.1.

The uncertainty of these data is considered moderate because the USGS BCM, adjusted to measured precipitation and streamflow in the Basin, was used to estimate this water budget term and is discussed in Section 3.3.2.1.

3.3.2.3 Groundwater Inflow Components

The data sources used for the groundwater budget inflow terms are described below.

Mountain Front Recharge

As shown in Figure 3-1, the Basin is rimmed by the Casmalia and Solomon Hills to the north, the San Rafael Mountains to the east, and the Purisima Hills to the south. Groundwater enters the Basin where the Basin deposits abut underlying bedrock on the mountain slopes. This component of inflow is termed mountain front recharge.

Mountain front recharge was calculated using the adjusted BCM model as described above in Section 3.3.2.1. Mountain front recharge was calculated as the sum of the adjusted BCM recharge data set over the contributing watershed areas outside the Basin minus the portion routed to native streamflow.

The uncertainty of these data is considered moderate because the USGS BCM, adjusted to measured precipitation and streamflow in the Basin, was used to estimate this water budget term and is discussed in Section 3.3.2.1.

Streamflow Percolation

The calculation of streamflow percolation to groundwater is detailed above in Section 3.3.2.2.

Deep Percolation of Direct Precipitation

Precipitation falling on the land surface of the Basin represents the principal source of inflows. The precipitation varies spatially and seasonally. The precipitation that falls on the ground surface within the contributing watershed to the Basin either runs off into stream channels that eventually discharge to San Antonio Creek and ultimately to Barka Slough, or it infiltrates into the soil zone.

Recharge to groundwater from deep percolation of precipitation was determined using the USGS BCM gridded recharge data set. As described above in Section 3.3.2.1, the BCM recharge data set has been adjusted based on comparison to monthly precipitation records at meteorological stations located within and adjacent to the Basin.

The level of uncertainty of these data is considered moderate because the USGS BCM, adjusted to measured precipitation and streamflow in the Basin, was used to estimate this water budget term and is discussed in Section 3.3.2.1. These data are also within the range of values commonly applied to similar geologic settings.

Percolation of Treated Wastewater (Effluent Spray Irrigation)

LACSD WWTP discharges treated wastewater to the land surface through spray irrigation. Because the LACSD WWTP was constructed prior to 1981, it was evaluated for the historical water budget. The spray irrigation discharge volume and location of irrigated land was provided by LACSD, and details of plant operation were specified in the LACSD Sewer System Management Plan (LACSD, 2011). From 1994 through 2005, 38 acres were irrigated by the LACSD WWTP spray irrigation, which accounted for an average of 63 percent of the irrigated crop reference ET (ETo).[30] LACSD WWTP irrigated acres increased to 64 in 2006. From 2006 through 2018, the spray irrigation accounted for an average of 45 percent of the irrigated crop ETo. Based on the volume of reported annual discharge, the irrigated acreage, and the crop ETo, it is unlikely that effluent from the LACSD WWTP spray irrigation system percolate in any significant volume to groundwater; therefore, it does not contribute to the Basin water budget.

The uncertainty of these data is considered low because the LACSD meters and reports the effluent volume and irrigated acreage. The irrigated crop reference ETo is based on published data.

Percolation from Septic Systems

The residences and businesses in Los Alamos are connected to sewer service. Wastewater flows from these properties are transmitted to the LACSD WWTP and subsequently discharged as spray irrigation. These WWTP discharges do not contribute to the Basin water budget, as discussed in Section 3.3.2.3. Outside of the sewer-serviced areas within the Basin, domestic wastewater is discharged to on-site wastewater treatment systems (OWTS, formerly referred to as septic tank – leach field systems). Return flows from these OWTS provide recharge to the groundwater system. Septic tank return flow was calculated by using a 2018 aerial survey of the Basin to count residences suspected to have an OWTS unit in the Basin, then multiplying that value by an assumed return flow rate of 0.11 acre-feet per year (AFY) per unit (an amount provided in Tetra Tech, 2010). This was then scaled through time using a compilation of census data for nearby communities.

These groundwater recharge components were estimated based on an aerial survey and published OWTS return flow rates. Consequently, the uncertainty of this groundwater budget component is considered moderate. The annual estimated volumes for this groundwater budget component are relatively small compared to other groundwater budget component terms and, therefore, have little impact on the overall water budget.

Irrigation Return Flow

Irrigation return flow is defined as the amount of water applied to the crop in excess of the crop ET demand. The portion of applied water that is used to satisfy crop ET demand is equivalent to the irrigation efficiency, expressed as a percentage. The remaining percentage is equivalent to the irrigation return flow. Return flows can reenter the hydrologic system either as deep drainage and recharge to groundwater, or water that leaves the cropped field as surface flow "tail water" and discharges to a nearby stream. It is assumed that most of the irrigation return flow percolates to groundwater within the Basin. For irrigated agriculture in the Basin, an irrigation efficiency of 80 percent is assumed for all crops except vineyards, which are generally irrigated using a drip system at an efficiency of 90 percent.[31] The urban landscape irrigation efficiency is assumed to be 70 percent. These irrigation return flow proportions were based on feedback from the SABGSA's Special Advisory Committee and conversations between GSI staff and representatives from the

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[30] Crop ETo used was for grass in Irrigation Training & Research Center ET Zone 6 during a typical year (http://www.itrc.org/etdata/).

[31] Irrigation efficiencies within vineyards have increased from 70 percent in the 1970s to 80 percent in the 1980s, and to 90 percent more recently, based on verbal conversations with regional irrigators.

Santa Ynez River Valley Groundwater Basin – EMA, Central Management Area, and Western Management Area GSAs. These irrigation return flows were used throughout the Basin. Irrigation return flow volumes have been calculated using these efficiencies multiplied by the calculated annual volumes of irrigation water applied to each crop type (based on land use surveys within the Basin in 1959, 1968, 1977, 1986, 1996, 2006, 2016, and 2020 [see Appendix E]) and assigned crop-specific water duty factors. These applied water volumes are discussed further in Section 3.3.2.4.

These groundwater recharge components were estimated based on published values for irrigation efficiency, which were used throughout both the entire Basin and adjacent basins. Therefore, the level of uncertainty of these data is relatively low.

3.3.2.4 Groundwater Outflow Components

The data sources used for the groundwater budget outflow terms are described below.

LACSD Pumping

LACSD pumping was calculated using production data provided by LACSD from water years 1994 through 2020. LACSD pumping volumes prior to 1994 were calculated by scaling the 1994 demand using a compilation of census data for nearby communities.

Pumping volumes provided by the LACSD are from metered pumping and are considered highly reliable with low uncertainty.

VSFB Pumping

VSFB pumping was calculated using production data provided by VSFB. The entire historical water budget period is included in the VSFB pumping data set provided.

Pumping volumes provided by VSFB are from metered pumping and are considered highly reliable with low uncertainty.

Agricultural Irrigation Pumping

ET by crops results in a loss, or depletion, of water from the system. To meet the crop ET demand, irrigation water is diverted from the surface or groundwater source and applied to the cropped land. All water used to irrigate crops in the Basin is sourced by pumping groundwater. In the absence of metered pumping records, agricultural irrigation pumping was estimated using periodic land use survey data (from 1959, 1968, 1977, 1986, 1996, 2006, 2016, and 2020 [see Appendix E]) provided by the USGS (USGS, 2020e) and the Santa Barbara County Agricultural Commissioner, Weights and Measures Department (Santa Barbara County, 2020) to determine crop types and acreages. Crop-specific water duty factors for the Basin were derived in part from the Groundwater Production Information and Instructions pamphlet prepared by Santa Ynez River Valley Water Conservation District (SYRWCD) (SYRWCD, 2010). Some crop duty factors were adjusted based on feedback from some growers in the Basin. These crop-specific water duty factors were applied to the acreage associated with the agricultural land use types in the land survey data provided by USGS and Santa Barbara County for the Basin. Because land use surveys were not available for every year, spatial-temporal interpolations were made between the land use surveys for the intervening years.

This groundwater budget component is estimated by utilizing crop-specific water duty factors provided by SYRWCD for use in its water use estimates and annual reports. Basin stakeholders reviewed and modified the SYRWCD crop-specific water duty factors to be more accurate for the Basin. Irrigated acreage by crop type was determined using land use surveys provided by the USGS and available from Santa Barbara County (see Appendix E). While the accuracy of the land use mapping of irrigated crops for the recent years is high, uncertainty remains in the estimates of water use from these irrigated lands and hence the assumed amount of pumping needed to meet the crop water requirement. The uncertainty of this groundwater budget component is considered moderate.

Rural Domestic Pumping

Rural domestic pumping is all domestic pumping that occurs outside of LACSD. Rural domestic pumping was calculated by conducting an aerial survey to identify land parcels with home sites in the area outside the LACSD service area in 2018. The 2018 domestic demand for each of these land parcels was calculated using variable demand factors based on parcel acreage, as specified in Tetra Tech (2010) (see Table 3-15). The calculated 2018 rural domestic demand was then scaled through time using a compilation of census data for nearby communities.

Table 3-15. Rural Domestic Demand Factors Based on Lot Size

Lot Size (acres)	Annual Water Use (AFY per lot)
0.16	0.14
0.5	0.52
1	0.82
5	0.98
10	1.15

Source: Tetra Tech, 2010

These groundwater recharge components were estimated based on an aerial survey and published estimated water demand based on parcel size. Consequently, the uncertainty of this groundwater budget component is considered moderate. The annual estimated volumes for this groundwater budget component are relatively small compared to other groundwater budget component terms and, therefore, have little impact on the overall water budget.

Riparian Evapotranspiration

Riparian ET was calculated using the LandFire Existing Vegetation Type (EVT) spatial data set[32] to determine acreages of riparian vegetation types occurring within the Basin. It is assumed that the riparian acreage in the Basin did not change significantly during the historical period. The riparian acreage determined from the LandFire EVT analysis was then multiplied by a variable riparian water duty factor, varied based on water year type. The riparian water duty factor used is 4.5 acre-feet (AF) per acre per year, on average.[33] The riparian acreage included the riparian vegetation present within Barka Slough, San Antonio Creek, and tributaries.

The acreage and water use factors used to estimate riparian ET are based on authoritative sources. The acreage, however, has been collected by remote-sensing methods and has not been field-verified to confirm the presence of the indicated plants. In addition, there is considerable uncertainty associated with the

[32] LandFire is a shared program between the U.S. Department of Agriculture, Forest Service, and the U.S. Department of the Interior's wildland fire management programs. LandFire provides landscape-scale geo-spatial products to assist cross-boundary planning, management, and operations (https://landfire.gov).
[33] The 4.5 AF per acre per year water duty factor used for calculation of riparian evapotranspiration was derived from Muir, 1964 (4.7 AF and 3.0 AF per acre per year for Barka Slough and along San Antonio Creek, respectively) and professional judgement.

phreatophyte ET because the inputs to this water budget term are not directly measured and there is likely to be considerable variability. Therefore, the uncertainty associated with this data source is considered to be high.

Discharge to Surface Water

Refer to Section 3.3.2.1.

3.3.3 Historical Water Budget Results [§ 354.18(c)(2)(B)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:

(B) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.

3.3.3.1 Historical Surface Water Budget

Historical Surface Water Inflows

Local surface water supplies include surface water flows that enter the Basin from precipitation runoff within the watershed and groundwater in the Basin discharging to surface water in the Basin. Table 3-16 summarizes the annual average, minimum, and maximum values for these inflows.

Table 3-16. Annual Surface Water Inflows, Historical Period

Surface Water Inflow Component	Average	Minimum	Maximum
Inflow to Basin including San Antonio Creek and Tributaries	5,100	300	35,200
Groundwater Discharge to Surface Water	2,000	400	5,400
Total[1]	7,100	—	—

Notes

All values are in units of acre-feet.
[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
— = not applicable

The estimated average annual total inflow from these sources over the historical period is 7,100 AF. The largest component of this average inflow is flow in San Antonio Creek. The large difference between the minimum and maximum inflows reflects the difference between dry and wet years in the Basin.

Historical Surface Water Outflows

The estimated annual average total surface water outflow leaving the Basin as flow in San Antonio Creek west of Barka Slough and percolation into the groundwater system over the historical period is summarized in Table 3-17.

Table 3-17. Annual Surface Water Outflows, Historical Period

Surface Water Outflow Component	Average	Minimum	Maximum
San Antonio Creek West of Barka Slough Outflow from Basin	4,200	400	27,500
Streamflow Percolation	3,100	300	12,000
Total[1]	7,300	—	—

Notes

All values are in units of acre-feet.

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

— = not applicable

The estimated average annual total outflow from these sources over the historical period is 7,300 AF. All surface water outflow from the Basin occurs in San Antonio Creek west of Barka Slough. The large difference between the minimum and maximum outflows reflects the difference between dry and wet years in the Basin.

Historical Surface Water Budget Summary

Figure 3-61 summarizes the historical surface water budget for the Basin. This figure illustrates the strong correlation between precipitation and streamflow in the Basin. In wet periods, shown with a blue background, surface water inflows and outflows are generally large. In contrast, in dry periods, shown with a tan background, surface water inflows and outflows are small.

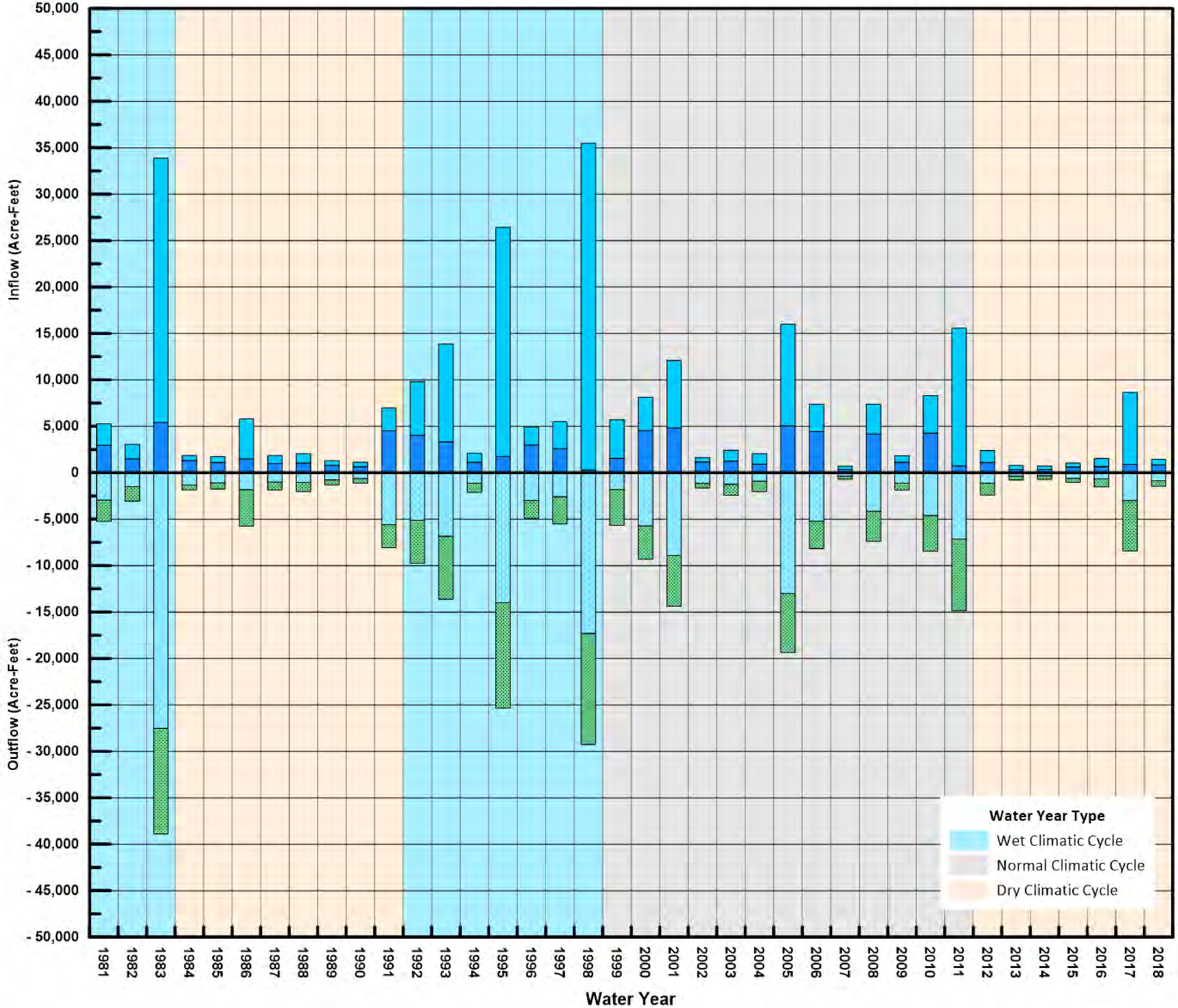

Figure 3-61
Historical Surface Water Budget

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Surface Water Inflow Components

- Surface Water Inflow
- Groundwater Discharge to Surface Water

Surface Water Outflow Components

- Surface Water Outflow
- Streamflow Percolation

GSI Water Solutions, Inc.

Reliability of Historical Surface Water Supplies [§ 354.18(c)(2)(A)]

> **§ 354.18 Water Budget.**
>
> **(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:**
>
> **(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:**
>
> **(A) A quantitative evaluation of the availability or reliability of historical surface water supply deliveries as a function of the historical planned versus actual annual surface water deliveries, by surface water source and water year type, and based on the most recent ten years of surface water supply information.**

Historically, no water surface water deliveries or instances of imported water have occurred in the Basin. Similarly, surface water in the Basin has not been used as a direct resource. Therefore § 354.18(c)(2)(A) of the SGMA regulations is not applicable to the Basin and this GSP.

3.3.3.2 Historical Groundwater Budget

Groundwater, including production from both the Paso Robles Formation and the Careaga Sand, supplied all the water pumped and used in the Basin over the historical period. The historical groundwater budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage.

Historical Groundwater Inflows

Groundwater inflow components include streamflow percolation, agricultural irrigation return flow, deep percolation of direct precipitation, mountain front recharge, septic system return flow, and urban irrigation return flow. Estimated annual groundwater inflows for the historical period are summarized in Table 3-18. Values reported in the table were estimated or derived from the data sources reported in Table 3-14.

Table 3-18. Annual Groundwater Inflow, Historical Period

Groundwater Inflow Component	Average[1]	Minimum	Maximum
Mountain Front Recharge	2,400	10	13,600
Streamflow Percolation[2]	3,100	300	12,000
Deep Percolation of Direct Precipitation	8,600	100	42,400
Septic System Return Flow	20	10	20
Agricultural Irrigation Return Flow	3,500	2,100	4,400
Urban Irrigation Return Flow	1	1	1
Total[3]	17,500	—	—

Notes

All values are in units of acre-feet.
[1] Due to rounding, total does not correspond to the sum of all figures shown.
[2] Streamflow Percolation includes San Antonio Creek percolation and tributary channel percolation.
[3] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
— = not applicable

During the historical period, estimated total groundwater inflow ranged from 3,300 AFY to 69,600 AFY, with an average annual inflow of 17,500 AF. The largest groundwater inflow component is percolation of direct precipitation, which accounts for approximately 49 percent of the total annual average inflow. The large difference between the minimum and maximum inflows from streamflow percolation and direct precipitation reflects the variations in precipitation over the historical period.

Historical Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, groundwater discharge to surface water, and riparian ET. No areas of subsurface flow out of the Basin have been identified. Estimated annual groundwater outflows for the historical period are summarized in Table 3-19.

Table 3-19. Annual Groundwater Outflow, Historical Period

Groundwater Outflow Component	Average	Minimum	Maximum
Total Groundwater Pumping	19,500	13,800	24,300
Riparian Evapotranspiration	6,500	6,300	6,700
Groundwater Discharge to Surface Water	2,000	300	5,400
Total[1]	28,000	—	—

Notes

All values are in units of acre-feet.
[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
— = not applicable

The largest groundwater outflow component from the Basin is groundwater pumping. Estimated annual groundwater pumping by water use sector for the historical period is summarized in Table 3-20.

Table 3-20. Annual Groundwater Pumping by Water Use Sector, Historical Period

Water Use Sector	Average[1]	Minimum	Maximum
LACSD	270	170	370
VSFB	1,800	0	3,430
Agricultural	17,300	10,300	22,200
Rural Domestic	140	100	170
Total[2]	19,500	—	—

Notes

All values are in units of acre-feet.
[1] Due to rounding, total does not correspond to the sum of all figures shown.
[2] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
— = not applicable
VSFB = Vandenberg Space Force Base

Agricultural pumping is the largest component of total groundwater pumping, accounting for approximately 89 percent of total pumping for the historical period. In general, agricultural pumping increased during the historical period; however, planted acreage did not increase significantly between 2006 and 2020. VSFB, LACSD, and rural domestic pumping account for approximately 9 percent, 1 percent, and 1 percent, respectively, of total average annual pumping over the historical period.

Historical Groundwater Budget and Changes in Groundwater in Storage

Average groundwater inflows and outflows for the historical period are presented on Figure 3-62. The average total inflow of approximately 17,500 AFY is less than the average total outflow of 28,100 AFY. A summary of annual groundwater inflows and outflows for the entire historical period is presented on Figure 3-63 (also tabulated in Table 3-21 and Appendix E). Figure 3-63 shows groundwater inflow and outflow components for every year of the historical period. Inflow components are graphed above the zero line and outflow components are graphed below the zero line. Groundwater outflow by pumping (green bars) includes pumping from all water use sectors (see Table 3-20). The blue line shows the cumulative change in groundwater storage over the historical period. The results of the water budget indicate that average pumping in the Basin has exceeded average recharge throughout the historical period.

Annual variations in the volume of groundwater in storage were calculated for each year of the historical period. The changes in storage for the 38-year period were used to evaluate conditions of water supply surplus and deficiency and in identifying conditions of long-term groundwater storage deficit.

As shown on Figure 3-63, there was an accumulated reduction of groundwater in storage of 400,100 AF over the entire 38-year period, which is equal to an average deficit of approximately 10,600 AFY.

Prior to the beginning of the current water budget period of 2011 through 2018, which is discussed below, the cumulative change in groundwater storage was -264,600 AF during the 30-year period between 1981 and 2010. During the current drought that began in 2012, an additional cumulative change in groundwater storage deficit of approximately 135,500 AF occurred, which is approximately 34 percent of the total cumulative change in storage during the historical period.

Table 3-21. San Antonio Creek Valley Groundwater Basin Historical, Current, and Projected Water Budget Summaries

Values in acre-feet

= Component of Inflow

= Component of Outflow

Water Budget	Water Year	Rainfall: Inches	Rainfall: % of Average	Components of Inflow: Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows	Total Inflow	Components of Outflow: Groundwater Pumping: LACSD Pumping	VAFB Pumping	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping	Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow	Total Outflow	Change in Storage	Cumulative Change in Storage
Historical Water Budget	1981	13.3	86%	0	1,400	2,300	4,900	0	10	2,100	1	10,700	170	3,270	10,300	100	13,800	6,600	3,000	0	23,400	-12,700	-12,700
	1982	14.4	94%	0	1,600	1,600	4,600	0	10	2,100	1	9,900	170	3,430	10,700	100	14,400	6,400	1,500	0	22,300	-12,400	-25,100
	1983	35.7	232%	0	13,600	11,400	42,400	0	10	2,200	1	69,600	180	3,080	11,200	110	14,600	6,500	5,400	0	26,500	43,100	18,000
	1984	9.7	63%	0	200	500	600	0	10	2,300	1	3,600	190	3,230	11,600	110	15,100	6,600	1,300	0	23,000	-19,400	-1,400
	1985	10.4	68%	0	400	600	1,400	0	10	2,400	1	4,800	190	3,370	12,000	110	15,700	6,500	1,100	0	23,300	-18,500	-19,900
	1986	15.9	103%	0	2,700	3,900	8,500	0	10	2,500	1	17,600	200	3,000	12,500	120	15,800	6,500	1,500	0	23,800	-6,200	-26,100
	1987	11.7	76%	0	700	800	2,200	0	10	2,500	1	6,200	210	3,140	12,700	120	16,200	6,500	1,000	0	23,700	-17,500	-43,600
	1988	15.1	98%	0	1,100	1,000	3,200	0	10	2,600	1	7,900	210	3,250	13,000	120	16,600	6,500	1,000	0	24,100	-16,200	-59,800
	1989	8.2	54%	0	10	500	200	0	10	2,600	1	3,300	220	3,080	13,200	130	16,600	6,500	800	0	23,900	-20,600	-80,400
	1990	8.1	52%	0	20	500	200	0	10	2,700	1	3,400	220	3,410	13,400	130	17,200	6,500	600	0	24,300	-20,900	-101,300
	1991	16.5	107%	0	700	2,500	4,100	0	10	2,700	1	10,000	230	3,240	13,600	130	17,200	6,400	4,500	0	28,100	-18,100	-119,400
	1992	17.0	110%	0	3,800	4,600	14,000	0	10	2,800	1	25,200	230	3,240	13,900	130	17,500	6,600	4,000	0	28,100	-2,900	-122,300
	1993	24.7	160%	0	6,800	6,800	21,300	0	10	2,800	1	37,700	230	2,840	14,100	140	17,300	6,600	3,300	0	27,200	10,500	-111,800
	1994	13.4	87%	0	600	1,000	1,900	0	10	2,900	1	6,400	230	2,860	14,300	140	17,500	6,500	1,100	0	25,100	-18,700	-130,500
	1995	29.2	190%	0	7,500	11,300	32,400	0	10	2,900	1	54,100	240	2,690	14,600	140	17,700	6,500	1,800	0	26,000	28,100	-102,400
	1996	15.5	101%	0	1,300	1,900	5,100	0	10	3,000	1	11,300	290	3,120	14,800	140	18,400	6,600	3,000	0	28,000	-16,700	-119,100
	1997	13.2	85%	0	2,500	2,900	6,900	0	20	3,100	1	15,400	290	3,320	15,500	140	19,300	6,600	2,600	0	28,500	-13,100	-132,200
	1998	36.2	235%	0	7,400	12,000	38,300	0	20	3,200	1	60,900	260	1,130	16,200	140	17,700	6,400	300	0	24,400	36,500	-95,700
	1999	16.2	105%	0	2,800	3,900	8,900	0	20	3,400	1	19,000	300	410	16,900	140	17,800	6,300	1,600	0	25,700	-6,700	-102,400
	2000	17.5	114%	0	3,400	3,600	10,400	0	20	3,500	1	20,900	320	840	17,700	150	19,000	6,600	4,500	0	30,100	-9,200	-111,600
	2001	18.3	119%	0	4,400	5,500	12,400	0	20	3,700	1	26,000	310	640	18,400	150	19,500	6,500	4,800	0	30,800	-4,800	-116,400
	2002	7.7	50%	0	20	500	400	0	20	3,800	1	4,700	340	460	19,100	150	20,100	6,500	1,200	0	27,800	-23,100	-139,500
	2003	14.8	96%	0	1,100	1,200	3,400	0	20	4,000	1	9,700	320	410	19,800	150	20,700	6,500	1,200	0	28,400	-18,700	-158,200
	2004	9.4	61%	0	800	1,100	2,400	0	20	4,100	1	8,400	370	460	20,500	150	21,500	6,600	900	0	29,000	-20,600	-178,800
	2005	28.3	184%	0	7,800	6,400	22,700	0	20	4,200	1	41,100	350	430	21,200	150	22,100	6,500	5,100	0	33,700	7,400	-171,400
	2006	18.3	119%	0	3,100	3,000	8,100	0	20	4,400	1	18,600	350	340	21,900	150	22,700	6,500	4,400	0	33,600	-15,000	-186,400
	2007	6.3	41%	0	10	300	100	0	20	4,400	1	4,800	360	340	21,900	150	22,800	6,500	400	0	29,700	-24,900	-211,300
	2008	17.0	111%	0	2,200	3,200	8,600	0	20	4,400	1	18,400	360	1,140	22,000	160	23,700	6,500	4,200	0	34,400	-16,000	-227,300
	2009	10.5	68%	0	200	700	800	0	20	4,400	1	6,100	350	1,420	22,000	160	23,900	6,500	1,100	0	31,500	-25,400	-252,700
	2010	17.6	114%	0	2,900	3,800	11,600	0	20	4,400	1	22,700	300	1,470	22,000	160	23,900	6,400	4,300	0	34,600	-11,900	-264,600
	2011	21.7	141%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	300	590	22,000	160	23,100	6,400	700	0	30,200	16,700	-247,900
	2012	10.6	69%	0	50	1,300	1,200	0	20	4,400	1	7,000	310	300	22,000	160	22,800	6,500	1,100	0	30,400	-23,400	-271,300
	2013	6.3	41%	0	100	400	300	0	20	4,400	1	5,200	320	430	22,000	160	22,900	6,600	400	0	29,900	-24,700	-296,000
	2014	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	320	1,800	22,000	160	24,300	6,600	400	0	31,300	-26,300	-322,300
	2015	7.6	50%	0	10	400	200	0	20	4,400	1	5,000	250	1,720	22,000	160	24,100	6,700	600	0	31,400	-26,400	-348,700
	2016	11.8	77%	0	30	900	1,100	0	20	4,400	1	6,500	250	390	22,000	160	22,800	6,600	700	0	30,100	-23,600	-372,300
	2017	21.8	142%	0	2,600	5,400	14,500	0	20	4,400	1	26,900	250	0	22,100	170	22,500	6,600	900	0	30,000	-3,100	-375,400
	2018	9.1	59%	0	100	600	500	0	20	4,400	1	5,600	280	150	22,200	170	22,800	6,600	900	0	30,300	-24,700	-400,100
	Minimum	6.2	41%	0	10	300	100	0	10	2,100	1	3,300	170	0	10,300	100	13,800	6,300	300	0	22,300	-26,400	
	Maximum	36.2	235%	0	13,600	12,000	42,400	0	20	4,400	1	69,600	370	3,430	22,200	170	24,300	6,700	5,400	0	34,600	43,100	**Basin Yield**
	Average	**15.4**	**100%**	**0**	**2,400**	**3,100**	**8,600**	**0**	**20**	**3,500**	**1**	**17,500**	**270**	**1,800**	**17,300**	**140**	**19,500**	**6,500**	**2,000**	**0**	**28,100**	**-10,600**	**8,900**
			% of Total:	0%	14%	18%	49%	0%	0%	20%	0%		1%	6%	62%	0%		23%	7%	0%			
Current Water Budget	2011	21.7	141%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	300	590	22,000	160	23,100	6,400	700	0	30,200	16,700	16,700
	2012	10.6	69%	0	50	1,300	1,200	0	20	4,400	1	7,000	310	300	22,000	160	22,800	6,500	1,100	0	30,400	-23,400	-6,700
	2013	6.3	41%	0	100	400	300	0	20	4,400	1	5,200	320	430	22,000	160	22,900	6,600	400	0	29,900	-24,700	-31,400
	2014	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	320	1,800	22,000	160	24,300	6,600	400	0	31,300	-26,300	-57,700
	2015	7.6	50%	0	10	400	200	0	20	4,400	1	5,000	250	1,720	22,000	160	24,100	6,700	600	0	31,400	-26,400	-84,100
	2016	11.8	77%	0	30	900	1,100	0	20	4,400	1	6,500	250	390	22,000	160	22,800	6,600	700	0	30,100	-23,600	-107,700
	2017	21.8	142%	0	2,600	5,400	14,500	0	20	4,400	1	26,900	250	0	22,100	170	22,500	6,600	900	0	30,000	-3,100	-110,800
	2018	9.1	59%	0	100	600	500	0	20	4,400	1	5,600	280	150	22,200	170	22,800	6,600	900	0	30,300	-24,700	-135,500
	Minimum	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	250	0	22,000	160	22,500	6,400	400	0	29,900	-26,400	
	Maximum	21.8	142%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	320	1,800	22,200	170	24,300	6,700	1,100	0	31,400	16,700	**Basin Yield**
	Average	**11.9**	**77%**	**0**	**1,300**	**2,100**	**5,700**	**0**	**20**	**4,400**	**1**	**13,500**	**290**	**670**	**22,000**	**160**	**23,200**	**6,600**	**700**	**0**	**30,500**	**-17,000**	**6,200**
			% of Total:	0.0%	10%	16%	42%	0%	0%	33%	0%		1%	2%	72%	1%		22%	2%	0%			
																							Basin Yield
Projected Water Budget	2042	15.8	101%	0	2,300	4,200	8,200	0	20	5,000	1	19,700	340	510	24,900	220	26,000	6,900	2,100	0	35,000	-15,300	10,700
	2072	15.4	100%	0	2,200	4,200	8,000	0	20	5,100	1	19,500	340	510	25,500	220	26,600	7,000	2,100	0	35,700	-16,200	10,400
	Minimum	15.4	100%	0	2,200	4,200	8,000	0	20	5,000	1	19,500	340	510	24,900	220	26,000	6,900	2,100	0	35,000	-16,200	
	Maximum	15.8	101%	0	2,300	4,200	8,200	0	20	5,100	1	19,700	340	510	25,500	220	26,600	7,000	2,100	0	35,700	-15,300	**Basin Yield**
	Average	**15.6**	**101%**	**0**	**2,300**	**4,200**	**8,100**	**0**	**20**	**5,100**	**1**	**19,600**	**340**	**510**	**25,200**	**220**	**26,300**	**7,000**	**2,100**	**0**	**35,400**	**-15,800**	**10,500**
			% of Total:	0.0%	12%	21%	41%	0%	0%	26%	0%		1%	1%	71%	1%		20%	6%	0%			

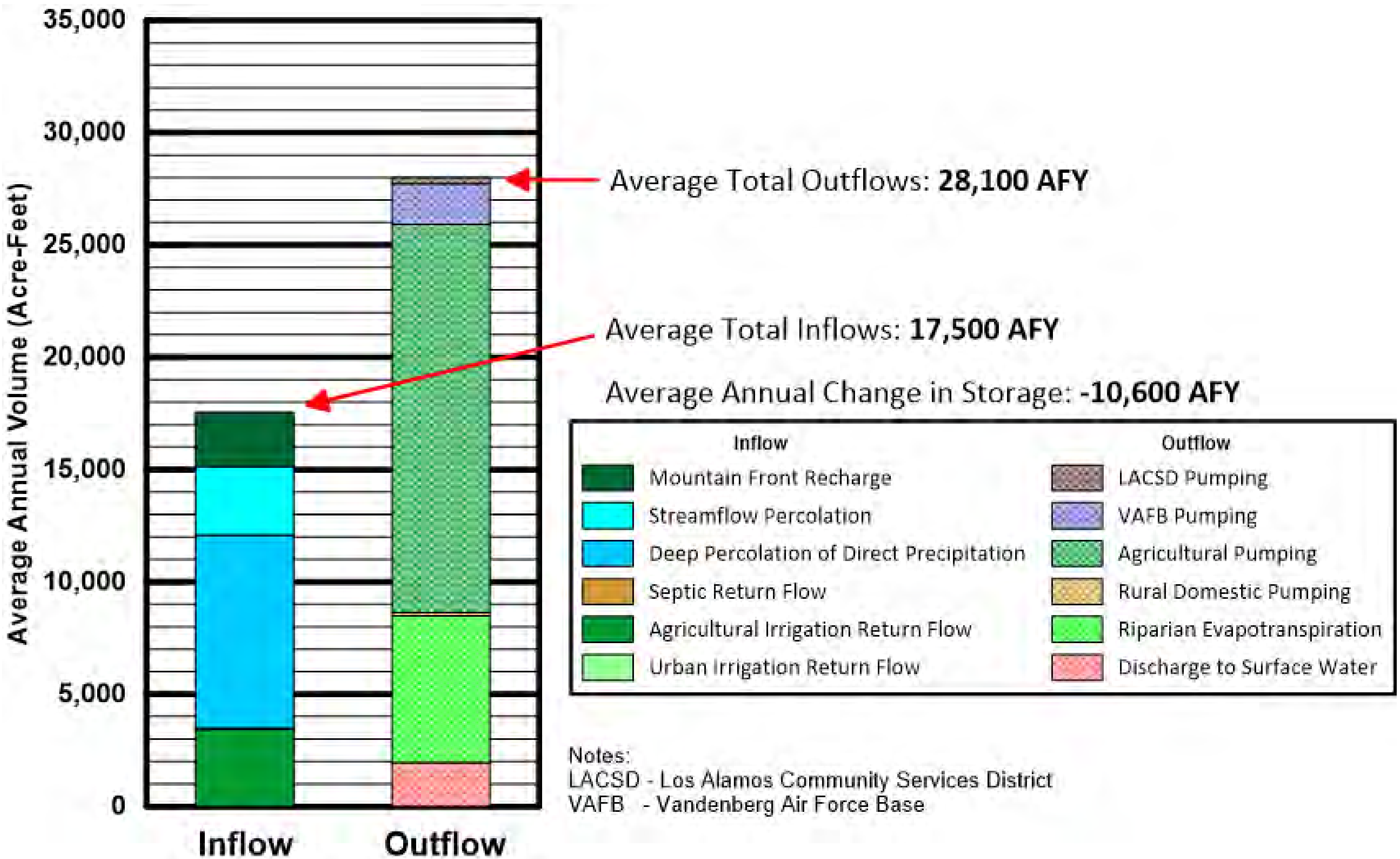

Figure 3-62. Average Groundwater Budget Volumes, Historical Period

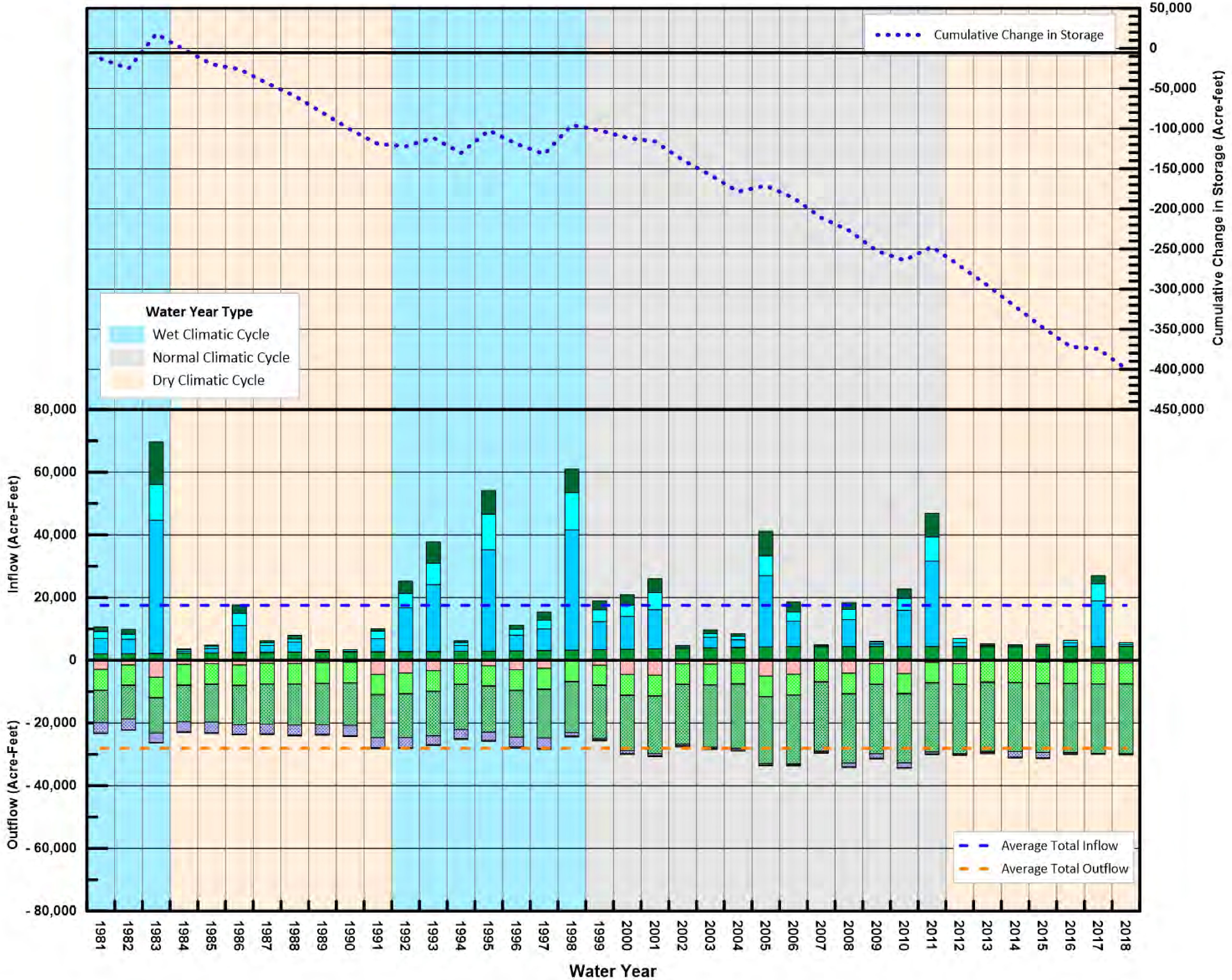

Figure 3-63
Historical Groundwater Budget Summary

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Notes:
LACSD - Los Alamos Community Services District
VAFB - Vandenberg Air Force Base

GSI Water Solutions, Inc.

The historical groundwater budget is substantially influenced by the amount of precipitation falling on the Basin. During the historical period, dry conditions prevailed from 1984 through 1991 and 2012 through 2018, as depicted by the tan areas on Figure 3-63. During these dry periods, the amount of deep percolation of direct precipitation, mountain front recharge, and streamflow percolation was generally orders of magnitude lower than in normal or wet periods. The net result was a loss of groundwater from storage.

In contrast, wet conditions prevailed in the early 1980s and 1992 through 1998, as shown by blue areas on Figure 3-63. During these wet periods, the amount of deep percolation of direct precipitation, mountain front recharge, and streamflow percolation was generally 10,000 AFY or more. The net result was a gain of groundwater in storage. The period from 1999 through 2011 had generally alternating years of average precipitation. During this period, the amount of deep percolation of direct precipitation, mountain front recharge, and streamflow percolation was average; however, due to the amount of groundwater pumping occurring in the Basin, the net result was a loss of groundwater from storage.

Groundwater pumping is the largest component of outflow in the historical water budget. Over the historical period, the total amount of groundwater pumping increased from 1981 to 2009 and remained at that amount of pumping through 2018. Based on the USGS land use survey data, the increase in pumping corresponds with an increase in irrigated agricultural land use. Table 3-22 lists the total acreage of agricultural land use and approximate associated groundwater pumping for years when land use survey data were available. Agricultural land use area more than doubled in acreage from 1977 to 2020. An increase in irrigation efficiencies is indicated by the change in crop types (e.g., conversion to vineyard or hemp) as well as the reduction in groundwater pumping per acre of agricultural land use.

Over the 38-year historical period, a net loss of groundwater storage of about 400,100 AF occurred. The average annual groundwater storage loss was approximately 10,600 AFY.

Table 3-22. Groundwater Pumping and Agricultural Land Uses

Year	Crop Type[1]	Acres[1]	Total (acres)	Agricultural Irrigation Groundwater Pumping (acre-feet)
1977	Tree Crops	5	4,983	8,700
	Field Crops	1,929		
	Pasture	916		
	Truck and Berry Crops	1,402		
	Vineyards	731		
1986	Tree Crops	7	7,918	12,500
	Field Crops	1,110		
	Truck and Berry Crops	3,059		
	Vineyards	3,742		
1996	Tree Crops	3	9,032	14,800
	Field Crops	636		
	Truck and Berry Crops	3,186		
	Pasture	467		
	Vineyards	4,740		
2006	Field Crops	86	13,094	21,900
	Tree Crops	33		
	Truck and Berry Crops	4,668		
	Vineyards	8,306		
2016	Tree Crops	449	13,137	22,000
	Truck and Berry Crops	5,289		
	Vineyards	7,190		
2020	Field Crops	432	13,459	23,600
	Tree Crops	882		
	Truck and Berry Crops	4,687		
	Pasture	654		
	Vineyards	6,796		
	Cannabis/Hemp	9		

Notes

[1] Crop types and acreages are according to USGS, 2020e and Santa Barbara County, 2020 (see Appendix E).

The crop water use factors are shown below in acre-feet per year by evapotranspiration zones 6 and 3, respectively, and are according to SYRWCD, 2010 and the basin stakeholders (except for the cannabis/hemp totals, which are from Battany, 2019):

Tree Crops: 2.06 / 1.65
Field Crops: 1.23 / 0.99
Truck and Berry Crops: 2.62 / 2.10
Pasture: 3.75 / 3.00
Vineyards: 1.60 / 1.28
Cannabis/Hemp: 1.5 / 1.2

Historical Water Balance of the Basin

The computed long-term decrease of groundwater in storage indicates that total groundwater outflow exceeded the total inflow in the Basin from 1981 through 2018. As summarized in Table 3-19, total groundwater pumping averaged approximately 19,500 AFY during the historical period.

The historical basin yield was estimated by summing the estimated average groundwater storage decrease of 10,600 AFY with the estimated total average amount of groundwater pumping, of 19,500 AFY, for the historical period. This results in a historical basin yield for the Basin of about 8,900 AFY. This estimated value reflects historical climate, hydrologic, and pumping conditions and provides insight into the amount of groundwater pumping that could be sustained in the Basin to maintain a balance between groundwater inflows and outflows. It is anticipated that this value may fluctuate in the future as conditions change or as more data are obtained.

Section 354.18(b)(7) of the SGMA regulations requires a quantification of sustainable yield for the Basin for the historical period. Sustainable yield is the maximum quantity of groundwater, calculated over a period representative of long-term conditions in the Basin and including any temporary surplus that can be withdrawn annually from a groundwater supply without causing an undesirable result. Sustainable yield differs from the basin yield because sustainable yield incorporates consideration of the sustainable management criteria developed for the Basin. Based on the Basin's sustainable management criteria described in Section 4, the basin yield is equal to the sustainable yield for the Basin calculated for the historical period.

3.3.3.3 Impact of Historical Conditions on Basin Operations [§ 354.18(c)(2)(C)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(2) Historical water budget information shall be used to evaluate availability or reliability of past surface water supply deliveries and aquifer response to water supply and demand trends relative to water year type. The historical water budget shall include the following:

(C) A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon.

The data sources used to generate the historical water budget, as summarized in Section 3.3.2, are considered of high enough quality and consist of a sufficiently long period of record to adequately estimate and project future water budget information and future aquifer response to proposed groundwater management practices over the planning and implementation horizon. Data gaps identified in the data sources, if any, are discussed in Section 3.3.2.

3.3.4 Current Water Budget [§ 354.18(c)(1)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(1) Current water budget information shall quantify current inflows and outflows for the basin using the most recent hydrology, water supply, water demand, and land use information.

SGMA regulations require that the current surface water and groundwater budget be based on the most recent hydrology, water supply, water demand, and land use information. For this GSP, 2011 through 2018 was selected as the period for the current water budget. This period is a subset of the historical period described in Section 3.3.3.2.

The current water budget period corresponds to a drought period when annual precipitation averaged about 77 percent of the historical average and percolation of direct precipitation averaged about 66 percent of the historical average. As a result, the current water budget period represents drought conditions and is not representative of the long-term hydrological conditions needed for sustainability planning purposes.

Estimates of the surface water and groundwater inflow and outflow and changes in storage for the current water budget period are provided below.

3.3.4.1 Current Surface Water Budget

The current surface water budget quantifies important sources of surface water. Similar to the historical surface water budget, the current surface water budget includes one surface water source type: local supplies.

Current Surface Water Inflow

Current local surface water supplies include surface water flows that enter the Basin from precipitation runoff within the watershed and groundwater in the Basin discharging to surface water in the Basin. Table 3-23 summarizes the annual average, minimum, and maximum values for these inflows.

Table 3-23. Annual Surface Water Inflow, Current Period

Surface Water Inflow Component	Average	Minimum	Maximum
Inflow to Basin, including San Antonio Creek and Tributaries	3,300	400	14,800
Groundwater Discharge to Surface Water	700	400	1,100
Total[1]	4,000	—	—

Notes

All values are in units of acre-feet.

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

— = not applicable

The estimated average inflow from precipitation runoff over the current water budget period was approximately 3,300 AFY, or about 65 percent of the average annual 5,100 AFY of inflow during the historical period. The estimated average groundwater discharge to surface water over the current water budget period was approximately 700 AFY, or about 35 percent of the average annual 2,000 AFY of groundwater discharge to surface water during the historical period. The reduction in surface water inflows reflects the drought conditions that prevailed during the current water budget period.

Current Surface Water Outflows

The estimated annual average, minimum, and maximum surface water outflow leaving the Basin as flow in San Antonio Creek west into Barka Slough and the percolation into the groundwater system over the current period is summarized in Table 3-24. Reductions in surface water outflow for the current water budget period were similar to those reported for the surface water inflows.

Table 3-24. Annual Surface Water Outflow, Current Period

Surface Water Outflow Component	Average	Minimum	Maximum
San Antonio Creek West of Barka Slough Outflow from Basin	1,800	400	7,100
Streamflow Percolation	2,100	400	7,700
Total[1]	3,900	—	—

Notes

All values are in units of acre-feet.

[1] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.

— = not applicable

Current Surface Water Budget

Figure 3-64 summarizes the current surface water budget for the Basin and shows the effects of the drought conditions that prevailed during the period of 2011 through 2018. During this period, precipitation was below average and average annual groundwater discharge to surface water decreased compared to the historical period, which resulted in reduced surface water flow.

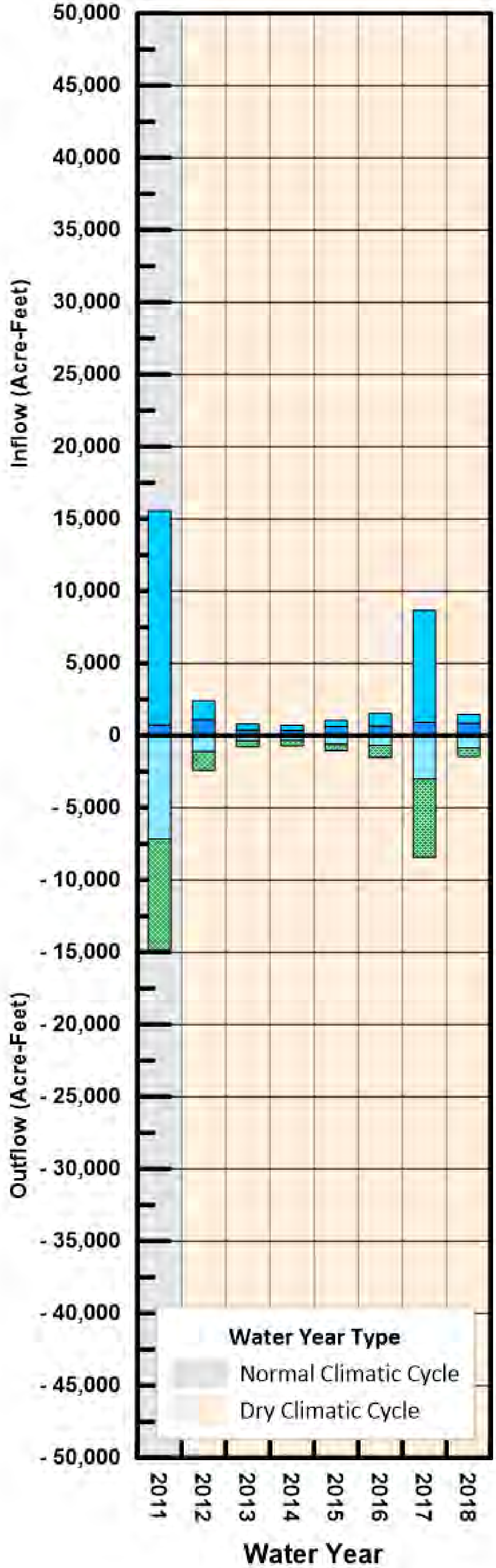

Figure 3-64
Current Surface Water Budget

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Surface Water Inflow Components

Surface Water Inflow
Groundwater Discharge to Surface Water

Surface Water Outflow Components

Surface Water Outflow
Streamflow Percolation

GSI Water Solutions, Inc.

3.3.4.2 Current Groundwater Budget

Groundwater supplied all the beneficial uses in the Basin during the current water budget period. The current water budget includes a summary of the estimated groundwater inflows, groundwater outflows, and change in groundwater in storage.

Current Groundwater Inflows

Groundwater inflow components include streamflow percolation, agricultural irrigation return flow, deep percolation of direct precipitation and mountain front recharge, septic system return flow, wastewater treatment plant spray irrigation, and urban irrigation return flow. Estimated annual groundwater inflows for the current water budget period are summarized in Table 3-25.

Table 3-25. Annual Groundwater Inflow, Current Period

Groundwater Inflow Component	Average[1]	Minimum	Maximum
Mountain Front Recharge	1,300	10	7,500
Streamflow Percolation[2]	2,100	400	7,700
Deep Percolation of Direct Precipitation	5,700	200	27,300
Septic System Return Flow	20	20	20
Agricultural Irrigation Return Flow	4,400	4,400	4,400
Urban Irrigation Return Flow	1	1	1
Total[3]	13,500	—	—

Notes

All values are in units of acre-feet.
[1] Due to rounding, total does not correspond to the sum of all figures shown.
[2] Streamflow Percolation includes San Antonio Creek percolation and tributary channel percolation.
[3] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
— = not applicable

For the current water budget period, the estimated total average groundwater inflow ranged from 5,000 AFY to 46,900 AFY, with an average inflow of 13,500 AFY. Notable observations from the summary of groundwater inflows for the current water budget period include the following:

- Average total inflow during the current water budget period was about 77 percent of the historical period.
- Total annual average recharge from percolation of direct precipitation for the current water budget period was about 66 percent of the recharge from direct precipitation for the historical period.
- Total annual average streamflow percolation in the current water budget period was approximately 68 percent of the recharge from streamflow percolation for the historical period.
- Total annual average recharge from mountain front recharge for the current water budget period was about 54 percent of the recharge from mountain front recharge for the historical period.

Current Groundwater Outflows

Groundwater outflow components include total groundwater pumping from all water use sectors, groundwater discharge to surface water, and riparian ET. No areas of subsurface flow out of the Basin have been identified because there is low-permeability bedrock high located on the west end of the Basin at Barka Slough. Estimated annual groundwater outflows for the current water budget period are summarized in Table 3-26.

Table 3-26. Annual Groundwater Outflow, Current Period

Groundwater Outflow Component	Average	Minimum	Maximum
Total Groundwater Pumping	23,200	22,500	24,300
Riparian Evapotranspiration	6,600	6,400	6,700
Groundwater Discharge to Surface Water[1]	700	400	1,100
Total[2]	30,500	—	—

Notes

All values are in units of acre-feet.
[1] Volume of groundwater discharge to surface water in Barka Slough in excess of evapotranspiration.
[2] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
—= not applicable

For the current water budget period, estimated total average groundwater outflows ranged from 29,900 AFY to 31,400 AFY, with an average annual outflow of 30,500 AF; equating to a 9 percent increase in the total average groundwater outflows that were estimated for the historical period.

The largest groundwater outflow component from the Basin in the current water budget period is pumping. Estimated annual groundwater pumping by water use sector for the current water budget period is summarized in Table 3-27.

Table 3-27. Annual Groundwater Pumping by Water Use Sector, Current Period

Water Use Sector	Average[1]	Minimum	Maximum
LACSD	290	250	320
VSFB	670	0	1,800
Agricultural	22,000	22,000	22,200
Rural Domestic	160	160	170
Total[2]	23,200	—	—

Notes

All values are in units of acre-feet.
[1] Due to rounding, total does not correspond to the sum of all figures shown.
[2] Minimum and maximum values are not totaled because the values for each component may have occurred in different years.
LACSD = Los Alamos Community Services District
— = not applicable
VSFB = Vandenberg Space Force Base

For the current water budget period, estimated total average groundwater pumping ranged from 22,500 AFY to 24,300 AFY, with an average pumping of 23,200 AFY. Agricultural pumping is the largest component of total groundwater pumping, accounting for approximately 95 percent of total pumping over the current water budget period. Agricultural pumping increased by approximately 27 percent during the current water budget period compared to the historical period due to an increase in irrigated acres (see Table 3-22). VSFB, LACSD, and rural domestic pumping account for approximately 3 percent, 1 percent, and 1 percent, respectively, of total average annual pumping during the current water budget period.

Current Groundwater Budget and Change in Groundwater Storage

Average groundwater inflows and outflows for the current water budget period are presented on Figure 3-65 and a summary of annual groundwater inflows and outflows are presented on Figure 3-66. Inflow components are graphed above the zero line and outflow components are graphed below the zero line. Figure 3-66 also shows annual and cumulative change in groundwater storage during the current water budget period. Annual decreases in groundwater in storage are graphed below the zero line. The dotted blue line shows the cumulative change in groundwater storage over the current period

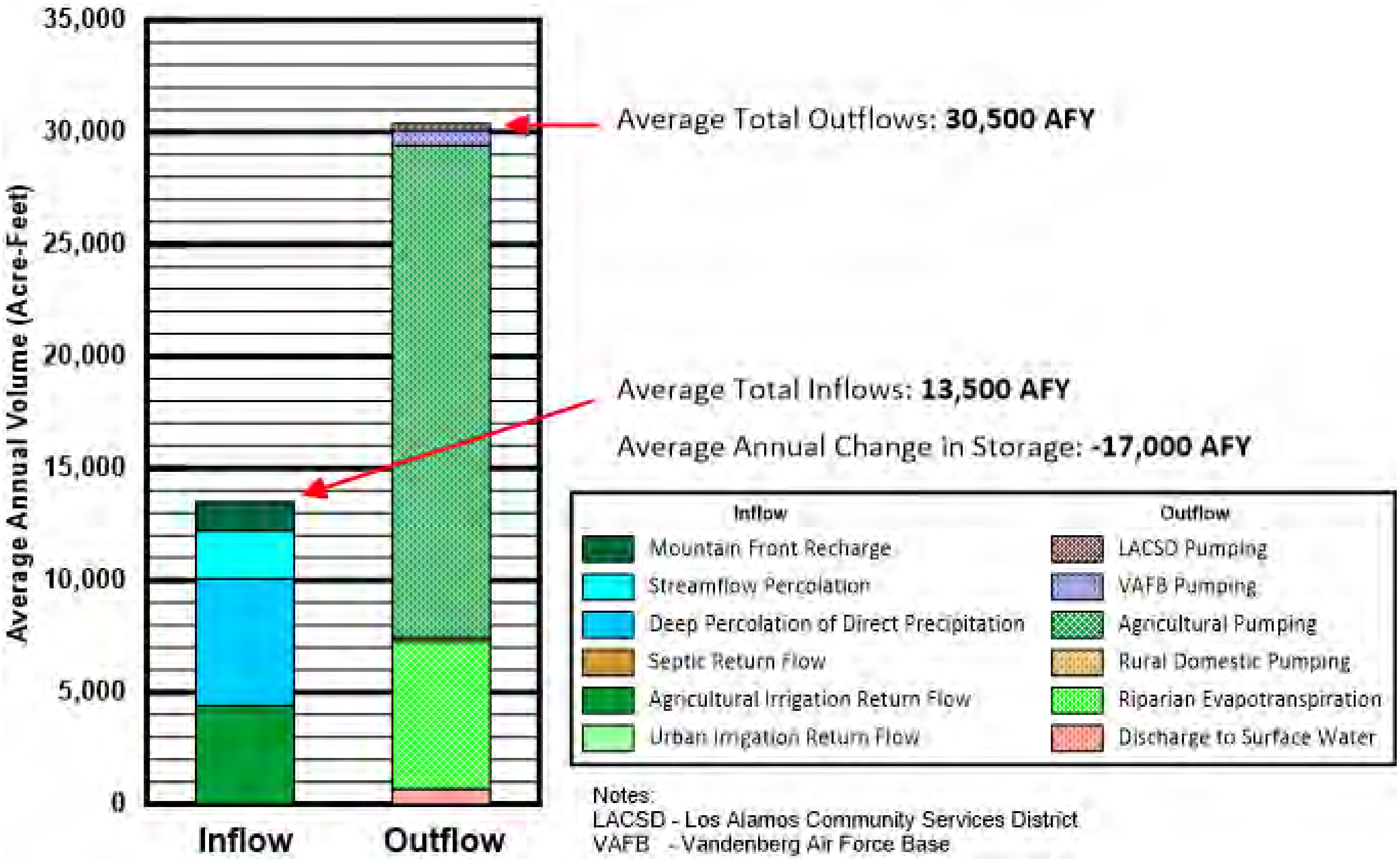

Figure 3-65. Current Groundwater Budget Average Volumes

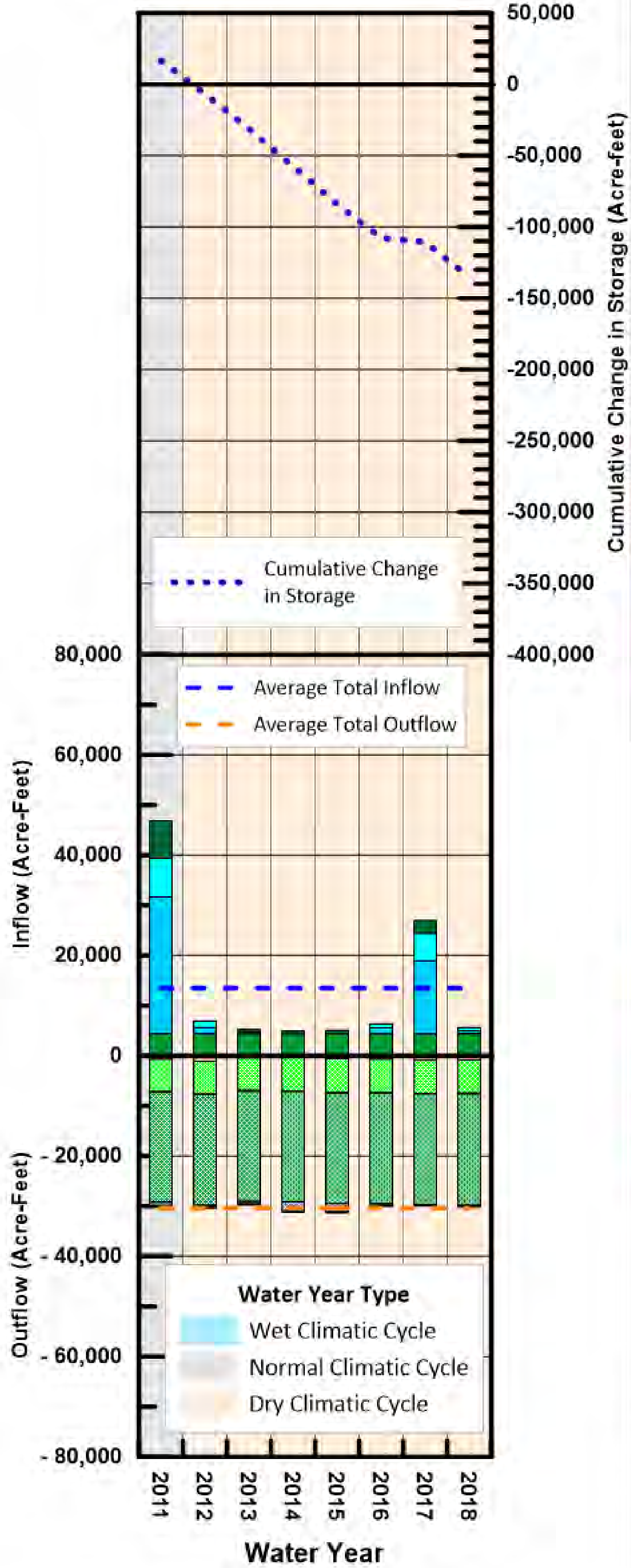

Figure 3-66
Current Groundwater Budget Summary

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

Inflow Components

- Mountain Front Recharge
- Streamflow Percolation
- Deep Percolation of Direct Precipitation
- Septic Return Flow
- Agricultural Irrigation Return Flow
- Urban Irrigation Return Flow

Outflow Components

- LACSD Pumping
- VAFB Pumping
- Agricultural Pumping
- Rural Domestic Pumping
- Riparian Evapotranspiration
- Discharge to Surface Water

Notes:
LACSD - Los Alamos Community Services District
VAFB - Vandenberg Air Force Base

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The current groundwater budget is strongly influenced by the current drought, beginning in 2012, and groundwater pumping associated with agricultural irrigation. During the current water budget period, the amounts of streamflow percolation, mountain front recharge, and percolation of direct precipitation were approximately 68 percent, 54 percent, and 66 percent, respectively, compared to what occurred during the historical period. The average amount of total pumping was 19 percent higher during the current water budget period than during the historical period. Over the 8-year current water budget period, an estimated net loss of groundwater in storage of about 135,500 AF occurred (see Figure 3-66). The annual average groundwater in storage loss, or the difference between outflow and inflow to the Basin, was approximately 17,000 AFY.

Current Water Balance

The short-term depletion of groundwater in storage indicates that total groundwater outflows exceeded the total inflows over the current water budget period. As summarized in Figure 3-65, total groundwater pumping averaged approximately 23,200 AFY during the current water budget period. A quantification of the basin yield for the Basin during the current water budget period is estimated by subtracting the average groundwater storage deficit (17,000 AFY) from the total average amount of groundwater pumping (23,200 AFY) to yield about 6,200 AFY. Based on the Basin's sustainable management criteria described in Section 4, the basin yield is equal to the sustainable yield for the Basin calculated for the historical period. Due to the drought conditions, the current water budget period is not appropriate for long-term sustainability planning.

3.3.5 Projected Water Budget [§ 354.18(c)(3)(A)(B)(C)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

(C) Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate.

3.3.5.1 Projected Water Budget Calculation Methods [§ 354.18(d)(1),(d)(2),(d)(3),(e), and (f)]

The surface water and groundwater inflow and outflow components of the projected water budget in the Basin were estimated using estimated future land uses and related pumping volumes and repeating factors associated with the observed historical climatic conditions forward in time through 2042 and 2072. The effects of climate change were also evaluated using DWR-provided climate change factors. The USGS BCM, as discussed in Section 3.3.2.1, was adjusted to the DWR Variable Infiltration Capacity (VIC) hydrology model (see Section 3.3.5.1) for 2030 and 2070 climate data to estimate surface and groundwater flow components for the projected water budget. Table 3-14 lists the methodologies used to project volumes for each water budget component. This section briefly describes the estimated components of the projected water budget that include the effects of changing land use and water demand and effects caused by climate change.

Projected Climate

The 2030 and 2070 precipitation, ET, and streamflow climate change factors are available on 6-kilometer resolution grids from DWR. The climate data sets were processed by a soil moisture accounting model known as the VIC hydrology model developed by Hamman et al. (2018) and Liang et al. (1994) and routed to the outlet of basins or subbasins contributing water to the Basin. The resulting downscaled hydrologic time series are available on the SGMA Data Viewer hosted by DWR.[34] Climate grid cells for precipitation and ET data are defined by the DWR Bulletin 118 groundwater basin boundaries (DWR, 2018a) and streamflow climate grid cells are defined by the 8-digit Hydrologic Unit Codes (HUCs). Precipitation and ET data used in this analysis were downloaded from the SGMA Data Viewer for climate grid cells within San Antonio Creek Valley Groundwater Basin (3-014). Streamflow data used in this analysis were downloaded from the SGMA Data Viewer for climate grid cells within HUC 8-18060009. Monthly time series change factors were then developed for the Basin. Mean monthly and annual values were computed from the basin time series to show projected patterns of change under 2030 and 2070 conditions.

Projected Groundwater and Surface Water Inflow and Non-Pumping Outflow Components

Projected groundwater and surface water inflow components, including mountain front recharge, streamflow percolation, percolation of direct precipitation, and groundwater discharge to surface water, were calculated with methodologies and historical data sets consistent with those used to develop the historical and current water budgets (see Section 3.3.2.1). Additionally, projected changes in climatic factors, including ET and precipitation (see Section 3.3.5.1), were used to adjust the USGS BCM, as outlined in Table 3-14.

Projected Agricultural, Municipal, and Industrial Pumping

Calculation methodologies for projected agricultural pumping and municipal and industrial (M&I) pumping are discussed in Section 3.3.5.3.

[34] Available at https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels. (Accessed February 4, 2021.)

Projected Hydrology [§ 354.18(c)(3)(A)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.

DWR's Water Budget and Modeling BMPs (DWR, 2016d, 2016e, and 2020c) describe the use of climate change data to estimate projected hydrology. DWR has also provided SGMA Climate Change Data[35] and published a *Guidance for Climate Change Data Use for Groundwater Sustainability Plan Development* (DWR, 2018b), which is the primary source of technical guidance used in this analysis.

The DWR-provided climate change data are based on the California Water Commission's Water Storage Investment Program (WSIP) climate change analysis results, which used the global climate models and radiative forcing scenarios recommended for hydrologic studies in California by the Climate Change Technical Advisory Group. Climate data from the recommended General Circulation Model models and scenarios have also been downscaled and aggregated to generate an ensemble time series of change factors that describe the projected change in precipitation, ET, and streamflow values for climate conditions that are expected to prevail at mid-century and late century, centered around 2030 and 2070, respectively. The DWR data set also includes two additional simulation results for extreme climate scenarios under 2070 conditions. Use of the extreme scenarios, which represent Drier/Extreme Warming (2070DEW) and Wetter/Moderate Warming (2070WMW) conditions in GSPs, is optional.

This section describes the retrieval, processing, and analysis of DWR-provided climate change data to project the impact of climate change on precipitation, ET, and streamflow under 2030 and 2070 conditions. The precipitation and ET change projections are computed relative to a baseline period of 1981 to 2011 (due to the availability of the data for DWR-provided climate change factors and the USGS BCM data set). The baseline period was selected based on the historical period (which includes water years from 1981 to 2018), the availability of concurrent climate projections from the DWR VIC hydrology model (calendar years 1915 to 2011) and derived hydrologic simulations from the USGS BCM (water years 1981 to 2018). The projected 50-year based period included the following sequence of historical water years: 1981–2011, 1984–1992, and 1998–2001 (see Figure 3-67).

[35] Available at https://data.cnra.ca.gov/dataset/sgma-climate-change-resources. (Accessed February 4, 2021.)

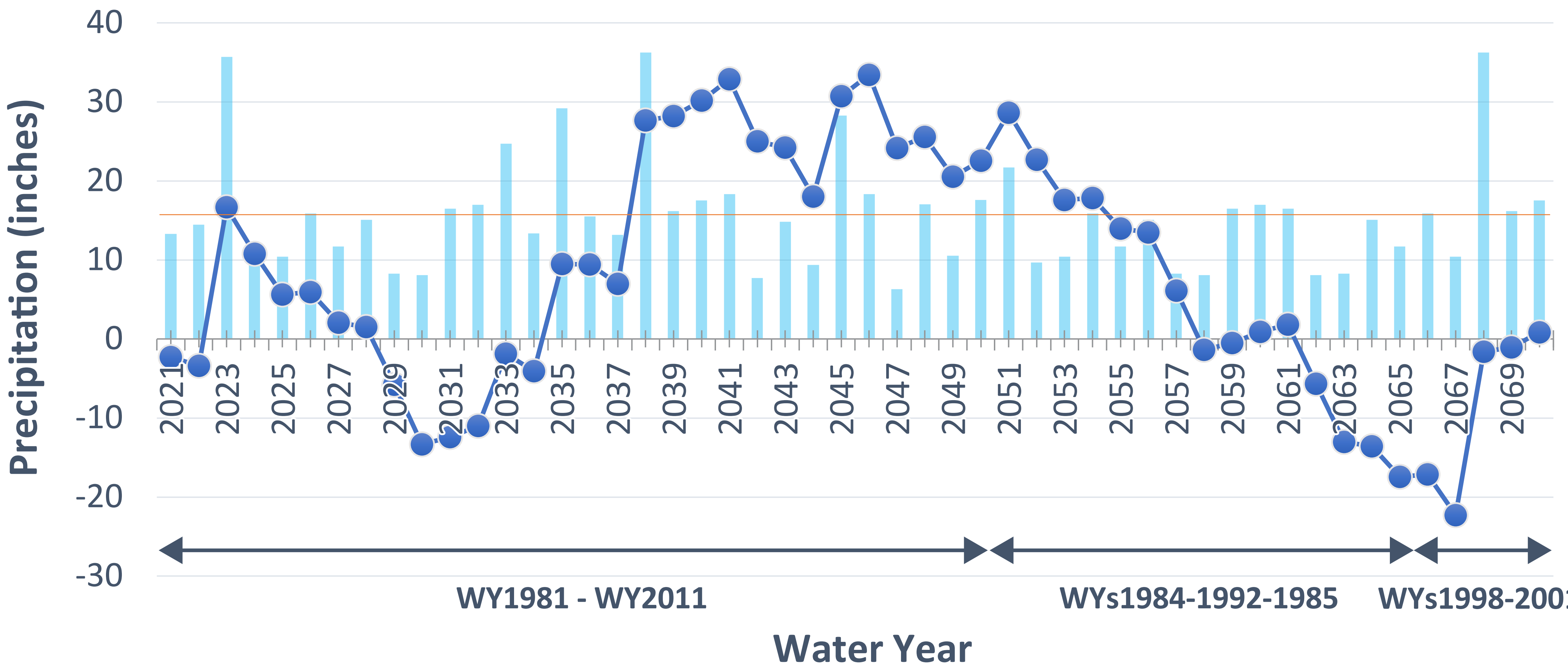

FIGURE 3-67

Projected Future Precipitation at the Los Alamos Fire Station Projected Water Budget 50-Year Future Baseline

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Precipitation (inches)

Cumulative Departure from Mean Precipitation

Date: September 16, 2021
Data Sources: County of Santa Barbara (n.d.)

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Projected Changes in Evapotranspiration. In a warmer climate such as that of the Basin, crops require more water to sustain growth, and this increased water requirement is characterized in climate models using the rate of ET. Under 2030 conditions, the Basin is projected to experience average annual ET increases of approximately 3.6 percent relative to the baseline period. The largest monthly changes would occur in late fall, with projected average increases of approximately 4.9 percent and 5.6 percent in October and November, respectively. Under 2070 conditions, annual ET is projected to increase by approximately 8 percent relative to the baseline period. The largest monthly changes would occur in late fall to early winter, with projected average increases of 11.5 percent and 11 percent in November and December, respectively. Summer increases peak at approximately 8 percent in May.

Projected Changes in Precipitation. The seasonal timing and amount of precipitation in the Basin is projected to change. Decreases are projected in the summer, mid-fall, and late winter. Increases are projected in mid-winter, early spring, and late summer to early fall. Under 2030 conditions, the largest monthly changes would occur in October with projected decreases of 12 percent, while increases of approximately 8 percent would occur in January and August and 12 percent in May. Under 2070 conditions, decreases of up to 23 percent are projected in May and the largest increases are projected to occur in January (17 percent) and September (22 percent). The Basin is projected to experience minimal changes in total annual precipitation. Annual precipitation increases by approximately 1 percent projected under 2030 conditions relative to the baseline period. Under 2070 conditions, small decreases in annual precipitation, of approximately 2 percent, are projected. The DWR-provided climate change data do not include descriptions regarding precipitation intensity.

Projected Changes in Streamflow. The DWR-provided time series of climate change factors for streamflow was compiled as annual factors. Consequently, changes in projected streamflow cannot be determined on a seasonal basis without additional analysis. The Basin is projected to experience average annual increases in streamflow of approximately 2 percent and 6 percent under 2030 and 2070 conditions, respectively,

3.3.5.2 Projected Surface Water Budget

The projected surface water budget inflow includes surface water flows that enter the Basin from precipitation runoff within the watershed and groundwater in the Basin discharging to surface water in the Basin. Table 3-28 summarizes the annual averages for the historical and projected water budgets.

Table 3-28. Annual Surface Water Inflows, Historical and Projected Periods

Surface Water Inflow Component	Annual Average		
	Historical Period	2042[1]	2072[1]
Inflow to Basin including San Antonio Creek and Tributaries	5,100	5,100	5,000
Groundwater Discharge to Surface Water	2,000	2,100	2,100
Total	7,100	7,200	7,100

Notes

All values are in units of acre-feet.
[1] 2042 and 2072 volumes are annual averages calculated using the 50-year base period described in Section 3.3.5.1.

Surface water inflows are projected to increase in the 2042 projected water budget by approximately 1 percent compared to the historical period. Future surface water inflow for the 2072 projected period is equal to the historical period average. The DWR climatic factors discussed in Section 3.3.5.1 are forecasted for 2030 and 2070. To generate a 50-year period to develop projected water budgets for 2042 and 2072, the two data sets were combined for calculating water years 2031 through 2042. Consequently, the forecasted increase of precipitation as part of the 2030 DWR climatic factors (and decrease as part of the 2070 climatic factors) are moderated, due to the combining of the data sets for water years 2031 through 2042.

Projected surface water budget outflows include surface water leaving the Basin as flow in San Antonio Creek west of Barka Slough and streamflow percolation into the groundwater system. These annual average surface water outflows are summarized in Table 3-29.

Future streamflow percolation is projected to increase by 35 percent for the 2042 and 2072 projected future water budget periods. The increase in streamflow percolation could be a result of declining groundwater water levels (discussed further in Section 3.3.5.3), resulting in an increased recharge capacity. The projected increase in surface water outflow is a result of projected increases in streamflow-based DWR climate factors.

Table 3-29. Annual Surface Water Outflows, Historical and Projected Periods

Surface Water Outflow Component	Annual Average		
	Historical Period	2042[1]	2072[1]
San Antonio Creek West of Barka Slough, Outflow from Basin	4,200	4,400	4,600
Streamflow Percolation	3,100	4,200	4,200
Total	7,300	8,600	8,800

Notes

All values are in units of acre-feet.

[1] 2042 and 2072 volumes are annual averages calculated using the 50-year base period described in Section 3.3.5.1.

3.3.5.3 Projected Groundwater Budget

Groundwater inflow components for the projected water budget include mountain front recharge, streamflow percolation, deep percolation of direct precipitation, septic system return flow, agricultural irrigation return flow, and urban irrigation return flow. Estimated annual groundwater inflows for the historical and projected periods are summarized in Table 3-30. Values reported in the table were estimated or derived from the data sources reported in Table 3-14.

Table 3-30. Annual Groundwater Inflows, Historical and Projected Periods

Groundwater Inflow Component	Annual Average		
	Historical Period[1]	2042[1]	2072[2]
Mountain Front Recharge	2,400	2,300	2,200
Streamflow Percolation[3]	3,100	4,200	4,200
Deep Percolation of Direct Precipitation	8,600	8,200	8,000
Septic System Return Flow	20	20	20
Agricultural Irrigation Return Flow	3,500	5,000	5,100
Urban Irrigation Return Flow	1	1	1
Total	17,500	19,700	19,500

Notes
All values are in units of acre-feet.
[1] Due to rounding, total does not correspond to the sum of all figures shown.
[2] 2042 and 2072 volumes are annual averages calculated using the 50-year base period described in Section 3.3.5.1.
[3] Streamflow percolation includes San Antonio Creek and tributary channel percolation.

The total average annual groundwater inflow is 2,200 AF greater than the historical period average during the 2042 projected period, and 2,000 AF greater during the 2072 projected period. As discussed in Section 3.1, the Basin is a closed basin; therefore, the only source of recharge from outside of the Basin boundaries is precipitation. Groundwater inflow components directly correlated to precipitation, such as mountain front recharge and deep percolation of direct precipitation, indicate a slight decrease in the projected water budget. Groundwater inflow components indicating a notable increase include agricultural return flow and streamflow percolation. The increase in agricultural return flow is due to the projected increased water demand for agricultural irrigation.

Table 3-31 summarizes the historical and projected annual average groundwater outflows.

Table 3-31. Annual Groundwater Outflows, Historical and Projected Periods

Groundwater Outflow Component	Annual Average		
	Historical Period	2042[1]	2072[1]
Total Groundwater Pumping	19,500	26,000	26,600
Riparian Evapotranspiration	6,500	6,900	7,000
Groundwater Discharge to Surface Water	2,000	2,100	2,100
Total	28,000	35,000	35,700

Notes
All values are in units of acre-feet.
[1] 2042 and 2072 volumes are annual averages calculated using the 50-year base period described in Section 3.3.5.1.

The total average annual groundwater outflow is estimated to be 7,000 AF greater during the 2042 projected period than the historical period average, and 7,700 AF greater during the 2072 projected period. Projected groundwater pumping is estimated to increase by 6,500 AF and 7,100 AF for the 2042 and 2072 projected periods, respectively. Riparian ET is also estimated to increase by 400 AF and 500 AF for the 2042 and 2072 projected periods, respectively. The projected increase in groundwater demand from pumping and riparian ET results in a decrease of groundwater discharging to surface water at Barka Slough.

Projected Water Demand [§ 354.18(c)(3)(B)]

§ 354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

Total water demand within the Basin was estimated for the 2042 and 2072 projected water budget periods based on the historical and current water budgets. To estimate total demand for projected periods, two components of demand were considered: agriculture pumping and M&I pumping. This section describes the methods used to estimate these components through 2042 and 2072, and the respective results.

Between water years 1981 and 2018, irrigated agriculture demand ranged between 10,300 AFY and 22,200 AFY. Available crop survey data indicate that this demand is from a variety of crops, of which the acreages vary from year to year. The crop types are grouped into five categories: deciduous fruits and nuts (trees); field crops; pasture; vineyards; and truck and berry crops. Crop ET was derived for each of these crops for each year during the historical period of 1981 to 2018, based on trends in water use for each crop.

Crop acreages for each of the five categories were extrapolated with linear extrapolation techniques, based on crop distribution trends to determine projected water demand. The slope generated by the extrapolated planted acreage indicates an inflection point and decreased gradient beginning in 2006. The rate of growth of planted acreage in the Basin has slowed in the last two decades to approximately 0.2 percent annually. According to the United States Department of Agriculture (USDA) online Web Soil Survey tool,[36] there are approximately 13,436 acres of prime farmland within the Basin. The USDA tool considers factors such as soil type, slope, and drainage. Based on 2020 County of Santa Barbara spatial pesticide use permit data, there were approximately 13,459 planted acres in the Basin. Consequently, the 2020 planted acreage according to the County of Santa Barbara was used as the cap for irrigated acres in the Basin for the purposes of the projected water budget. Additionally, the percentages of planted crop types according to the

[36] Available at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm. (Accessed February 4, 2021.)

2020 pesticide use permit data remained constant during the projected water budget. Using the planted acreage, crop types, and crop water duty factors, a water demand of 1.75 AF/acre was calculated for 2020. The future agricultural water demand for the 2042 and 2072 projected water budget periods was calculated using the 50-year base period described in Section 3.3.5.1, DWR future climate factors for ET, and the calculated 2020 agricultural water demand. Future agricultural water demand was calculated at 24,900 AF (1.85 AF/acre) and 25,500 AF (1.9 AF/acre) for 2042 and 2072, respectively.

Future M&I demands were estimated for the VSFB, LACSD, and rural domestic users. To estimate future M&I demands, GSI reviewed the following:

- Historical demand records from VSFB and LACSD
- Estimated rural domestic pumping for the historical period
- Santa Barbara County Association of Governments Regional (population) Growth Forecasts (SBCAG, 2007)
- California Department of Finance Population and Housing Estimates (California Department of Finance, 2020)

These sources were used to project demand through time relative to estimated population increases and water demand trends. The estimated future agricultural and M&I water demand within the Basin during historical water budget period (1981–2018) and projected values for 2042 and 2072 are presented on Table 3-32.

Table 3-32. Projected Water Demand Summary

Average Demand	Historical Period	2042	2072
Agricultural Demand			
Irrigation Demand	17,300	24,900	25,500
Municipal and Industrial Demand			
VSFB[1]	1,800	510	510
LACSD[2]	270	340	340
Rural Domestic[2]	140	220	220
Total M&I	2,210	1,070	1,070
Total	19,510	25,970	26,570
Change	—	6,460	7,060

Notes

All values are in units of acre-feet per year.
[1] VSFB projected pumping assumes continued delivery of SWP water and no development of the proposed Vandenberg Dunes Golf Courses Project.
[2] LACSD and Rural Domestic projected pumping is based on a calculated 3-percent annual population increase from 2020 through 2072.
— = not applicable
DWR = California Department of Water Resources
LACSD = Los Alamos Community Services District
M&I = municipal and industrial
SWP = California State Water Project
VSFB = Vandenberg Space Force Base

Estimated M&I demands in the Basin were 2,210 AFY during the historical period, which was met with groundwater pumping. Imported SWP water became available to the VSFB in 1997 (during the historical water budget period [1981–2018]) through a water supply agreement with the Central Coast Water Authority (CCWA), which caused groundwater pumping in the Basin to decrease compared to previous years. The M&I demand calculated for the projected water budget assumes VSFB will continue to receive SWP deliveries and the proposed Vandenberg Dunes Golf Course Project will not be developed.

The delivery of imported SWP water to VSFB reduces VSFB's groundwater demand from the Basin; therefore M&I demand is projected to decrease in comparison to M&I demand during the historical period. By 2042, at the end of the GSP implementation period, total demand in the Basin may increase by 33 percent relative to the historical period, and further by a total of 36 percent by 2072 in response to an increase in agricultural demand to meet future climatic factors from DWR for ET. The increase in demand is assumed to be a linear projection from current conditions as presented graphically on Figure 3-68.

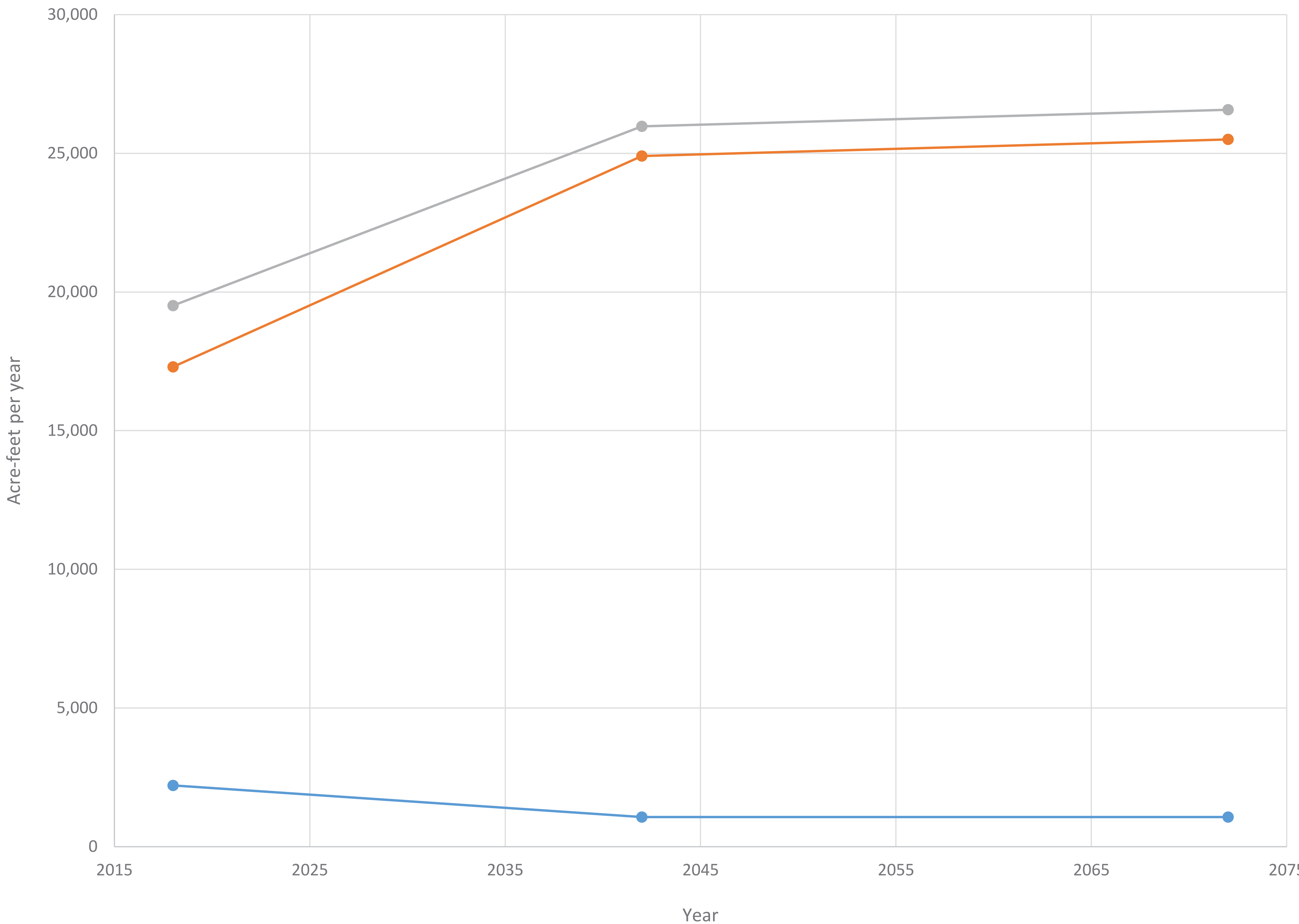

FIGURE 3-68

**Projected Demand –
Historical Period, 2042, and 2072**

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Total Demand

Agricultural Demand

M&I Demand

NOTE

M&I: Municipal and Industrial

Date: September 16, 2021

GSI Water Solutions, Inc.

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Approximately 921 AFY is the estimated water consumption for the Vandenberg Dunes Golf Courses Project (AECOM, 2019). Including this additional volume in the 2042 and 2072 projected water budgets equates to an additional 970 AFY and 1,000 AFY, respectively, of groundwater outflow from the Basin after applying the forecasted DWR climate factors for ET. The location of the proposed Vandenberg Dunes Golf Courses Project is west of the Basin and therefore the Basin would not receive any irrigation return flow or septic return flow from golf course operations. It should be noted that, in 1997, CCWA approved a portion of the SWP water the VSFB had requested. VSFB is currently working to secure the outstanding portion of the originally requested allotment as well as exploring options outside of the Basin such as desalination. Due to the annual fluctuations in percentage of SWP water allocations available, the formerly estimated additional groundwater outflow volumes of 970 AFY and 1,000 AFY did not include SWP water.

Projected Water Budget and Change in Groundwater Storage

Average groundwater inflows and outflows for the 2042 and 2072 projected periods are presented on Figure 3-69 and Figure 3-70, respectively. A summary of annual groundwater inflows and outflows are tabulated in Table 3-21 and Appendix E.

As discussed in Section 3.3.5.2, and consistent with the historical period, the projected water budget is dominated by groundwater pumping for agricultural irrigation. Consequently, on the inflow side of the water budget, there is an increase in agricultural irrigation return flow due to the increase in the volume of groundwater used for irrigation. The other inflow component, streamflow percolation, shows a notable increase even though a decrease in mountain front recharge and deep percolation of direct precipitation is projected from the BCM and VIC models. The increase in streamflow percolation likely results from a lowering of groundwater levels that creates an increased capacity for recharge in the aquifers.

Riparian ET is the second largest outflow component. This is consistent with the historical period and increases when applying future climatic factors from DWR for ET. Average annual precipitation for the projected period (using the 50-year base period described in Section 3.3.5.1 and DWR future climate factors) was calculated to be 3 percent greater than the historical period average annual precipitation for the 2042 projected period and equal to the historical period average for the 2072 projected period. As stated previously, the distribution of the precipitation throughout the year is projected to change.

The average annual groundwater inflow for the Basin is projected to increase by approximately 13 percent and 11 percent during the 2042 and 2072 projected periods, respectively, compared to the historical period. The average annual groundwater outflow is projected to increase by approximately 25 percent and 27 percent during the 2042 and 2072 projected periods, respectively, compared to the historical period. The average annual change in storage for the Basin is projected to decrease by approximately 44 percent and 53 percent during the 2042 and 2072 project periods, respectively, compared to the historical period.

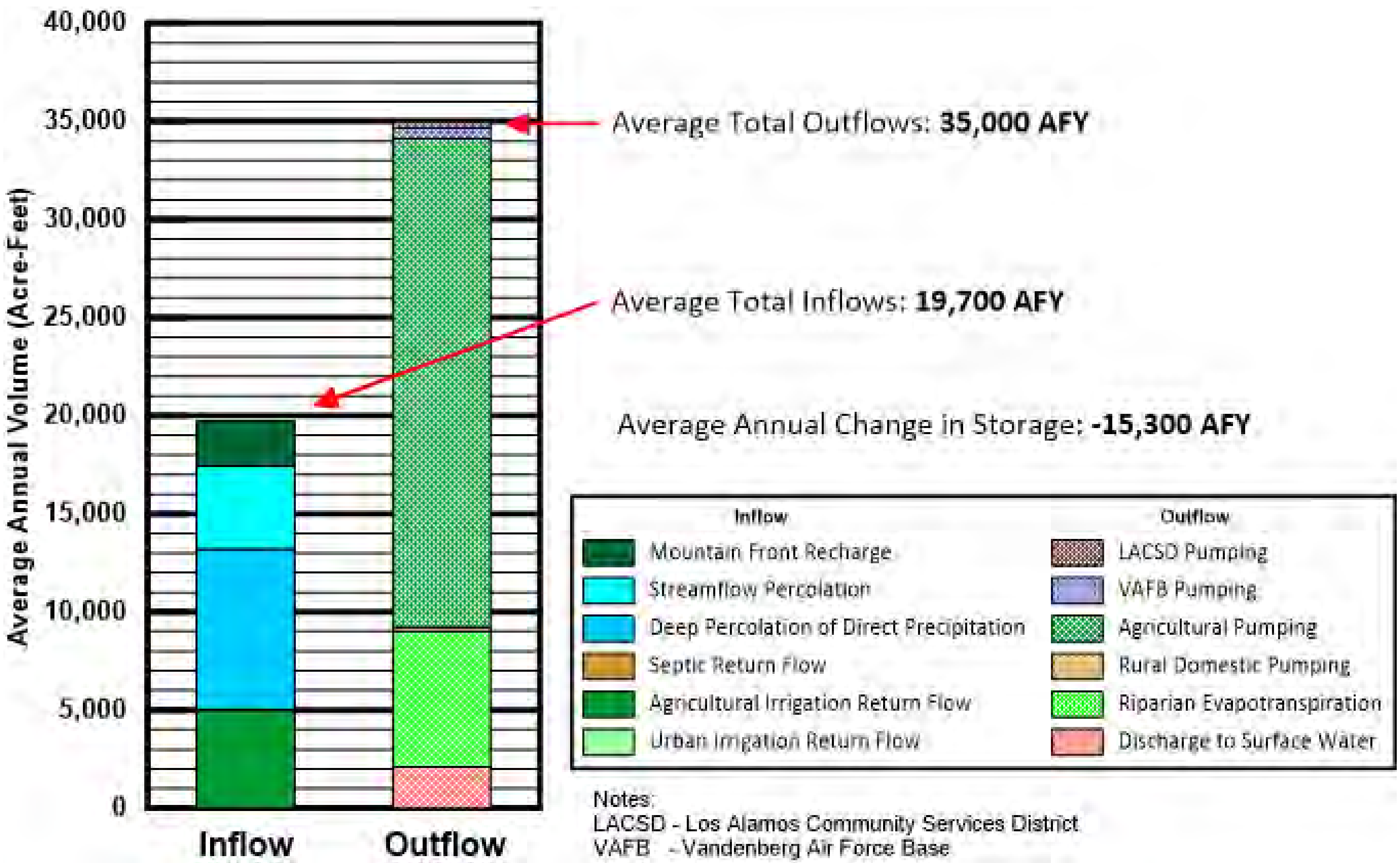

Figure 3-69. 2042 Projected Water Budget Average Volumes

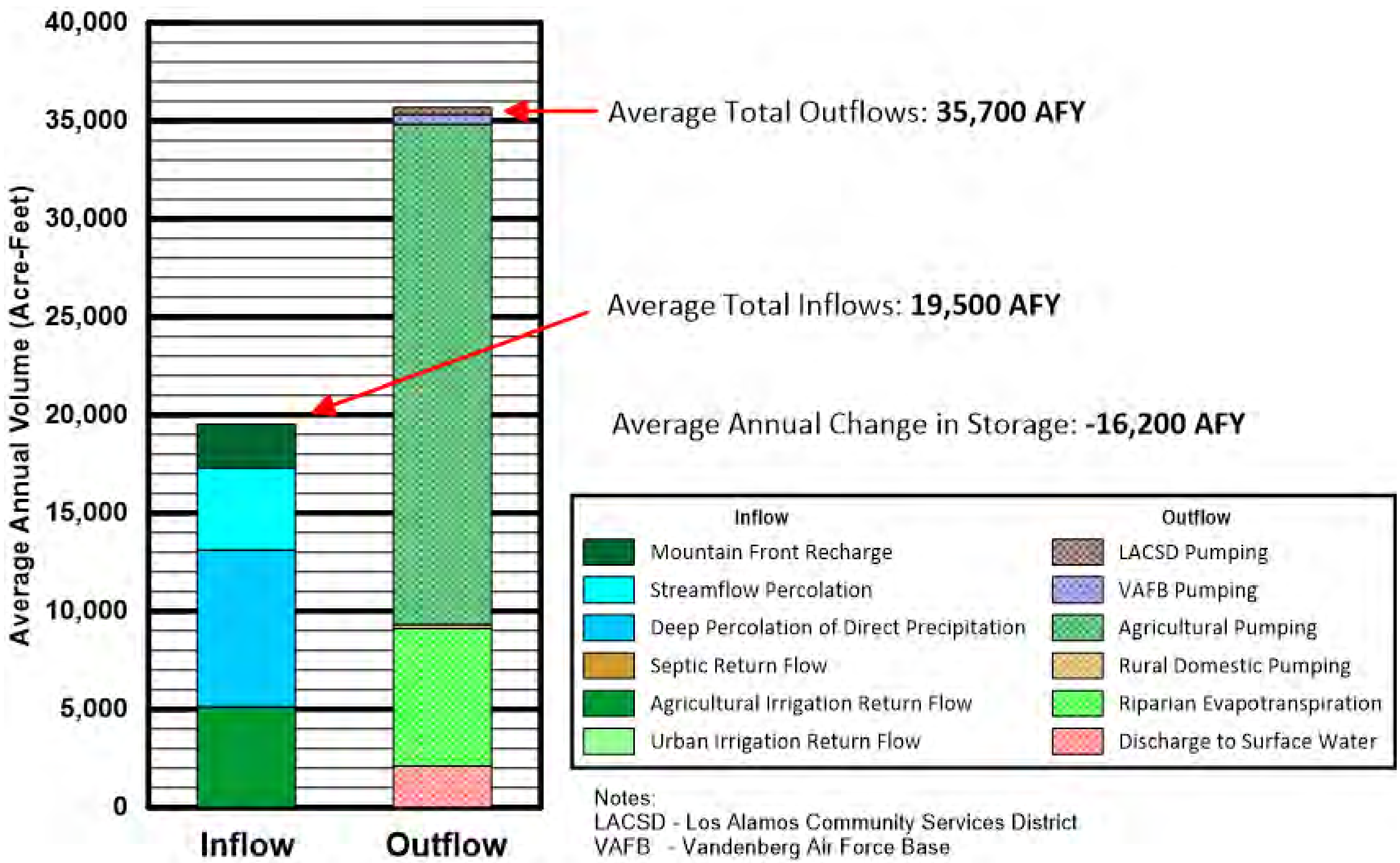

Figure 3-70. 2072 Projected Water Budget Average Volumes

Projected Water Levels in Barka Slough

As discussed in Section 3.2.1.3, the formation and continued existence of Barka Slough is largely due to surface water inflow and the upward flow (vertical hydraulic gradient) of groundwater from the underlying Careaga Sand through the Barka Slough sediments and becoming surface water or available to phreatophytes. Groundwater levels in wells near Barka Slough have decreased significantly over the period of record (40 ft in well 16C2 and 45 ft in well 16C4 from 1970 through 2019). This results in a decrease in the magnitude of the upward vertical groundwater gradient into the Slough, which equates to less upward flow of groundwater into the Slough. Figure 3-71 shows the reduction in vertical hydraulic gradient from nested groundwater wells 16C2 and 16C4 from 1970 through 2019. The cumulative departure from mean annual precipitation for the period from 1960 through 2019 is also shown on the figure.

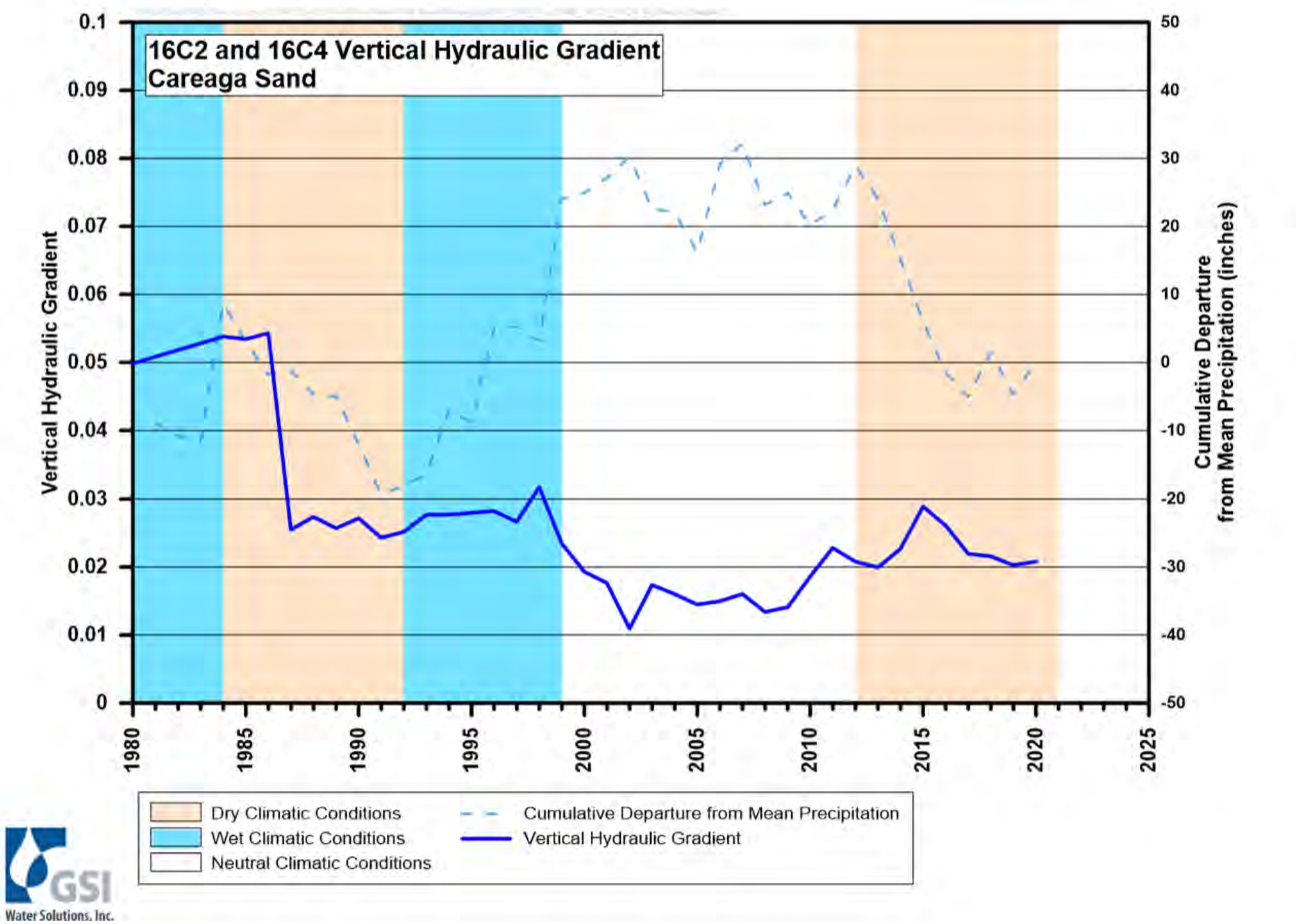

Figure 3-71. Vertical Hydraulic Gradient for Nested Groundwater Wells 16C2 and 16C4

The historical high vertical groundwater gradient of 0.07 was measured in 1982. The current vertical groundwater gradient is approximately 0.02. The vertical gradient has remained relatively stable after a sharp decline in the middle 1980s. Due to the depth of the wells and the location within the Basin, the vertical gradient response to periods of above-average rainfall is delayed. Without the use of a groundwater model and based on the available information, it is difficult to determine at what groundwater elevation the vertical hydraulic gradient in Barka Slough could reverse, causing groundwater to no longer discharge into Barka Slough. As discussed in Section 3.3.5.3, in response to climate change effects, the projected water budget indicates an annual average 5 percent increase in groundwater discharge to surface water at Barka Slough for the 2042 and 2072 projected water budgets and an 8 percent and 18 percent average annual increase in surface water discharge to Barka Slough for the 2042 and 2072 projected water budgets, respectively.

Basin Yield Estimate [§ 354.18(b)(7)]

§ 354.18 Water Budget.

(b) The water budget shall quantify the following, either through direct measurements or estimates based on data:

(7) An estimate of sustainable yield for the basin.

The projected groundwater budget indicates that total outflows relative to total inflows in the Basin increase over time and contribute to a chronic decrease of groundwater in storage. The projected average annual amount of groundwater in storage is estimated to decrease by approximately 44 percent and 53 percent during the 2042 and 2072 projected periods, respectively, compared to the historical period (as discussed in Section 3.3.5.3). A calculated annual volume for the projected basin yield of the Basin was estimated by adding the average groundwater storage deficit to the projected average annual volume of groundwater pumping for the 2042 and 2072 projected periods. The projected basin yield for the 2042 projected period is estimated to be 10,700 AFY, and 10,400 AFY for the 2072 projected period.

The estimated projected basin yield of 10,700 AFY and 10,400 AFY for the 2042 and 2072 projected periods, respectively, is 1,800 AFY and 1,500 AFY greater than the estimated basin yield for the historical period. This comparison of basin yield values between the historical and projected periods indicates that projected future climate change is expected to have an impact on the basin yield.

The primary reason that the average basin yield increases during the projected periods compared to the historical period—even coupled with the assumed climate change modifiers and increased projected groundwater pumping—is the increase in agricultural irrigation return flow and streamflow percolation.

3.3.6 Spreadsheet Tool Assumptions and Uncertainty

The GSP spreadsheet tool is based on available hydrogeologic and land use data from the past several decades, former studies of Basin hydrogeologic conditions, and the adjusted USGS BCM for the Basin. The GSP spreadsheet gives insight into how the complex hydrologic processes are operating in the Basin. Limited data sets and methodologies used by USGS for its Groundwater Study, and made available to the SABGSA, were incorporated into the spreadsheet tool to the extent practical. The spreadsheet tool is unable to model various scenarios of surface and groundwater processes and other time-variant processes that are occurring in the Basin.

Estimates of changes in groundwater in storage and sustainable yield made with the spreadsheet tool have uncertainty due to limitations in available data and assumptions made to develop the tool including, but not limited to, accuracy of publicly available spatial data, water use factors based on parcel size, thicknesses of geologic units to calculate hydraulic properties, irrigation return flow factors, and crop water duty factors. Uncertainty inherent in the spreadsheet tool has been considered in the development of management actions and projects discussed in Section 6. The results of the water budget analysis using the spreadsheet tool are sufficient to establish the magnitude of the annual and cumulative change in groundwater in storage. As a check on the validity of the change in groundwater in storage calculations using the water budget tool, GSI computed the change in storage by comparing water level elevation contour maps prepared for the years 2015 and 2018. The difference between the volume of groundwater represented by these two groundwater level surfaces multiplied by a basin storage coefficient (0.15 for the Paso Robles Formation and 0.001 for the confined portion [Barka Slough area] of the Careaga Sand) (Martin, 1985) results in a volume of groundwater removed from storage for the years between 2015 and 2018 equal to a deficit of approximately 83,800 AF. This results in approximately a 7 percent difference with the estimated change in storage using the spreadsheet water budget tool.

New data will be collected and/or refined throughout the early implementation of this GSP (after adoption by the SABGSA). The information will be used to recalculate volumes generated from the spreadsheet tool or as inputs into the model currently being calibrated for the Basin by USGS. New hydrologic data and an updated spreadsheet tool or calibrated model will be used in the future to evaluate the effectiveness of proposed or new management actions, and to monitor that progress toward the sustainability goal is being achieved.

3.4 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

AECOM. 2019. *Biological Assessment, Potential Effects to California Red-legged Frog, El Segundo Blue Butterfly, Tidewater Goby, Unarmored Threespine Stickleback, and Beach Layia, Vandenberg Dunes Golf Courses Project, Vandenberg Air Force Base, Santa Barbara County.* September 25.

Arroyo Seco Foundation. 2021. The Arroyo Chub. Retrieved from https://www.arroyoseco.org/arroyochub.htm. (Accessed November 3, 2021.)

Battany, M. 2019. *An Initial Estimate of a Water Duty Factor for Field-Grown CBD Hemp in the Paso Robles Area.* The University of California, working in cooperation with San Luis Obispo County and the U.S. Department of Agriculture. April 22, 2019.

California Department of Finance. 2020. E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2011-2021. Sacramento, California, May 2021.

California Department of Public Health. 2014. *Nitrate Fact Sheet.* Available at California State Water Resources Control Board website: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Nitrate.html. (Accessed August 5, 2021.)

Carlson, J. 2019. *Investigation of Pervasive Clay Layers and Their Effect on Groundwater Flow Using Electrical Resistivity Tomography in the San Antonio Groundwater Basin.* San Luis Obispo: California Polytechnic State University. June 2019.

CDFW. 2013. *La Graciosa Thistle* (Cirsium scariosum var. loncholepis). Prepared by the California Department of Fish and Wildlife (CDFW). Updated September 23, 2013. Available at https://wildlife.ca.gov/Conservation/Plants/Endangered/Cirsium-scariosum-var-loncholepis. (Accessed May 11, 2021).

County of Santa Barbara Public Works Department. No date. Daily Rainfall Data. Available at https://www.countyofsb.org/pwd/dailyrainfall.sbc. (Accessed September 1, 2020.)

CRCD. 2003. *San Antonio Creek Coordinated Resource Management Plan.* Prepared for the Central Coast Regional Water Quality Control Board. Prepared by the Cachuma Resource Conservation District (CRCD). December 2003.

Davis, T., M. Landon, and G. Bennett. 2018. *Prioritization of Oil and Gas Fields for Regional Groundwater Monitoring Based on Preliminary Assessment of Petroleum Resource Development and Proximity to California's Groundwater Resources.* Scientific Investigation Report 2018-5065.

Dibblee, T.W., Jr. and H.E. Ehrenspeck. 1989. *Geologic Map of the Casmalia and Orcutt Quadrangles, Santa Barbara County, California*. 1:24,000. Dibblee Foundation Map DF-24. Dibblee Geological Foundation.

Dibblee, T.W., Jr. and H.E. Ehrenspeck. 1993a. *Geologic Map of the Zaca Creek Quadrangle, Santa Barbara County, California*. 1:24,000. Dibblee Foundation Map DF-45. Dibblee Geological Foundation.

Dibblee, T.W., Jr. and H.E. Ehrenspeck. 1993b. *Geologic Map of the Los Alamos Quadrangle, Santa Barbara County, California*. 1:24,000. Dibblee Foundation Map DF-46. Dibblee Geological Foundation.

Dibblee, T.W., Jr., H.E. Ehrenspeck, and W.L. Bartlett. 1994. *Geologic Map of the Sisquoc Quadrangle, Santa Barbara County, California*. 1:24,000. Dibblee Foundation Map DF-53. Dibblee Geological Foundation.

DOC. 2020. California Department of Conservation (DOC), CalGEM, Well Finder. Retrieved from California Department of Conservation website: https://www.conservation.ca.gov/calgem/Pages/WellFinder.aspx. (Accessed August 5, 2021.)

Driscoll, F.G. *Groundwater and Wells, Second Edition*. (Saint Paul, Minnesota; Johnson Screens, 1986).

DWR. 2002. *Water Resources of the Arroyo Grande – Nipomo Mesa Area.* Southern District Report.

DWR. 2003. *California's Groundwater, Working Toward Sustainability: Bulletin 118, Central Coast Hydrologic Region, San Antonio Creek Valley Groundwater Basin.* Prepared by California Department of Water Resources (DWR).

DWR. 2016a. BMP 1 Monitoring Protocols Standards and Sites. Prepared by California Department of Water Resources (DWR).

DWR. 2016b. BMP 2 Monitoring Networks and Identification of Data Gaps. Prepared by California Department of Water Resources (DWR).

DWR. 2016c. *Best Management Practices for the Sustainable Management of Groundwater, Water Budget BMP.* December.

DWR. 2016d. *Best Management Practices for the Sustainable Management of Groundwater: Water Budget.* Prepared by the California Department of Water Resources Sustainable Groundwater Management Program.

DWR. 2016e. *Best Management Practices for the Sustainable Management of Groundwater: Modeling.* Prepared by the California Department of Water Resources Sustainable Groundwater Management Program.

DWR. 2018a. *3-014 San Antonio Creek Valley Basin Boundaries.* Prepared by the California Department of Water Resources.

DWR. 2018b. *Guidance Document for the Sustainable Management of Groundwater: Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development.* Prepared by the California Department of Water Resources Sustainable Groundwater Management Program.

DWR. 2020a. September. SGMA Data Viewer. Retrieved from California Department of Water Resources, SGMA Portal: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#landsub. (Accessed August 5, 2021.)

DWR. 2020b. NC Dataset Viewer. Retrieved from California Department of Water Resources GIS Application website: https://gis.water.ca.gov/app/NCDatasetViewer/. (Accessed September 2020.)

DWR. 2020c. *Draft Handbook for Water Budget Development, With or Without Models.* Prepared by the California Department of Water Resources.

DWR. No date. Well Completion Report Map Application. California Department of Water Resources Available at https://dwr.maps.arcgis.com/apps/webappviewer/index.html?id=181078580a214c0986e2da28f8623b37. (Accessed September 1, 2020.)

EPA. 1991. Title 40, Chapter I, Subchapter D, Part 141. *Control of Lead and Copper.* 56 Federal Register 26548, June 7, 1991. Prepared by the U.S. Environmental Protection Agency (EPA). Available at https://www.ecfr.gov/cgi-bin/text-idx?SID=9c5415b2fe8eb76878a169c14454171f&mc=true&node=sp40.25.141.i&rgn=div6. (Accessed August 5, 2021.)

EPA. 2018. *2018 Edition of the Drinking Water Standards and Health Advisories Tables.* EPA 822-F-18-001. Prepared by the U.S. Environmental Protection Agency, Office of Water.

Flint, L., and A. Flint. 2014. California Basin Characterization Model: A Dataset of Historical and Future Hydrologic Response to Climate Change. Version 1.1, May 2017.: U.S. Geological Survey Data Release: https://doi.org/10.5066/F76T0JPB.

GAMA. 2021. Groundwater Ambient Monitoring and Assessment (GAMA) Program County-Specific Data Download for County of Santa Barbara. Available at https://gamagroundwater.waterboards.ca.gov/gama/datadownload. (Accessed August 26, 2021.)

Gorelick, N., M. Hancher, M. Dixon, S. Ilyushchenko, D. Thau, and R. Moore. 2017. "Google Earth Engine: Planetary-scale Geospatial Analysis for Everyone." *Remote Sens. Environ.* Vol. 202, No.3. December 1, 2017.

Hamman, J.J., B. Nijssen, T.J. Bohn, D. R. Gergel, and Y. Mao. 2018. "The Variable Infiltration Capacity Model Version 5 (VIC-5): Infrastructure Improvements for New Applications and Reproducibility*." Geosci. Model Dev.* Vol. 11, 3481-96, https://doi.org/10.5194/gmd-11-3481-2018.

Hanson, B., S. Grattan, and A. Fulton. 2006. *Agriculture Salinity and Drainage. Division of Agriculture and Natural Resources Publication 3375.* University of California Irrigation Program, University of California, Davis. Revised 2006.

Huntington, J., K. Hegewisch, B. Daudert, C. Morton, J. Abatzoglou, D. McEvoy, and T. Erickson. 2017. "Climate Engine: Cloud Computing of Climate and Remote Sensing Data for Advanced Natural Resource Monitoring and Process Understanding." *Bull Amer Meteor* Vol. 98, No. 11. Available at http://journals.ametsoc.org/doi/abs/10.1175/BAMS-D-15-00324.1. (Accessed August 5, 2021.)

Hutchinson, C. B. 1980*. Appraisal of Ground-Water Resources in the San Antonio Creek Valley, Santa Barbara County, California.* U.S. Geological Survey Open-File Report 80-750.

Katherman Exploration Co., LLC. 2009. *Water Well Drilling Project, Hunter Four Deer Ranch, Los Alamos Area, Santa Barbara County, CA.* Prepared by Katherman Exploration Company, LLC. November 2009.

Klausmeyer K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. *Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report.* San Francisco, California.

Kofron, C.P., J. Langford, M. K. Skinner, C. Rutherford, and C. Darst. 2019. "Status of Endangered *La Graciosa* Thistle *Cirsium scariosum var. loncholepis (Asteraceae)* in Coastal Southern California." *Bulletin, Southern California Academy of Sciences* 118, No. 2, 111-38. September 18, 2019. Available at https://doi.org/10.3160/0038-3872-118.2.111. (Accessed August 5, 2021.)

LACSD. 2005. Water Well Drilling Log, Well #4. Los Alamos Community Services District. Record dated March 30, 2005.

LACSD. 2006a. State of California Well Completion Report, Well 5. Los Alamos Community Services District. November 18, 2006.

LACSD. 2006b. Well Construction and Testing Report for St. Joseph Street Well #5, Los Alamos Community Services District, Santa Barbara County. Prepared by Cleath & Associates. Prepared for Los Alamos Community Services District. December 13, 2006.

LACSD. 2010. State of California Well Completion Report, Well #3A. Los Alamos Community Services District. Record dated September 19, 2010.

LACSD. 2011. *Los Alamos Community Service District, Sewer System Management Plan.* Revised August 2017.

LACSD. 2017. Electric Gamma Ray Temperature Log, Reamed Borehole. Dated November 1, 2017. Prepared by Filipponi and Thompson Drilling for boredata. Prepared for Los Alamos Community Services District.

Lewis, D.C. and R.H. Burgy. 1964. "The Relationships Between Oak Tree Roots and Groundwater in Fractured Rock as Determined by Tritium Tracing." *J. Geophys. Res*., Vol. 69, No. 12, pp. 2579–88.

Liang, X, D.P. Lettenmaier, E.F. Wood, and S. J. Burges. 1994. "A Simple Hydrologically Based Model of Land Surface Water and Energy Fluxes for General Circulation Models." *J. Geophys. Res*., Vol. 99 No. D7. 14415–28, doi:10.1029/94JD00483.

Mallory, M. J. 1980. *Potential Effects of Increased Ground-Water Pumpage on Barka Slough, San Antonio Creek Valley, Santa Barbara County, California.* U.S. Geological Survey Water Resources Investigations Report 80-95.

Mann, J. 1968. *Concepts in Ground Water Management.* American Water Works Association, Vol. 60 No. 12, 1336–44.

ManTech. 2010. Wetlands and Riparian Habitats Management Plan, Vandenberg Air Force Base, California. Prepared for 30th Space Wing Asset Management Flight, Vandenberg Air Force Base. Prepared by ManTech SRS Technologies, Inc.

Martin, P. 1985. *Development and Calibration of a Two-Dimensional Digital Model for the Analysis of the Ground-Water Flow System in the San Antonio Creek Valley, Santa Barbara County, California.* U.S. Geological Survey Water-Resources Investigations Report 84-4340.

Maxar. 2020. Base maps for California. Provided by Maxar Imagery.

Meridian Consultants. 2012. *City of Solvang Water System Master Plan Update Environmental Impact Report.* Prepared by Meridian Consultants, LLC. June 2012.

Muir, K. S. 1964. *Geology and Ground-Water of San Antonio Creek Valley, Santa Barbara County, California.* U.S. Geological Survey Water-Supply Paper 1664.

NASA JPL. 2018. InSar Land Surveying and Mapping Services in Support of the DWR SGMA Program Technical Report. Provided by the National Aeronautics and Space Administration Jet Propulsion Laboratory (NASA JPL).

O'Geen A., M. Saal, H. Dahlke, D. Doll, R. Elkins, A. Fulton, G. Fogg, T. Harter, J. Hopmans, C. Ingels, F. Niederholzer, S. S. Sandoval, P. Verdegaal, M. Walkinshaw. 2015. "Soil Suitability Index Identifies Potential Areas for Groundwater Banking on Agricultural Lands." *Calif Agr* Vol. 69 No. 2: 75-84. https://doi.org/10.3733/ca.v069n02p75.

Rohde, M. M., B. Seapy, R. Rogers, X. Castañeda, editors. 2019. *Critical Species LookBook: A Compendium of California's Threatened and Endangered Species for Sustainable Groundwater Management.* Published by The Nature Conservancy. San Francisco, California.

Rohde, M. M., S. Matsumoto, J. Howard, S. Liu, L. Riege, and E. J. Remson. 2018. *Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans.* Published by The Nature Conservancy. San Francisco, California.

SAGBI. No date. Soil Agricultural Groundwater Banking Index. Provided by the California Soil Resource Lab at University of California (UC) Davis and the UC Agricultural and Natural Resources Department. Available at https://casoilresource.lawr.ucdavis.edu/sagbi/. (Accessed September 1, 2020.)

Santa Barbara County. 2020. *Agricultural Commissioner, Weights and Measures Department.* Retrieved January 22, 2021, from Santa Barbara County: https://cosantabarbara.app.box.com/s/jdt95fy7gst3g8649l9t3ukrorr5xeh9/folder/109007441066. April 1, 2020.

SBCAG. 2007. *Regional Growth Forecast 2005-2040*. Prepared by the Santa Barbara County Association of Governments. http://www.sbcag.org/uploads/2/4/5/4/24540302/regionalgrowthforecastcomplete_final.pdf. August 2007.

Sweetkind, D., M. Tennyson, V. Langenheim, and L. Shumaker. 2010. *Digital Tabulation of Stratigraphic Data from Oil and Gas Wells in the Santa Maria Basin and Surrounding Area, Central California Coast.* U.S. Geological Survey Open-File Report 2010-1129.

Swift, C.C., P. Duangsitti, C. Clemente, K. Hasserd, and L. Valle. 1997. *Final Report: Biology and Distribution of the Tidewater Goby, Eucyclogobius newberryi, on Vandenberg Air Force Base, Santa Barbara County, California.* Published under Cooperative Agreement 1445-007-94-8129 between U.S. National Biological Services, San Simeon, California, and Loyola Marymount University, Los Angeles, California.

SWRCB. 2011. *Division of Water Rights Final Environmental Impact Report, Consideration of Modifications to the U.S. Bureau of Reclamation's Water Right Permits 11308 and 11310 (Applications 11331 and 11332) to Protect Public Trust Values and Downstream Water Rights on the Santa Ynez River below Bradbury Dam (Cachuma Reservoir).* State Clearinghouse #1999051051. Prepared by the State Water Resources Control Board. December 2011.

SWRCB. 2017a. *Groundwater Information Sheet - Salinity.* Prepared by the California State Water Resources Control Board Division of Water Quality Groundwater Ambient Monitoring & Assessment (GAMA) Program. October 2017.

SWRCB. 2017b. *Groundwater Information Sheet - Arsenic.* Prepared by the California State Water Resources Control Board Division of Water Quality Groundwater Ambient Monitoring & Assessment (GAMA) Program. October 2017.

SWRCB. 2018. *Secondary Drinking Water Standards.* Prepared by the California State Water Resources Control Board Division of Water Quality Groundwater Ambient Monitoring & Assessment (GAMA) Program. October 2017.

SWRCB. 2019. *Water Quality Control Plan for the Central Coastal Basin.* Prepared by the California State Water Resources Control Board Division of Water Quality. June 2019.

SWRCB. 2020a. Geotracker. Retrieved from California State Water Resources Control Board website: https://geotracker.waterboards.ca.gov/. (Accessed August 5, 2021.)

SWRCB. 2020b. *MCLs, DLRs, PHGs, for Regulated Drinking Water Contaminants.* Prepared by the California State Water Resources Control Board. August 2020. Available at https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/mclreview/mcls_dlrs_phgs.pdf. (Accessed August 5, 2021.)

SYRWCD. 2010. Groundwater Production Information and Instructions Pamphlet. Prepared by the Sant Ynez River Water Conservation District. June 2010.

Tetra Tech. 2010. *Assessment of Groundwater Availability on the Santa Ynez Chumash Reservation.* March.

TNC. 2019. *Identifying GDEs Under SGMA, Best Practices for Using the NC Dataset.* Prepared by The Nature Conservancy (TNC). July 2019.

TNC. 2020. Groundwater Resource Hub: GDE Rooting Depths Database. Prepared by The Nature Conservancy (TNC). Available at https://groundwaterresourcehub.org/sgma-tools/gde-rooting-depths-database-for-gdes/. (Accessed August 5, 2021.)

Towill, Inc. 2020*. InSar Data Accuracy for California Groundwater Basins, CGPS Data Comparative Analysis, January 2015 to September 2019.* Prepared for the California Department of Water Resources. March 23, 2020.

TRE ALTAMIRA, Inc. 2020. *InSar Land Surveying and Mapping Services in Support of the DWR SGMA Program Technical Report.* March 2020.

UNAVCO. 2020a. *UNAVCO Instrumentation Networks Map.* Retrieved September 29, 2020, from UNAVCO website: https://www.unavco.org/instrumentation/networks/map/map.html.

UNAVCO. 2020b. September. ORES - Overview | Station Page. Retrieved from UNAVCO website: https://www.unavco.org/instrumentation/networks/status/nota/overview/ORES. (Accessed August 5, 2021).

USDA. 2007. Chapter 7, "Hydrologic Soil Groups" in *National Engineering Handbook, Part 630 Hydrology.* U.S. Department of Agriculture, Natural Resources Conservation Service.

USDA. 2009. *Vegetation Descriptions, South Coast and Montane Ecological Province, CALVEG Zone 7.* Prepared by the United States Department of Agriculture (USDA), Forest Service. March 30, 2009.

USDA. 2020. Web Soil Survey. Retrieved from https://websoilsurvey.nrcs.usda.gov/. (Accessed July 20, 2020.)

USFWS. 2021a. ECOS Environmental Conservation Online System, Southwestern willow flycatcher (*Empidonax traillii extimus*). U.S. Fish and Wildlife Service. Retrieved from https://ecos.fws.gov/ecp/species/6749. (Accessed November 3, 2021.)

USFWS. 2021b. ECOS Environmental Conservation Online System, Least Bell's vireo (*Vireo bellii pusillus*). U.S. Fish and Wildlife Service. Retrieved from https://ecos.fws.gov/ecp/species/5945. (Accessed November 3, 2021.)

USFWS. 2021c. IPaC Information for Planning and Consultation. U.S. Fish and Wildlife Service. Retrieved from https://ecos.fws.gov/ipac/. (Accessed November 3, 2021.)

USFWS. 2021d. ECOS Environmental Conservation Online System, Steelhead (Oncorhynchus (=Salmo) mykiss). U.S. Fish and Wildlife Service. Retrieved from https://ecos.fws.gov/ecp/species/1007. (Accessed November 3, 2021.)

USGS. 2020a. StreamStats: Streamflow Statistics and Spatial Analysis Tools for Water-Resources Applications. Available at the U.S. Geological Survey website: https://www.usgs.gov/mission-areas/water-resources/science/streamstats-streamflow-statistics-and-spatial-analysis-tools?qt-science_center_objects=0#qt-science_center_objects. (Accessed August 5, 2021.)

USGS. 2020b. The National Map, Data Download and Visualization Services. NHDPlus High Resolution Data Model v1.0. Provided by the U.S. Geological Survey. Available at https://www.usgs.gov/media/files/nhdplus-high-resolution-data-model-v10. (Accessed August 5, 2021.)

USGS. 2020c. *San Antonio Creek Geohydrologic Framework Model.* Prepared by the U.S. Geological Survey (USGS). Available at https://ca.water.usgs.gov/projects/san-antonio-creek/san-antonio-creek-geologic-hydrologic-model.html. (Accessed August 5, 2021.)

USGS. 2020d. *California Water Science Center, Sustainable Groundwater, Interconnected Surface-Water Depletion.* Retrieved from USGS website: https://ca.water.usgs.gov/sustainable-groundwater-management/interconnected-surface-water-depletion.html. (Accessed August 5, 2020.)

USGS. 2020e. San Antonio Creek Valley Groundwater Basin Land Use Spatial Data. April 27, 2020.

USGS. 2020f. Surface-Water Data for the Nation. National Water Information System, U.S. Geologic Survey (USGS). Available at https://waterdata.usgs.gov/nwis/sw. (Accessed September 1, 2020.)

USGS. 2020g. Locations of Springs and Seeps. Data package provided by U.S. Geologic Survey (USGS).

USGS. 2021a. "San Antonio Creek Groundwater Availability Study: Hydrogeologic Characterization and Integrated Hydrologic Model." Presented at the March 19, 2021, San Antonio Creek Communication Meeting. Available at https://ca.water.usgs.gov/projects/san-antonio-creek/. (Accessed August 5, 2021.)

USGS. 2021b. NAS – Nonindigenous Aquatic Species. Gila orcuttii (Arroyo Chub). Retrieved from https://nas.er.usgs.gov/queries/SpecimenViewer.aspx?SpecimenID=28195. (Accessed November 3, 2021.)

VAFB. 2020. Vandenberg AFB – San Antonio Wells – Production, 1964–2020. Prepared by Vandenberg Air Force Base (VAFB).

Woolfenden L., J.A. Engott, J.D. Larsen, and G. Cromwell. 2021. *Preliminary Simulation of Groundwater and Surface-Water Resources of the San Antonio Creek Valley Watershed, Santa Barbara County, California. Groundwater Availability and Use Assessments.* Groundwater Availability and Use Assessments. Prepared in Cooperation with Santa Barbara County Water Agency and Vandenberg Air Force Base. Prepared by the U.S. Geological Survey, Sacramento, California.

SECTION 4: **Sustainable Management Criteria [Article 5, Subarticle 3]**

§ 354.22 Introduction to Sustainable Management Criteria. This Subarticle describes criteria by which an Agency defines conditions in its Plan that constitute sustainable groundwater management for the basin, including the process by which the Agency shall characterize undesirable results, and establish minimum thresholds and measurable objectives for each applicable sustainability indicator.

This section defines the conditions that constitute sustainable groundwater management and discusses the process by which the San Antonio Basin Groundwater Sustainability Agency (SABGSA) will characterize undesirable results and establish minimum thresholds and measurable objectives for each sustainability indicator in the San Antonio Creek Valley Groundwater Basin (Basin).

Section 4 presents the data and methods used to develop sustainable management criteria (SMCs) and demonstrate how these criteria influence beneficial uses and users. The SMCs presented in this section are based on currently available data and application of the best available science. As noted in this Groundwater Sustainability Plan (GSP), data gaps exist in the hydrogeologic conceptual model. Uncertainty caused by these data gaps was considered when developing the SMCs. These SMCs are considered initial criteria and will be reevaluated, at a minimum of once every 5 years during GSP interim periods, and potentially modified as new data become available.

The SMCs are grouped by sustainability indicator. The following five sustainability indicators are applicable in the Basin:

- Chronic lowering of groundwater levels
- Reduction of groundwater in storage
- Degraded groundwater quality
- Land subsidence
- Depletion of interconnected surface water

The sixth SMC, seawater intrusion, is not applicable in the Basin.

To retain a consistent and organized approach, this section follows the same format for each sustainability indicator. The description of each SMC includes all the information required by § 354.22 et seq. of the Sustainable Groundwater Management Act (SGMA) regulations and outlined in the California Department of Water Resources (DWR) SMC best management practice (BMP) guidance (DWR, 2017), including the following:

- How the definition of what might constitute significant and unreasonable conditions was developed
- How minimum thresholds were developed, including the following:
  - The information and methodology used to develop minimum thresholds (§ 354.28 (b)(1))
  - The relationship between minimum thresholds and each sustainability indicator (§ 354.28 (b)(2))
  - The effect of minimum thresholds on neighboring basins (§ 354.28 (b)(3))
  - The effect of minimum thresholds on beneficial uses and users (§ 354.28 (b)(4))
  - How minimum thresholds relate to relevant federal, state, or local standards (§ 354.28 (b)(5))

  - The method for quantitatively measuring minimum thresholds (§ 354.28 (b)(6))
- How measurable objectives and interim milestones were developed, including the following:
  - The methodology for setting measurable objectives (§ 354.30)
  - The methodology for setting interim milestones (§§ 354.30 (a), 354.30 €, and 354.34 (g)(3))
- How undesirable results were developed, including:
  - The criteria defining when and where the undesirable effects (potential effects on beneficial uses and users of groundwater as described by the sustainability indicators) cause undesirable results (when the effects are significant and unreasonable), based on a quantitative description of the combination of minimum threshold exceedances (§ 354.26 (b)(2))
  - The potential causes of undesirable results (§ 354.26 (b)(1))
  - The effects of these undesirable results on the beneficial users and uses (§ 354.26 (b)(3))

4.1 Definitions

The SGMA legislation and regulations include a number of new terms relevant to the SMCs. These terms below use the definitions in the SGMA regulations (§ 351, Article 2). Where appropriate, additional explanatory text is added in italics. This explanatory text is not part of the official definitions of these terms. To the extent possible, plain language, with only a limited use of highly technical terms and acronyms, was used to assist as broad an audience as possible in understanding the development process and implications of the SMCs.

Groundwater-dependent ecosystem (GDE) refers to habitat, plant communities, and aquatic and terrestrial species that rely on surface or near surface water that is supported by groundwater.

Interconnected surface water refers to surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer. Interconnected surface waters are parts of streams, lakes, or wetlands where the groundwater table is close enough to the ground surface to influence water in the lakes, streams, or wetlands or vice versa.

Interim milestone refers to a target value representing measurable groundwater conditions, in increments of 5 years, set by a Groundwater Sustainability Agency (GSA or Agency) as part of a Groundwater Sustainability Plan (Plan or GSP). Interim milestones are targets such as groundwater levels that will be achieved every 5 years to demonstrate progress towards sustainability.

Management area (MA) refers to an area within a basin for which the Plan may identify different minimum thresholds, measurable objectives, monitoring, or projects and management actions based on differences in water use sector, water source type, geology, aquifer characteristics, or other factors.

Measurable objectives (MOs) refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the basin. Measurable objectives are goals that the Plan is designed to achieve.

Minimum thresholds (MTs) refer to numeric values for each sustainability indicator that are used to define undesirable results. Minimum thresholds are established at representative monitoring sites. Minimum thresholds are defined when an unreasonable condition might occur. For example, a particular groundwater level might be a minimum threshold if lower groundwater levels would result in a significant and unreasonable reduction of groundwater in storage.

Representative monitoring site (RMS) refers to a monitoring site within a broader network of sites that typifies one or more conditions within the basin or an area of the basin.

Sustainability indicator refers to the set of six conditions defined by the DWR that may be present in a basin that may result in effects, when significant and unreasonable, that cause undesirable results (defined below), and impact sustainability of the basin as described in California Water Code § 10721(x).

Uncertainty refers to a lack of understanding of the basin setting that significantly affects the Agency's[37] ability to develop SMCs and appropriate projects and management actions in the Plan,[38] or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed.

Undesirable result refers to the definition provided in § 10721 of SGMA, which states that:

> "*Undesirable result means one or more 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 if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.*
>
> *(2) Significant and unreasonable reduction of groundwater storage.*
>
> *(3) Significant and unreasonable seawater intrusion.*
>
> *(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.*
>
> *(5) Significant and unreasonable land subsidence that substantially interferes with surface land uses.*
>
> *(6) Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.*"

Section 354.26 of the SGMA regulations states that "The criteria used to define when and where the effects of the groundwater conditions cause undesirable results shall be based on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin."

[37] The SABGSA is the Agency referred to in this definition.
[38] The San Antonio Creek Valley Groundwater Basin GSP is the Plan referred to in this definition.

4.2 Sustainability Goal [§ 354.24]

§ 354.24 Sustainability Goal. Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

Per § 354.24 of the SGMA regulations, the sustainability goal for the Basin has three parts:

- A description of the sustainability goal
- A discussion of the measures that will be implemented to ensure the Basin will be operated within sustainable yield
- An explanation of how the sustainability goal is likely to be achieved

Sustainability Goal: The goal of this GSP is to sustainably manage the groundwater resources of the Basin for current and future beneficial uses of groundwater, including Barka Slough (Slough), through an adaptive management approach that builds on best available science and monitoring and considers economic, social, and other objectives of Basin stakeholders. This goal was developed with input from Basin stakeholders. It takes into consideration the need to maintain a vibrant agricultural community while ensuring that domestic and environmental water uses are protected. As discussed in Section 3 of the GSP, the GSA recognizes that the observed water level declines and chronic storage deficit are undesirable. The GSA is committed to implementing a number of projects and management actions, including a pumping allocation program, after the GSP is adopted (see Section 6) that will result in basin pumping within the sustainable yield and avoidance of undesirable results within the next 20 years. The GSP includes plans to fill critical data gaps and an extensive monitoring program (see Section 5) that addresses each of the applicable sustainability indicators. Minimum thresholds, measurable objectives, and interim milestones have been established to measure sustainability and to assess progress toward meeting the sustainability goal over the next 20 years. This GSP is intended to be an adaptive plan that allows for consideration of observed basin conditions and adaptive management actions through the planning horizon.

4.2.1 Qualitative Objectives for Meeting Sustainability Goals

Qualitative objectives are designed to help stakeholders understand the overall purpose for sustainably managing groundwater resources (e.g., Avoid Chronic Lowering of Groundwater Levels) and reflect the local economic, social, and environmental values within the Basin. A qualitative objective is often compared to a mission statement. The qualitative objectives for the Basin are the following:

- **Avoid Chronic Lowering of Groundwater Levels**
  - Maintain groundwater levels that continue to support current and future groundwater uses and sustain the health of Barka Slough in the Basin.
- **Avoid Chronic Reduction of Groundwater in Storage**
  - Maintain sufficient groundwater volumes in storage to sustain current and planned groundwater use in prolonged drought conditions while avoiding impacts to Barka Slough resulting from groundwater pumping.

- **Avoid Degraded Groundwater Quality**
  - Maintain access to drinking water supplies.
  - Maintain access to agricultural water supplies.
  - Maintain quality consistent with current ecosystem uses.
- **Avoid Land Subsidence**
  - Prevent land subsidence that causes significant and unreasonable effects to groundwater supply, land uses, infrastructure, and property interests.
- **Avoid Depletion of Interconnected Surface Water**
  - Avoid significant and unreasonable effects to beneficial uses, including GDEs, caused by groundwater extraction.
  - Maintain sufficient groundwater levels to maintain areas of interconnected surface water as of January 2015 when SGMA was enacted.
- **Avoid Seawater Intrusion**
  - Not applicable due to the inland location of the Basin.

4.3 Process for Establishing Sustainable Management Criteria [§ 354.26(a)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

This section presents the process that was used to develop the SMCs for the Basin, including input obtained from Basin stakeholders, the criteria used to define undesirable results, and the information used to establish minimum thresholds and measurable objectives.

4.3.1 Public Input

The public input process was developed in conjunction with the SABGSA member agency's continued engagement of local stakeholders and interested parties on water issues. This included the formation of the Stakeholder Advisory Committee (SAC), whose members were selected by the SABGSA Board because members have an interest in maintaining a healthy agricultural and business community, good water quality, and a healthy environment. The SMCs and beneficial uses presented in this section were developed using a combination of information from public input, public meetings, comment forms, hydrogeologic analysis, and meetings with SAC members.

The general process for establishing SMCs included the following:

- Holding a series of SAC meetings and workshops that outlined the GSP development process and introduced stakeholders to SMCs.

- Conducting public meetings to present initial conceptual minimum thresholds and measurable objectives and receive additional public input. Three virtual meetings on SMCs were held.[39]

4.3.2 Criteria for Defining Undesirable Results [§ 354.26(b)(2) and (d), (b)(3)]

§ 354.26 Undesirable Results.

(b) The description of undesirable results shall include the following:

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

(3) Description of potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

Section 4.2.1 discusses the qualitative objectives for meeting sustainability goals. These goals were discussed in terms of avoiding undesirable results for each of the sustainability indicators. The general criteria used (conjunctively) to define undesirable results in the Basin are as follows:

- There must be significant and unreasonable effects caused by pumping
- A minimum threshold is exceeded in a specified number of representative monitoring sites over a prescribed period
- Significant and unreasonable impacts to beneficial uses occur, including to GDEs and/or threatened or endangered species

These criteria may be refined during the 20-year GSP implementation period based on monitoring data and analysis.

[39] See https://sanantoniobasingsa.org/meeting-agendas/ for details on the meetings and workshops.

4.3.3 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives [§ 354.28(b)(1),(c)(1)(A)(B), a€(e)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(A) The rate of groundwater elevation decline based on historical trend, water year type, and projected water use in the basin.

(B) Potential effects on other sustainability indicators.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

The following information and data were used to establish minimum thresholds and measurable objectives for each of the sustainability indicators.

4.3.3.1 Avoid Chronic Lowering of Groundwater Levels

The information used for establishing the minimum thresholds and measurable objectives that pertain to chronic lowering of groundwater levels includes the following:

- Information gathered from the public meetings about the public's perspective of significant and unreasonable conditions and preferred current and future groundwater levels
- Historical groundwater level data plotted versus time from wells monitored by the U.S. Geological Survey (USGS), Los Alamos Community Services District (LACSD), Vandenberg Space Force Base (VSFB), and other agencies
- Depths and locations of existing wells
- Maps of current and historical groundwater level data
- Mapping of the location and types of GDEs
- Analysis of the potential for lowered groundwater levels to impact municipal, domestic, and agricultural wells (see Section 3.2)

- An historical and projected future water budget for the Basin (see Section 3.3), including determination of water year types, used to estimate the magnitude of annual storage reduction that has already occurred and may occur in the future, and to estimate the amount of pumping that can be sustained annually.

The monitoring network and protocols that will be used to measure groundwater levels at the RMSs are presented in Section 5. The data will be used to monitor groundwater levels and assess changes of groundwater in storage as discussed below.

4.3.3.2 Avoid Chronic Reduction of Groundwater in Storage

Groundwater levels can be used as a surrogate for assessing changes in groundwater in storage and evaluating whether basin-wide total groundwater withdrawals could lead to undesirable results. Therefore, the information that is used to establish minimum thresholds and measurable objectives for the chronic groundwater level decline sustainability indicator can also be used to avoid chronic reduction of groundwater in storage.

4.3.3.3 Avoid Degraded Groundwater Quality

The information used for assessing degraded groundwater quality thresholds includes the following:

- Historical groundwater quality data from wells in the Basin
- Municipal drinking water supply wells (LACSD and VSFB wells) via the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) compliance monitoring program
- Domestic and irrigation wells via the SWRCB Irrigated Lands Regulatory Program (ILRP) and USGS National Water Information System (NWIS)
- Observation wells via the USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program and SWRCB GeoTracker database
- Federal and state drinking water quality standards (SWRCB, 2019) and Basin water quality objectives (WQOs) presented in the Water Quality Control Plan for the Central Coastal Basin (Basin Plan) (RWQCB, 2019)
- Feedback about significant and unreasonable conditions from the SABGSA members and the public

The historical groundwater quality data used to establish thresholds are presented in Section 3.2.3.

Thresholds for contaminants (e.g., volatile organic compounds) are not proposed because assessment, source identification, and cleanup of these constituents of concern are regulated under the authority of state agencies, including the Central Coast Regional Water Quality Control Board (RWQCB). The SABGSA does not have the responsibility nor the authority to manage contaminants. It is, however, the responsibility of the SABGSA to ensure concentrations, if any, of these constituents present in groundwater prior to the enactment of SGMA in January 2015 are not increased as a result of pumping or actions taken by the SABGSA. Elevated concentrations of salts and nutrients (e.g., total dissolved solids [TDS], sulfate, chloride, and nitrate) can impact beneficial uses, including drinking water and agricultural uses. Thus, minimum thresholds and measurable objectives are proposed for these constituents in accordance with the Basin Plan.

4.3.3.4 Avoid Land Subsidence

Minimum thresholds for subsidence were established to protect groundwater supply, land uses, infrastructure, and property interests from substantial subsidence that may lead to undesirable results. Changes in ground surface elevation are presently measured using Interferometric Synthetic Aperture Radar (InSAR) data available from DWR and the University NAVSTAR Consortium (UNAVCO) Continuous Global Positioning System (CGPS) ORES, located in the town of Los Alamos, near Los Alamos Park. The general minimum threshold is the absence of long-term land subsidence arising from groundwater pumping in the Basin. Section 3.2.4 includes a detailed discussion of the InSAR data provided by DWR and the measured land subsidence data collected by the UNAVCO CGPS.

As described in Section 3.1 of the GSP, the principal aquifers in the Basin include the Paso Robles Formation and the Careaga Sand. The Paso Robles Formation contains stream-deposited lenticular beds of sand, gravel, silt and clay; however, the fine-grained material that would be subject to subsidence are not laterally continuous, which tends to reduce the likelihood for significant subsidence. Total subsidence recorded by the UNAVCO station located in Los Alamos during the 20-year period of record (2000 to 2020) indicates a land subsidence rate of approximately 0.49 inches per year. There have been no reports from landowners of impacts resulting from subsidence.

To supplement the InSAR and UNAVCO data, an analysis of the potential for land subsidence was conducted by GEI Consultants and is summarized in Section 3.2.4 and presented in Appendix D. The analysis includes an assessment of the soils and geology in this Basin and the degree to which they would be subject to subsidence and an assessment of the potential for significant and unreasonable subsidence to occur as a result of projected changes in future groundwater levels.

4.3.3.5 Avoid Depletion of Interconnected Surface Water

The information used for establishing minimum thresholds and measurable objectives for depletion of interconnected surface water includes the following:

- Available stream gage data for Harris Canyon Creek and San Antonio Creek
- Groundwater levels measured in shallow wells near Barka Slough, including multi-level completion wells, that indicate changes in vertical gradients that affect groundwater flow into the Slough
- Water budget computations used to estimate exchanges between surface water and groundwater at the Slough during historical and projected future time frames
- Studies and analysis that identify the extent and distribution of GDEs
- Public input

4.3.4 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Section 354.28 of the SGMA regulations requires that the description of all minimum thresholds include a discussion about the relationship between the minimum thresholds for each sustainability indicator. In its BMP guidance for SMCs (DWR, 2017), DWR has clarified this requirement. First, the GSP must describe the relationship between each sustainability indicator's minimum threshold; in other words, describe why or how a groundwater level minimum threshold established at a particular RMS is similar to or different from groundwater level thresholds in nearby RMSs. Second, the GSP must describe the relationship between the selected minimum threshold and minimum thresholds for other sustainability indicators. For example, the GSP must describe how a groundwater level minimum threshold for chronic lowering of groundwater levels, if reached, would not trigger an undesirable result for land subsidence (because it had a more conservative threshold).

4.4 Representative Monitoring Sites

Minimum thresholds and measurable objectives are established at RMSs (also referred to as representative wells) that are deemed to be representative of local and basin-wide groundwater conditions in each principal aquifer. Representative wells were selected from a subset of the wells that have been monitored over time in the Basin and have the following characteristics:

- They have known well completion information and are screened exclusively within either the Paso Robles Formation or the Careaga Sand.
- They are spatially distributed to provide information across most of the Basin.
- They have a reasonably long record of data (period of record) so that trends can be determined.
- They have signatures (groundwater levels or water quality trends) that are representative of wells in the surrounding area.

See Section 5 for a detailed discussion of the rationale for selecting RMSs and Figure 3-11 for a map of their locations. In summary, the RMS network for groundwater level consists of 15 wells (8 wells in the Paso Robles Formation and 7 wells in the Careaga Sand) that will be used to help identify chronic reductions in groundwater levels and storage. One representative well is an observation well located adjacent to Barka Slough in the vicinity of the VSFB wellfield near the west end of the Basin. One well is a municipal drinking water supply well operated by the LACSD. Five are production wells used for agricultural irrigation. While not ideal for use as a monitoring well, these five production wells are currently included as RMSs because of their location in the Basin, available well construction data, and a long period of record. These five wells have been matched individually with nearby observation wells (non-pumping wells) that provide comparable spatial coverage of the Basin and have known well construction and aquifer completion data, but do not have a long period of record. Therefore, the five sets of paired wells will continue to be monitored until the period of record for the observation wells is adequate to identify trends in groundwater elevations and confirm the observation wells are representative of the pumping well to be eventually replaced in the monitoring program.

Minimum thresholds and measurable objectives have been established at these RMSs using measured groundwater elevation data and water quality data where available. Barka Slough is a GDE that receives both surface water and groundwater discharging from the underlying Careaga Sand. It is apparent that there is a connection between Basin groundwater levels and the Slough; however, there is considerable uncertainty about how much lower groundwater levels can go in the Basin without causing significant and unreasonable impacts to the Slough. Additional characterization of the nature, type, and extent of the GDEs in the Slough, installation of surface water gages in the east and west end of the Slough, and evaluation of the Slough water budget and effects of the water level minimum thresholds on surface water depletion using the USGS groundwater model, when it is available, would significantly improve understanding of this dynamic. These actions are described in Section 6. For the interim, a minimum threshold for surface water depletion will be established based on measured flow leaving the Slough (measured at the Casmalia stream gage).

Two additional areas with interconnected surface water and associated GDEs were identified in the Basin based on observations from a local landowner, the Natural Communities data set (DWR, 2020), and the Cachuma Resource Conservation District (CRCD, 2003) (see Section 3.2.6). The Price Ranch seep is located northeast of Los Alamos on Price Ranch. Another area is located in the Las Flores watershed, a tributary to San Antonio Creek, in the low-lying grassland areas immediately west of U.S. Highway 101 (CRCD, 2003) (see Figure 3-56). Without additional analysis, it is unknown whether the groundwater source of these springs or seeps is from the underlying principal aquifer or perched water within the channel alluvium. Therefore, until flow of groundwater is better understood in these areas, meaningful SMCs related to interconnected surface water and supporting associated GDEs cannot be developed. If analysis of these areas indicates interconnected surface water with the Paso Robles Formation or the Careaga Sand, SMCs will be developed pursuant to avoid undesirable results as described Section 4.10. Planned additional analysis of these areas are described in Section 6.

Although groundwater levels and groundwater in storage have decreased substantially over the period of record, no significant and unreasonable impacts to beneficial uses of groundwater (by agriculture, recreation, businesses, municipal, and domestic users) have been reported and there is no indication that wells have been going dry. It is likely that groundwater and surface water entering Barka Slough has decreased over time, but it is unclear to what extent this has been caused by pumping versus drying conditions in the region. There is no documented impact to the Slough; however, significant and unreasonable impacts to beneficial uses of groundwater including the Slough may occur in the future under assumed climate conditions and if current pumping trends continue (e.g., groundwater levels continue to decline).

The RMS for subsidence utilizes UNAVCO satellite data. Should this satellite-based subsidence monitoring method indicate that subsidence may be occurring or if there is evidence of damage to infrastructure and property interests, benchmarks for monitoring land surface elevations will be established in the Basin. The RMS for monitoring depletion of interconnected surface water and impacts to GDEs will be established at a Casmalia stream gage located west of Barka Slough.

Minimum thresholds and measurable objectives for chronic groundwater level decline are presented in Section 4.5, and minimum thresholds and measurable objectives for reduction of groundwater in storage are presented in Section 4.6. The potential for impacts to GDEs for the chronic lowering of groundwater levels sustainability indicator are discussed in Section 4.5 and for the interconnected surface water sustainability indicator in Section 4.10. Minimum thresholds and measurable objectives for degraded groundwater quality are discussed in Section 4.8 and for land subsidence in Section 4.9.

4.5 Chronic Lowering of Groundwater Levels Sustainable Management Criterion

4.5.1 Undesirable Results for Groundwater Levels [§ 354.26(a),(b)(2),(c) and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result for groundwater levels in the Basin include the following:

- **Extended drought.** Extensive droughts may lead to excessively low groundwater levels and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.
- **High rate of pumping in the Paso Robles Formation.** If the amount of pumping in the Paso Robles Formation exceeds the long-term rate of recharge derived from mountain front recharge, stream percolation, percolation of direct precipitation, septic return flow, irrigation return flow, and discharges from the Careaga Formation (in western portion of the Basin), then groundwater levels may decline, which could affect Paso Robles Formation well production, groundwater discharge into Barka Slough, and GDEs.
- **High rate of pumping in the Careaga Sand.** If the amount of pumping in the Careaga Sand exceeds the long-term rate of natural recharge derived from mountain front recharge, stream percolation, percolation of direct precipitation, septic return flow, irrigation return flow, and recharge from the Paso Robles Formation, then groundwater levels may decline, which could affect Careaga Sand well production, reduce groundwater discharge into Barka Slough, and GDEs. Increased pumping by VSFB to irrigate proposed golf courses would exacerbate this problem.

Significant and unreasonable lowering of groundwater levels in the Basin are characterized (disjunctively) as follows:

- Groundwater levels in the Paso Robles Formation or Careaga Sand drop below the minimum threshold (see Section 4.5.2) after periods of average and above-average precipitation[40] in 50 percent[41] of representative wells for 2 consecutive years. By disqualifying periods of below-average precipitation or periods of drought that result in lowering of groundwater levels, this approach focuses on periods when groundwater levels are expected to increase (due to average or above-average precipitation measured at the Los Alamos Fire Station gage) to identify groundwater level decline associated with groundwater pumping.
- An acute or chronic, measurable significant and unreasonable impact to GDEs associated with interconnected surface water (see Section 4.10), specifically Barka Slough, caused by groundwater pumping in the Basin (during periods of average or above-average precipitation measured at the Los Alamos Fire Station gage).
- Lowering of groundwater levels results in an inability to produce estimated annual volume of groundwater equal to the sustainable yield for the Basin determined using the water budget method described in this GSP.

As discussed in Section 3.3.1, groundwater levels have reportedly declined over 140 feet in some areas of the Basin during the period of record. Additionally, from 1981 through 2018, an estimated decrease of 400,100 AF of groundwater in storage occurred in the Basin (see Section 3.3). Based on input from water users in the Basin, consultation with the California Department of Fish and Wildlife, and review of available water level data, no significant and unreasonable results associated with groundwater extraction and groundwater level decline have been observed in the Basin. However, if current rates of pumping continue (see Section 3.3.5), it is likely that undesirable results would occur in the future, particularly if the effects of climate change are observed.

[40] For the purposes of the Chronic Lowering of Groundwater Levels Sustainability Indicator Minimum Threshold, the total recorded precipitation from the preceding 3 water years will be used to determine if periods of average or above precipitation have occurred. Because climate change will likely have an effect on precipitation, a 20-year moving average will be utilized to determine average precipitation.

[41] A percentage of 50 representative wells was selected by basin stakeholders as significant and unreasonable for the Chronic Lowering of Groundwater Levels Sustainability Indicator. This was based on the location and distribution (spatially, completion depth, and aquifer of completion) of the representative wells.

4.5.2 Minimum Thresholds for Groundwater Levels [§ 354.28(a),(b)(1),(c)(1)(A)(B),(e), and (d)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(1) Chronic Lowering of Groundwater Levels. The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results. Minimum thresholds for chronic lowering of groundwater levels shall be supported by the following:

(A) The rate of groundwater elevation decline based on historical trend, water year type, and projected water use in the basin.

(B) Potential effects on other sustainability indicators.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(1) of the SGMA regulations states that "The minimum threshold for chronic lowering of groundwater levels shall be the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results." When selecting the minimum thresholds, the SABGSA considered the potential for depletion of supply to domestic, municipal, and agricultural wells if water levels continue to decline (discussed below and in Section 3.2).

As discussed in Section 3.2.1.3, a well impact analysis was performed to aid in identifying undesirable results and selecting minimum thresholds for the chronic lowering of groundwater levels sustainability indicator. In general, water levels that consistently continue to fall below the top of screen are likely to result in increased well clogging from biological growth and mineral precipitation, cascading water, sand pumping, and reduced yield and pump efficiencies and possibly, if continued, well failure. These conditions may cause a depletion of supply, depending on the type of well (domestic, municipal, or agricultural). The magnitude of this impact on well production differs depending on well type; agricultural versus municipal, versus domestic. For example, domestic wells tend to be shallower and may be more sensitive to water levels falling within the screen interval. Likewise, municipal wells serve drinking water to citizens living in the Basin and so supply reduction cannot be easily addressed. Agricultural wells often are deeper and have longer well screens that can tolerate loss of efficiency and more drawdown resulting from water levels falling below top of screen.

To gain some perspective on the significance of water level decline on different types of wells in the Basin, fall 2018 groundwater elevations were compared with top of well screen elevations for a total of 61 agricultural, municipal, and domestic wells screened in principal aquifers within the Basin. These wells were selected from a total of 423 well completion reports that were reviewed because of known location and well construction details. The percentage of wells with water levels below top of screen was calculated in 5-foot increments, starting with fall 2018 water levels (see Figures 3-13 and 3-15). The analysis illustrated the number and type of wells in the Basin that would be further impacted (groundwater elevations below well top of screen elevation) if groundwater elevations decline further compared to fall 2018 groundwater elevations.

The results of the analysis presented in Figure 3-23 indicate that groundwater elevations in fall 2018 were below top of screen in 20 percent of domestic wells, 12 percent of agricultural wells, and no municipal supply wells. As expected, the analysis indicates as water levels decline further, the number of wells and percentages of the different types of wells with water level below top of screen increase, but not significantly. When considering where to set the minimum thresholds, specific consideration was given to domestic wells, which are generally shallower, and municipal wells, which serve larger populations.[42]

The analysis indicates that water levels declining 25 feet below fall 2018 water levels do not result in a substantial increase in the number of wells affected by this condition. If water levels continue to decline, the analysis indicates well owners could observe some depletion of supply. Based on this analysis, stakeholders in the Basin believe that setting the minimum threshold for water levels at 25 feet below fall 2018 water levels will not result in depletion of supply or undesirable results. Setting the minimum threshold at this level allows time for project and management actions to be implemented before minimum thresholds are reached. Projects and management actions will be initiated upon implementation of the GSP. Projects and management actions are detailed in Section 6 and are designed to stabilize current groundwater levels. The well impact analysis presented in Section 3.2 indicates that the majority of the agricultural and domestic wells can tolerate additional groundwater level decline without experiencing undesirable results.

Table 4-1 includes the selected water level elevations for the minimum thresholds established for the Paso Robles Formation and Careaga Sand based on the foregoing analysis. Appendix F of the GSP presents a representative well location map and hydrographs showing the minimum thresholds for each representative well that will be used to monitor for chronic lowering of groundwater levels. Five representative wells are production wells used for agricultural irrigation. While not ideal for use as a monitoring wells, these five production wells are currently included as RMSs because of their location in the Basin, available well construction information, and long period of record. These five wells have been matched individually with nearby observation wells (non-pumping wells) that provide comparable spatial coverage of the Basin, have known well construction and aquifer completion data, but do not have a long period of record. Therefore, the five sets of paired wells will continue to be monitored until the period of record for the observation wells is

[42] Domestic well owners cannot easily respond to a reduction in supply, particularly during extended dry periods, and would have to absorb substantial cost if wells had to be deepened. The SABGSA agreed to provide mitigation (e.g., deepen their well or pump) to domestic well owners who experience depletion of supply as a result of basin pumping.

adequate to identify trends in groundwater elevations and confirm that the observation wells are representative of the pumping well that will be eventually replaced in the monitoring program.

Table 4-1. Chronic Lowering of Groundwater Levels Minimum Thresholds and Measurable Objectives for the Paso Robles Formation and the Careaga Sand

RMS ID[1]	Well Type	Minimum Threshold (feet NAVD 88)	Measurable Objective (feet NAVD 88)
Paso Robles Formation			
LACSD 4	Existing Production Well	407	440
30D1	Existing Production Well[2] (Awaiting Access Agreement)	345	388
SACC 1[3]	Existing Observation Well	348	--
22K3	Existing Production Well[2] (Awaiting Access Agreement)	344	370
SALS[3]	Existing Observation Well	397	--
20Q2	Existing Production Well[2] (Awaiting Access Agreement)	298	335
SACR 3[3]	Existing Observation Well	233	--
2M1	Existing Production Well	244	286
Careaga Sand			
25D1	Existing Production Well (Awaiting Access Agreement)	634	661
13C1	Existing Observation Well	565	597
24E1	Existing Production Well[2] (Awaiting Access Agreement)	220	257
SACR 1[3]	Existing Observation Well	291	--
34P1	Existing Production Well[2]	361	386
SAHC[3]	Existing Observation Well	358	--
16G3	Existing Observation Well	226	251

Notes

[1] Refer to Figure 3-11 and Appendix F for representative well locations.
[2] Production well proposed to be replaced with observation well.
[3] Observation well proposed to replace RMS production well. The well was constructed after spring 2015 (measurable objective water levels) and a measurable objective will be selected during the GSP-implementation period.
-- = Value to be selected during the GSP implementation period.
LACSD = Los Alamos Community Services District
NAVD 88 = North American Vertical Datum of 1988
RMS = representative monitoring site

4.5.2.1 Minimum Thresholds for the Paso Robles Formation and Careaga Sand Aquifers

As discussed previously, the minimum thresholds for the Paso Robles Formation and Careaga Sand aquifers are set at 25 feet below fall 2018 water levels (see Table 4-1). The rationale for setting this minimum threshold was discussed above. This threshold was selected to recognize that the Basin has experienced a lowering of groundwater levels without undesirable results to date and the well impact analysis indicates that a significant number of additional wells will not be affected if water levels decline to 25 feet below fall 2018 levels. This threshold level allows time for project and management actions to be implemented, recognizing that no significant and unreasonable effects have been observed during the historical period.

4.5.2.2 Relationship between Individual Minimum Thresholds and Relationships to Other Sustainability Indicators [§ 354.28(b)(2) and (d)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Groundwater level minimum thresholds can potentially influence other sustainability indicators, such as the following:

- **Avoid Chronic Reduction of Groundwater in Storage.** Changes in groundwater levels reflect changes in the amount of groundwater in storage. Pumping at, or less than, the sustainable yield will maintain average groundwater levels in the Basin. Likewise. the groundwater level minimum thresholds will maintain an adequate amount of groundwater in storage over an extended period when pumping is equal to or less than the sustainable yield. Therefore, maintaining groundwater levels above the minimum thresholds will not result in long-term significant or unreasonable change of groundwater in storage.
- **Avoid Degraded Groundwater Quality.** A significant and unreasonable condition for groundwater quality is the increase in concentration of constituents of concern exceeding Basin WQOs or state or federal maximum contaminant levels (MCLs) or secondary maximum contaminant levels (SMCLs) (regulatory thresholds) for drinking water caused by lowering of groundwater levels induced by groundwater pumping. Maintaining groundwater levels above minimum thresholds helps minimize the potential for experiencing degraded groundwater quality (since enactment of SGMA in 2015) or exceeding regulatory thresholds for constituents of concern in drinking water and agricultural wells. Groundwater quality could be affected through two processes:
    1. Low groundwater levels in an area could cause deeper, poor-quality groundwater to flow into existing supply wells. Groundwater level minimum thresholds are set below current groundwater levels, meaning a flow of deep, poor-quality groundwater could occur in the future at or below minimum threshold levels. Although no point-source groundwater contamination has been

identified in the Basin, the Careaga Sand is underlain by marine deposits. Consequently, groundwater within these underlying marine deposits likely contains increased salt concentrations and is of poorer quality than the groundwater within the overlying Careaga Sand. Should groundwater quality degrade due to lower groundwater levels, the groundwater level minimum thresholds will be reviewed.

2. Changes in groundwater levels arising from management actions implemented by the SABGSA to achieve sustainability could change groundwater gradients, which could cause poor-quality groundwater to flow towards supply wells that would not have otherwise been impacted. Examples of these actions may include installation of groundwater recharge facilities (e.g., gravity stormwater recharge or aquifer recharge with recharge wells using treated wastewater). Because these kinds of projects are subject to review under the California Environmental Quality Act, concerns about the potential to introduce or mobilize contaminant plumes would be evaluated before such a project could be implemented.

- **Avoid Land Subsidence.** A significant and unreasonable condition for subsidence is permanent pumping-induced subsidence that substantially interferes with surface land use. Subsidence is caused by dewatering and compaction of clay-rich sediments in response to lowering groundwater levels. Very small amounts of ground surface elevation fluctuations have been reported across the Basin and are within the measurement margin of error. The groundwater level minimum thresholds are set just below existing and historical groundwater levels, which could induce a minor amount of additional subsidence. However, the local soils and geological conditions are less susceptible to compaction and subsidence because there are no known thick clay layers that extend across the full area where the Paso Robles Formation is present (although some clay layers are distinctly present in localized areas). Groundwater levels would likely have to be substantially lower than are predicted to occur in the future to produce significantly more subsidence.
- **Avoid Depletion of Interconnected Surface Water.** A significant and unreasonable condition for depletion of surface water is a significant and unreasonable pumping-induced reduction in groundwater discharge to surface water and resulting impacts to GDEs. There is limited available information about the condition of the Slough during periods of historical low groundwater levels. In addition, the relative degree to which groundwater discharge and surface water discharge into the Slough supports the GDEs is not well understood. Drought conditions that have been prevalent in the area since the early 2000's is also a significant factor affecting the health of wetlands throughout California, including the Slough according to conversations with California Department of Fish and Wildlife (CDFW).[43] It is apparent that there is connection between basin groundwater levels and the Slough; however, there is considerable uncertainty about how much lower groundwater levels can go in the Basin without causing significant and unreasonable impacts to the Slough. Additional characterization of the nature, type, and extent of the GDEs in the Slough, installation of surface water gages in the east and west end of the Slough, and evaluation of the Slough water budget and effects of the water level minimum thresholds on surface water depletion using the USGS groundwater model, when it is available, would significantly improve understanding of this dynamic. These actions are described in Section 6.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to this Basin.

The minimum thresholds set for chronic groundwater level decline are protective of all beneficial uses and do not result in undesirable effects for the other sustainability indicators.

[43] Jennifer Strotman and Christopher Diel, CDFW, phone conversation, June 2020.

4.5.2.3 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

According to DWR Bulletin 118, there is no adjacent downstream groundwater basin; therefore, this section of the SGMA regulations is not applicable to the Basin or this GSP.

4.5.2.4 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The groundwater level minimum thresholds have been selected to protect beneficial uses in the Basin while providing a reliable and sustainable groundwater supply. They assume that mitigation of continued water level decline will prevent undesirable results and impacts to beneficial uses.

As presented in Section 3.2, a comparison of recent groundwater levels (fall 2018) and top of screen elevation for domestic, municipal, and agricultural wells (for wells with reported construction information) located in the Basin indicated significant or unreasonable effects leading to depletion of supply are not expected if groundwater levels were to reach the minimum threshold.

4.5.2.5 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for chronic lowering of groundwater levels unless significant or unreasonable reduction in groundwater levels caused by pumping significantly reduces the flow of water into the Slough where sensitive species may exist. This issue is further discussed in Section 4.1.

4.5.2.6 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(a) and (b)(6)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Groundwater level minimum thresholds will be directly measured from RMSs (see Table 4-1). The groundwater level monitoring program will be conducted in accordance with the monitoring plan outlined in Section 5 and will consist of collecting groundwater level measurements that reflect non-pumping conditions. The groundwater level monitoring program will be designed and conducted to meet the requirements of the technical and reporting standards included in the SGMA regulations. As discussed in Section 4.5.1, the potential exists for undesirable results to occur if minimum thresholds are exceeded in 50 percent of the representative wells for 2 consecutive years.

4.5.3 Measurable Objectives for Groundwater Levels [§ 354.30(a),(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The measurable objectives for chronic lowering of groundwater levels provide a target for stabilizing water levels (not recovering water levels to historical levels) over the 20-year GSP implementation period to ensure reliable access to groundwater without undesirable results. Measurable objectives for chronic lowering of groundwater levels provide operational flexibility above minimum threshold levels to ensure that the Basin can be managed sustainably over a reasonable range of climate and hydrologic variability. Measurable objectives may change after GSP adoption, as new information and hydrologic data become available.

4.5.3.1 Methodology for Setting Measurable Objectives

Measurable objectives were established to meet the sustainability goal and were based on trends in historical groundwater level data, historical precipitation data, and input from the SAC. The measurable objective levels were set so that: (1) declining water level trends caused by pumping do not continue to occur and (2) water levels stabilize with no chronic decline that continues during average and above-average rainfall conditions. With stakeholder input, the measurable objective groundwater elevation at representative wells was set at spring 2015 elevations when SGMA was enacted. Table 4-1 includes the estimated elevations for the measurable objectives established for the Paso Robles Formation and the Careaga Sand. Hydrographs showing the measurable objectives are presented in Appendix F.

4.5.3.2 Measurable Objectives for the Paso Robles Formation and Careaga Sand Aquifer

The measurable objectives for the Paso Robles Formation and Careaga Sand aquifers are the groundwater levels measured at each RMS in spring 2015. These levels were selected using available groundwater elevation monitoring data.

4.5.4 Interim Milestones for Groundwater Levels [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the SABGSA would move from current conditions to meeting the measurable objectives in the 20-year GSP implementation horizon. For this Basin, interim milestones are proposed every 5 years, beginning after the GSP is submitted in 2022 and continuing through 2042 (see Table 4-2). Figure 4-1 presents the general approach for setting interim milestones in the Basin.

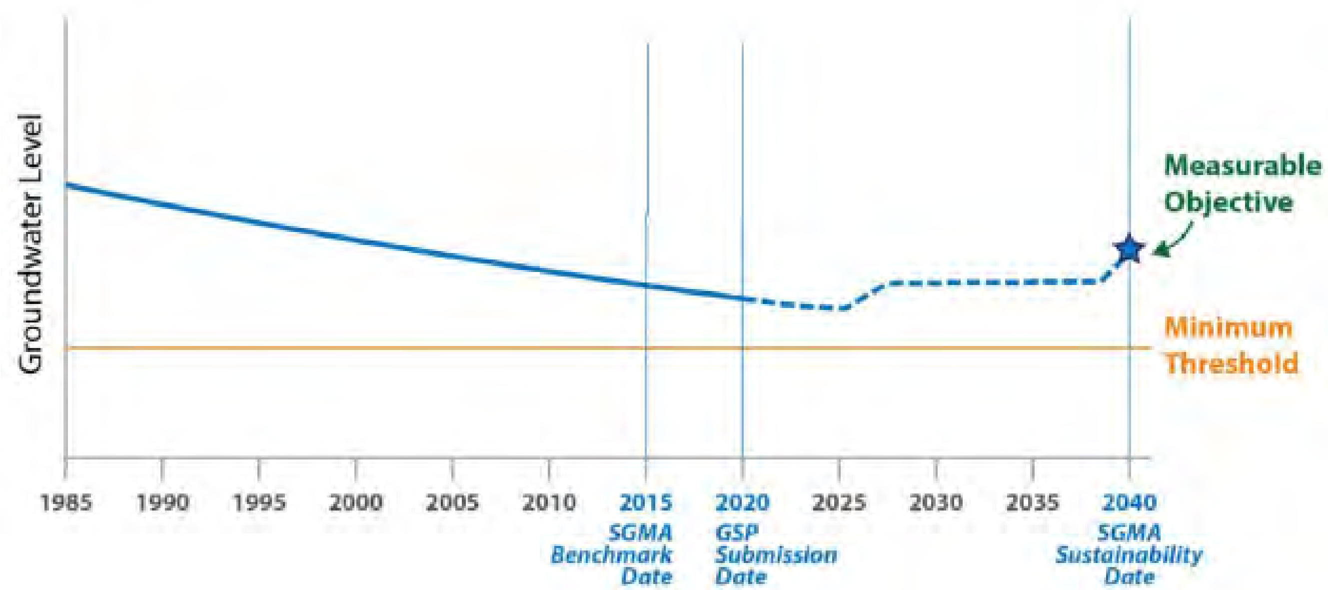

Figure 4-1. Generalized Approach to Setting Interim Milestones

Source: DWR, 2017

A period of 2 years following submittal of this GSP has been allotted to allow time for planning and funding of projects and management actions to be initiated. After the 2-year planning period, interim milestones identify target groundwater levels to be achieved every 5 years so that progress toward reaching the measurable objective target can be evaluated. Achievement of these targets will depend on both the effectiveness of any set of projects and management actions but also climate (precipitation) during that time. If new data identify undesirable results in the future, additional or modifications to existing interim milestones may be proposed as part of a GSP update that is planned for every 5 years.

Table 4-2. Chronic Lowering of Groundwater Levels Interim Milestones for the Paso Robles Formation and the Careaga Sand

	Interim Milestones (feet NAVD 88)				
RMS ID[1]	2022	2027	2032	2037	2042[4]
Paso Robles Formation					
LACSD 4	434	435	437	438	440
30D1[2]	374	377	381	384	388
SACC 1[3]	358	--	--	--	--
22K3[2]	362	364	366	368	370
SALS[3]	420	--	--	--	--
20Q2[2]	322	325	328	332	335
SACR 3[3]	243	--	--	--	--
2M1	268	271	276	281	286
Careaga Sand					
25D1	661	661	661	661	661
13C1	583	586	589	593	597
24E1[2]	252	253	254	255	257
SACR 1[3]	314	--	--	--	--
34P1[2]	386	386	386	386	386
SAHC[3]	382	--	--	--	--
16G3	249	249	250	250	251

Notes

[1] Refer to Figure 3-11 and Appendix F for representative well locations.
[2] Production well proposed to be replaced with subsequent observation well.
[3] Observation well proposed to replace RMS production well. The well was constructed after spring 2015 (measurable objective water levels) and a measurable objective will be selected during the GSP-implementation period.
[4] Value is equal to the measurable objective at the RMS for the respective sustainability indicator.
-- = Value to be selected during the GSP-implementation period.
LACSD = Los Alamos Community Services District
NAVD 88 = North American Vertical Datum of 1988
RMS = representative monitoring site

4.6 Reduction of Groundwater in Storage Sustainable Management Criterion

4.6.1 Undesirable Results for Storage Reduction [§ 354.26(a),(b)(2),(c), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result for groundwater in storage in the Basin are related to chronic lowering of groundwater levels and include the following:

- **Extended drought.** Extensive droughts may lead to excessively low groundwater levels, a reduced amount of groundwater in storage, and undesirable results. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.
- **High rate pumping in the Paso Robles Formation.** If the amount of pumping in the Paso Robles Formation exceeds the long-term rate of recharge derived from mountain front recharge, stream percolation, percolation of direct precipitation, septic return flow, irrigation return flow, and discharges from the Careaga Formation (in western portion of the Basin), then groundwater levels may decline, which could affect Paso Robles Formation well production, groundwater discharge into Barka Slough, GDEs, and the volume of groundwater in storage.
- **High rate pumping in the Careaga Sand.** If the amount of pumping in the Careaga Sand exceeds the long-term rate of natural recharge derived from mountain front recharge, stream percolation, percolation of direct precipitation, septic return flow, irrigation return flow, and recharge from the Paso Robles Formation, then groundwater levels may decline, which could affect Careaga Sand well production, reduce groundwater discharge into Barka Slough, GDEs, and the volume of groundwater in storage.

Significant and unreasonable reductions in the quantity of groundwater in storage are characterized as follows:

- Groundwater levels in the Paso Robles Formation or Careaga Sand drop below the minimum threshold (see Section 4.5.2) after periods of average and above-average precipitation in 50 percent of representative wells for 2 consecutive years.[44] By disqualifying periods of below-average precipitation or periods of drought that cause lowering of groundwater levels, this approach focuses on periods when groundwater levels are expected to increase to identify groundwater level decline associated with groundwater pumping.
- Reduction of groundwater in storage results in an inability to produce estimated annual volume of groundwater equal to the sustainable yield for the Basin determined using the water budget method described in this GSP.

The practical effect of this GSP for protecting against undesirable results arising from a reduction of groundwater in storage is that it encourages the maintenance of long-term stability in groundwater levels and storage during average hydrologic conditions over multiple years and decades. Maintaining long-term stability in groundwater levels maintains long-term stability in groundwater storage and prevents chronic declines, thereby providing beneficial uses and users with access to groundwater on a long-term basis and preventing undesirable results associated with groundwater withdrawals. Pumping at the long-term sustainable yield during drought years would likely temporarily lower groundwater levels and reduce the amount of groundwater in storage. Such short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods. Prolonged reductions in the amount of groundwater in storage could lead to undesirable results affecting beneficial users and uses of groundwater. In particular, groundwater pumpers that rely on water from shallow wells (e.g., domestic wells) in the Los Alamos and Harris Canyon areas of the Basin may be temporarily impacted by temporary reductions in the amount of groundwater in storage and lower groundwater levels in their wells. Domestic wells located in the fringe areas above the valley floor portion of the Basin could be affected by pumping in the lower portion of the Basin. There is a lack of water level data for shallow domestic wells, which is a data gap to be addressed in the Section 6 of this GSP.

[44] For the purposes of the Chronic Lowering of Groundwater Levels Sustainability Indicator Minimum Threshold, the total recorded precipitation from the preceding 3 water years will be used to determine if periods of average or above precipitation have occurred. Because climate change will likely have an effect on precipitation, a 20-year moving average will be utilized to determine average precipitation.

4.6.2 Minimum Thresholds for Storage Reduction [§ 354.28(a),(b)(1),(c)(2),(e), and (d)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(2) Reduction of Groundwater Storage. The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that my lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(2) of the SGMA regulations states that “The minimum threshold for reduction of groundwater storage shall be a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results. Minimum thresholds for reduction of groundwater storage shall be supported by the sustainable yield of the basin, calculated based on historical trends, water year type, and projected water use in the basin.”

The minimum threshold for reduction of groundwater in storage is based on achieving the sustainable yield and avoiding conditions that may lead to undesirable results. This pertains to the Basin as a whole, not for individual aquifers. Consequently, any reduction in storage that would cause an undesirable result in only a limited portion of the Basin, as determined through continuation of the groundwater elevation monitoring program, shall be addressed in that area or in areas where declining groundwater levels indicate management actions or projects will be effective.

In accordance with the SGMA regulation cited above, the minimum threshold metric is a volume of pumping per year, or an annual pumping rate. Conceptually, the sustainable yield is the total volume of groundwater that can be pumped annually from the Basin on a long-term (multi-year/multi-decadal) basis without leading to undesirable results. As discussed in Section 3.3.5, absent the addition of supplemental water, the 2042 projected future long-term sustainable yield of the Basin under reasonable climate change assumptions is approximately 10,700 AFY.

This GSP adopts changes in groundwater levels as a proxy for the change of groundwater in storage metric. As allowed in § 354.36(b)(1) of the SGMA regulations, an average of the groundwater elevation data at the RMSs will be reported annually as a proxy to track changes in the amount of groundwater in storage because water levels and storage are closely associated. The rationale for selecting minimum thresholds for water levels, and hence, the rationale for reduction in storage, are presented in Section 4.5.2.

Based on well-established hydrogeologic principles, maintaining long-term stability in groundwater levels above the minimum threshold for chronic lowering of groundwater levels will limit continued depletion of groundwater from storage. Therefore, using groundwater elevation levels as a proxy, the minimum threshold for chronic reduction of groundwater in storage at each RMS is defined by the minimum threshold for chronic lowering of groundwater levels (see Table 4-1).

4.6.2.1 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

The minimum threshold for reduction of groundwater in storage is based on the groundwater level minimum thresholds established for chronic groundwater level decline at RMSs. Therefore, the concept of potential conflict between minimum thresholds at different locations in the Basin is not applicable.

The minimum threshold for reduction of groundwater in storage could influence other sustainability indicators. The minimum threshold for reduction of groundwater in storage was selected to avoid undesirable results for other sustainability indicators, as outlined below.

- **Avoid Chronic Lowering of Groundwater Levels.** Because groundwater levels will be used as a proxy for estimating groundwater pumping and changes in groundwater storage, the groundwater in storage sustainability criteria would not cause undesirable results for this sustainability indicator.
- **Avoid Degraded Groundwater Quality.** The minimum threshold proxy of long-term stability in groundwater levels helps minimize the potential for experiencing degraded groundwater quality or exceeding regulatory limits for constituents of concern in supply wells.
- **Avoid Land Subsidence.** Future groundwater levels would likely have to be substantially lower than are predicted to occur in the future to produce significant subsidence. Should significant and unreasonable subsidence be observed from future groundwater levels, the groundwater level minimum thresholds for this sustainability indicator will be raised to avoid this subsidence.

- **Avoid Depletion of Interconnected Surface Water.** A significant and unreasonable condition for depletion of surface water is a pumping-induced reduction in groundwater discharge to surface water and resulting impacts to GDEs (Barka Slough). There is little available information about the condition of the Slough during periods of historical low groundwater levels. In addition, the relative degree to which groundwater discharge and surface water discharge into the Slough supports the GDEs is not well understood. Drought conditions that have been prevalent in the area since the early 2000's is also a significant factor affecting the health of wetlands throughout California, including the Slough according to conversations with CDFW.[45] It is apparent that there is connection between basin groundwater levels and the Slough; however, there is considerable uncertainty about how much lower groundwater levels can go in the Basin without causing significant and unreasonable impacts to the Slough. Additional characterization of the nature, type, and extent of the GDEs in the Slough, installation of surface water gages in the east and west end of the Slough, and evaluation of the Slough water budget and effects of the water level minimum thresholds on surface water depletion using the USGS groundwater model, when it is available, would significantly improve understanding of this dynamic. These actions are described in Section 6.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to this Basin.

4.6.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

According to DWR Bulletin 118, there is no adjacent downstream groundwater basin; therefore, this section of the SGMA regulations is not applicable to the Basin or this GSP. However, removing groundwater from storage in the Basin may result in a lowering of groundwater levels thus reducing groundwater flow into Barka Slough and then reducing flow to surface water that exits in the Basin in San Antonio Creek and flows west toward the Pacific Ocean.

4.6.2.3 Effects on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The minimum thresholds for reduction of groundwater in storage and lowering of groundwater levels have been established to avoid undesirable results. For this reason, groundwater serving beneficial uses (including GDEs) and land uses will not be adversely affected.

[45] Jennifer Strotman and Christopher Diel, CDFW, phone conversation, June 2020.

4.6.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

No federal, state, or local standards exist for reductions in groundwater storage.

4.6.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

The measurement program for evaluating the minimum thresholds for reductions in groundwater in storage will rely on the groundwater elevation monitoring program described previously for chronic lowering of groundwater levels (see Section 4.5). Groundwater levels (as a surrogate for change of groundwater in storage) that drop below the minimum threshold values for decline in groundwater levels in 50 percent of the same representative wells over 2 consecutive years may lead to undesirable results and long-term reduction of groundwater in storage.

4.6.3 Measurable Objectives for Storage Reduction [§ 354.30(a),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The measurable objectives for reduction of groundwater in storage are based on the measurable objectives for water levels and are shown in Table 4-1. These levels provide a target for stabilizing water levels (not recovering water levels to historical water levels) and groundwater in storage over the 20-year GSP implementation period to ensure reliable access to groundwater. Measurable objectives for water levels and groundwater in storage provide operational flexibility above minimum threshold levels to ensure that the Basin can be managed sustainably over a reasonable range of climate and hydrologic variability. Measurable objectives may change after GSP adoption, as new information and hydrologic data become available.

4.6.4 Interim Milestones for Storage Reduction [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the SABGSA would move from current conditions to meeting the measurable objectives in the 20-year GSP implementation horizon. For this Basin, interim milestones for groundwater in storage are proposed every 5 years, beginning after the GSP is submitted in 2022 and continuing through 2042 (see Table 4-2). Because chronic reduction in storage indicators rely on groundwater levels as a proxy, interim milestones for storage are the same as those set for chronic water level declines. A period of 2 years following submittal of this GSP has been allotted to allow time for planning and funding of projects and management actions to be initiated. After the 2-year planning period, interim milestones identify target groundwater levels to be achieved every 5 years so that progress toward reaching the measurable objective target can be evaluated. Achievement of these targets will depend on both the effectiveness of any set of projects and management actions but also climate (precipitation) during that time. If new data identify undesirable results in the future, additional or modifications to existing interim milestones may be proposed as part of a GSP update that is planned for every 5 years.

4.7 Seawater Intrusion Sustainable Management Criterion (Not Applicable)

The seawater intrusion sustainability indicator is not applicable to this Basin.

4.8 Degraded Groundwater Quality Sustainable Management Criterion

This sustainability indicator takes into consideration protection of municipal drinking water supplies, domestic uses, and agricultural uses of groundwater in the Basin. Table 3-5 presents a summary of groundwater quality data for the Basin. For municipal wells and drinking water supplied by domestic wells, state and federal regulatory standards (SMCLs and MCLs) established by the SWRCB DDW and U.S. Environmental Protection Agency, respectively, were used to establish thresholds. For agricultural uses, thresholds were established using WQOs presented in the Basin Plan (RWQCB, 2019). The SABGSA has no responsibility to manage groundwater quality unless it can be shown that water quality degradation is caused by pumping in the Basin, or the SABGSA implements a project that degrades water quality. Potential degradation of groundwater quality caused by groundwater pumping will be monitored as part of the Basin's water quality monitoring network (see Section 5). Likewise, potential degradation of water quality due to implementation of projects and management actions (see Section 6) will be evaluated during the planning stage of the respective action and monitored at a minimum as part of the Basin's water quality monitoring network.

4.8.1 Undesirable Results for Groundwater Quality [§ 354.26(a),(b)(1),(b)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result for groundwater quality in the Basin include the following:

- **Concentrations of regulated contaminants** in untreated groundwater from private domestic wells, agricultural wells. or municipal wells exceed regulatory thresholds as a result of pumping or SABGSA activities.
- **Groundwater pumping or SABGSA activities** cause concentrations of TDS, chloride, sulfate, boron, sodium, and nitrate to increase and exceed WQOs since SGMA was enacted in January 2015.

4.8.2 Minimum Thresholds for Groundwater Quality [§ 354.28(b)(1),(c)(4), and (e)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(4) Degraded Water Quality. The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicator of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(2) of the SGMA regulations states that "The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin." The purpose of the minimum thresholds for constituents of concern in this Basin is to avoid increased degradation of groundwater quality from baseline concentrations measured since enactment of SGMA in January 2015. Minimum thresholds established for contaminants and for salts and nutrients are presented in the following subsections.

4.8.2.1 Contaminants

Minimum thresholds that pertain to contaminants measured in groundwater are as follows:

- No minimum thresholds have been established for contaminants because state regulatory agencies, including the RWQCB and the Department of Toxic Substances Control, have the responsibility and authority to regulate and direct actions that address contamination.

As discussed in Section 3.2.3, groundwater quality samples have been collected and analyzed throughout the Basin for various studies and programs. A broad survey of groundwater quality has been conducted by USGS as part of its GAMA Program. Historical groundwater quality data were obtained from USGS NWIS and the SWRCB GeoTracker GAMA database, and the SWRCB ILRP database. Water quality data were also obtained for the LACSD and VSFB wells as part of the SWRCB DDW compliance monitoring program.

Groundwater in the Basin is of widely varying quality and generally decreases in quality from east to west. Concentrations of TDS generally increase from east to west along San Antonio Creek; and are greatest near the Barka Slough, along western San Antonio Creek, and in Harris Canyon. Concentrations of boron, sodium, and chloride are also elevated in the slough area, along western San Antonio Creek, and in Harris Canyon. Detected chloride concentrations exceeding the WQO were collected from wells located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon. Boron concentrations exceeding the WQO were collected from wells located in the western portion of the Basin along San Antonio Creek, near Barka Slough, or in Harris Canyon. Based on available information, the east to west trend of increasing TDS and salts concentrations is consistent between the Paso Robles Formation and the Careaga Sand. Analytical results from samples collected from a nested monitoring well (SACR) along San Antonio Creek, in the western portion of the Basin, indicate that concentrations of TDS decreased with depth.

Table 4-3 presents regulatory standards for selected constituents of concern for drinking water listed in the Basin Plan (RWQCB, 2019) and California Code of Regulations, Title 22 drinking water quality standards (SWRCB, 2019), and concentration of select constituents of concern in groundwater around the time SGMA was enacted (January 2015).

Constituent concentrations detected at or above their respective MCL in some public water supply wells include nitrate, arsenic, and di(2-ethylhexyl)phthalate (DEHP). A single exceedance of the MCL for nitrate occurred in a well located in Harris Canyon in 2011. A single exceedance of the MCL for arsenic occurred in a well in the VSFB wellfield in 1990. Exceedances of the MCL for DEHP occurred in samples from two wells in the VSFB wellfield in 1989 and 1990. Available data indicate that these are isolated detections of DEHP. Iron and manganese were most frequently detected at concentrations at or above their respective SMCL in public supply wells. Public supply wells with SMCL exceedances are primarily located in the VSFB wellfield. None of the samples from LACSD wells exceed MCLs. TDS, chloride, and nitrate concentrations indicate an increasing trend in LACSD well 4 located east of Los Alamos; however, concentrations of these constituents remain below MCLs, SMCLs, and WQOs.

Potential point sources of groundwater quality degradation were identified from the SWRCB GeoTracker data management system. Information for open/active contaminated sites and completed/case closed sites were reviewed. Based on available information, there are no known impacts to groundwater associated with these cases. Potential impacts on Basin groundwater quality from oil and gas development in the Basin is being investigated by the California Oil, Gas, and Groundwater program (see Section 3.2.3.5). The results of that study are not yet available.

The SABGSA intends to periodically review available water quality databases, including DDW, SWRCB ILRP, and GeoTracker databases, on an annual basis to identify contaminants that have been detected and reported. If contaminants exceed regulatory standards that affect beneficial uses in the Basin (domestic, agricultural, or municipal) are observed, the SABGSA will communicate with the appropriate state regulatory agency that has responsibility and authority to address the contamination. This information will also be reported in annual reports submitted to DWR and the public by the SABGSA.

Table 4-3. Water Quality Standards for Selected Constituents of Concern

Constituent	MCL (mg/L)	SMCL[2] (mg/L)	WQO (mg/L)
Nitrate[1]	10	--	5
Arsenic	0.01	--	--
DEHP[3]	0.004	--	--
Iron	--	0.3	--
Manganese	--	0.05	--
Boron	--	--	0.2
Chloride	--	500	150
Sodium	--	--	100
Sulfate	--	500	150
Total Dissolved Solids	--	1,000	600

Notes:
[1] Nitrate concentration measured as nitrogen (U.S. Environmental Protection Agency MCL)
[2] Upper consumer acceptance level
[3] State of California DDW MCL
-- = no value
DDW = Division of Drinking Water
mg/L = milligram per liter
MCL = maximum contaminant level (drinking water)
SMCL = secondary maximum contaminant level (drinking water)
WQO = water quality objective (median groundwater objective)
DEHP = di(2-ethylhexyl)phthalate

Sources: SWRCB, 2019 and RWQCB, 2019.

4.8.2.2 Salts and Nutrients [§ 354.28(a) and (d)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Minimum thresholds pertaining to salts and nutrients measured in groundwater are as follows:

- The WQOs presented in Table 4-3 are the minimum thresholds for TDS, chloride, sulfate, boron, sodium, and nitrate as measured by SWRCB ILRP and DDW programs in 20 percent of wells monitored. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the minimum threshold concentration is 110 percent of the ambient water quality in 20 percent of the wells.

4.8.2.3 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2) and (c)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

The groundwater quality minimum thresholds were set based on state and federal drinking water quality standards as well as WQOs included in the Basin Plan.

Because SGMA regulations do not require projects or actions to improve groundwater quality beyond what existed prior to January 1, 2015, or beyond that required by other regulatory agencies with clear jurisdiction over the matter, there will be no direct actions under the GSP associated with the groundwater quality minimum thresholds. Therefore, there are no actions that directly influence other sustainability indicators.

- **Avoid Chronic Lowering of Groundwater Levels.** Groundwater quality minimum thresholds could influence groundwater level minimum thresholds by limiting the types of water that can be used for recharge to raise groundwater levels. Water used for recharge cannot exceed any of the groundwater quality minimum thresholds.
- **Avoid Chronic Reduction of Groundwater in Storage.** Nothing in the groundwater quality minimum thresholds promotes pumping in excess of the sustainable yield. Therefore, the groundwater quality minimum thresholds will not result in an exceedance of the groundwater storage minimum threshold.
- **Avoid Land Subsidence.** Nothing in the groundwater quality minimum thresholds promotes a condition that will lead to additional subsidence; therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable level of subsidence.
- **Avoid Depletion of Interconnected Surface Waters.** There is no information indicating that the groundwater quality minimum thresholds would have significant and unreasonable effects on interconnected surface waters. Nothing in the groundwater quality minimum thresholds promotes additional pumping or lower groundwater levels in areas where interconnected surface waters may exist. Therefore, the groundwater quality minimum thresholds will not result in a significant or unreasonable depletion of interconnected surface waters.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to this Basin.

4.8.2.4 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

According to DWR Bulletin 118, there is no adjacent downstream groundwater basin; therefore, this section of the SGMA regulations is not applicable to the Basin or this GSP.

4.8.2.5 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.26(b)(3)]

§ 354.26 Undesirable Results.

(b) The description of undesirable results shall include the following:

(3) Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

The minimum thresholds for degraded groundwater quality have been established to avoid undesirable results. For this reason, groundwater serving beneficial uses (including GDEs) and land uses will not be adversely affected.

- **Agricultural land uses and users.** The degraded groundwater quality minimum thresholds generally benefit the agricultural water users in the Basin. For example, setting the minimum threshold for salts and nutrients at the WQOs described in the Basin Plan ensures that a supply of usable groundwater will exist for beneficial agricultural use.
- **Municipal uses and users.** The degraded groundwater quality minimum thresholds generally benefit the municipal water users in the Basin because there are existing regulatory programs and agencies that ensure there is an adequate supply of good quality groundwater for drinking water uses.
- **Domestic users.** The degraded groundwater quality minimum thresholds for municipal wells benefit the domestic water users in the Basin because these uses share the aquifer with municipal water supply wells. In addition, water quality standards for contaminants, salts, and nutrients are intended to be protective of drinking water uses.
- **Ecological land uses and users.** Although the degraded groundwater quality minimum thresholds do not directly benefit ecological uses, it can be inferred that the degraded groundwater quality minimum thresholds will benefit ecological water uses in the Basin because these thresholds limit future increases in concentrations of constituents of concern from what they are now, or prior to what they were when SGMA was enacted in January of 2015.

4.8.2.6 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

The degraded groundwater quality minimum thresholds specifically incorporate federal and state drinking water standards.

4.8.2.7 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Degraded groundwater quality minimum thresholds will be directly measured from existing or new municipal (DDW compliance monitoring program), domestic (ILRP) and agricultural supply wells (ILRP). Exceedances of regulatory standards and WQOs will be assessed on an annual basis in accordance with the monitoring program (see Section 5).

4.8.3 Measurable Objectives for Groundwater Quality [§ 354.30(a),(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

4.8.3.1 Measurable Objectives Pertaining to Contaminants

Improving groundwater quality is not a requirement under SGMA; however, protecting it from degradation is important to the beneficial users and uses of the resource in this Basin so that pumping can be maintained at desired levels. Thus, the measurable objective as it relates to contaminants is to maintain groundwater quality equal to or below regulatory standards or, equal to or below concentrations present in groundwater when SGMA was enacted.

4.8.3.2 Measurable Objectives Pertaining to Salts and Nutrients

The measurable objective as it relates to salts and nutrients (TDS, chloride, sulfate, boron, sodium, and nitrate) is to maintain groundwater quality equal to or below Water Quality Objectives presented in the Basin Plan, or equal to or below concentrations present in groundwater when SGMA was enacted.

4.8.4 Interim Milestones for Groundwater Quality [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the SABGSA anticipates moving from current conditions to meeting the measurable objectives. No significant or unreasonable results that significantly impact beneficial uses have been observed in the Basin in association with degraded groundwater quality. Therefore, no interim milestones are being proposed.

4.9 Land Subsidence Sustainable Management Criterion

4.9.1 Undesirable Results for Land Subsidence [§ 354.26(a),(b)(1),(b)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result in the Basin include a shift in pumping locations or substantial increase in pumping beyond what has been observed, which could lead to a substantial decline in groundwater levels that could result in subsidence. Shifting or increasing a significant amount of pumping that causes groundwater levels to fall in an area that is susceptible to subsidence could trigger subsidence exceeding the minimum thresholds.

Locally defined significant and unreasonable conditions for land subsidence are land subsidence rates exceeding rates observed from 2000 to 2020 at the UNAVCO CGPS Station ORES, located in the town of Los Alamos, near Los Alamos Park; and land subsidence that causes damage to groundwater supply, land uses, infrastructure, and property interests. For clarity, this SMC adopts two related concepts:

- **Land subsidence** is a gradual settling of the land surface caused by, among other processes, compaction of subsurface materials due to lowering of groundwater levels from groundwater pumping. Land subsidence from dewatering subsurface clay layers can be an inelastic process and the potential decline in land surface could be permanent. This can also be caused by exploitation of oil and gas from fields located within or near the Basin.
- **Land surface fluctuation.** Land surface may rise or fall, elastically, in any one year. Land surface fluctuation may or may not indicate long-term permanent subsidence. This can be caused by tectonic activity in the earth.

By regulation, the ground surface subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. For the Basin, no long-term subsidence that impacts groundwater supply, land uses, infrastructure, and property interests is acceptable. Therefore, the ground surface subsidence undesirable results (disjunctively) include the following:[46]

- Groundwater extraction results in subsidence that substantially interferes with surface land uses (including agricultural, residential, rural residential, and town buildings) and property interests.
- Groundwater extraction results in subsidence that causes land surface deformation that impacts the use of critical infrastructure (including LACSD wells, WWTP, and associated infrastructure) and roads.
- Groundwater extraction results in land subsidence greater than minimum thresholds at the UNAVCO CGPS Station ORES.

Currently, ground surface elevation is being monitored at one continuous global positioning system site in the Basin as reported by UNAVCO from its Data Archive Interface.[47] Since the beginning of data collection in 2000, the net vertical displacement is negative (0.82 feet). This means that the land surface elevation has decreased (negative displacement) 0.82 feet in the last 20 years. The Basin is located near the intersection of the Coastal Ranges and Transverse Ranges California Geomorphic Provinces. Consequently, the Basin is in a very tectonically active region. The 0.82 feet of vertical displacement measured at the UNAVCO station could be due to tectonic activity, groundwater extraction, oil and gas extraction, or a combination of the three. In addition, InSAR data provided by DWR shows that meaningful (greater than the range of uncertainty of InSAR data) land subsidence did not occur during the period between June 2015 and June 2019 in the Basin (see Section 3.2.4).

To supplement the InSAR and UNAVCO data and assess the general susceptibility of the Basin to experience subsidence as a result of lowering groundwater levels below historical levels, a preliminary subsidence evaluation was completed. The preliminary evaluation was based on review of subsurface geologic information and groundwater level data for key wells and included estimating ranges of possible long-term subsidence that might be expected in the future. The evaluation, which is included in Appendix D, included the following key conclusions:

- There have been no reports from landowners or public agencies of impacts resulting from subsidence.

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[46] The listed criteria for ground surface subsidence undesirable results only apply if groundwater levels are below historical low groundwater levels during the period of ground surface subsidence in question.
[47] The UNAVCO Data Archive Interface is available at http://www.unavco.org/data/data.html.

- The analysis was completed at two representative well locations and showed an estimated total potential subsidence on the order of 1 to 2 feet over the historical period resulting from the changes in groundwater elevation reported in the hydrographs.
- Historical subsidence on the order of 1 to 2 feet appears relatively consistent with the estimated subsidence rate of 0.5 inches per year reported for the UNAVCO CGPS Station ORES (see Section 3.2.4.2).

Based on the result of this analysis, it is unlikely that the full measure of estimated subsidence (of 1 to 2 feet) would be observed unless groundwater elevations declined significantly below what has been observed historically and did not recover for an extended period.

There has been no reported historical or anecdotal information regarding land subsidence in the Basin as a result of groundwater extractions. There may be, and likely has been, some subsidence as a result of groundwater extraction, but the effects, to date, have not been documented to impact surface features. With groundwater declines of as much as 70 to 143 feet in the Basin (see Section 3.2.1.2), some subsidence may have occurred prior to the initiation of SGMA (January 2015), but there is no readily available information to document that. Due to the limited data available and the fact that factors other than groundwater extraction (e.g., tectonic activity and oil and gas extraction) must be considered, it is unknown how much subsidence has occurred, or how it relates to the maximum amount that may occur in the future. For these reasons, the SABGSA intends to continue to monitor for subsidence.

Staying above the minimum threshold will avoid the subsidence undesirable result and protect the beneficial uses and users from impacts to groundwater supply, land uses, infrastructure, and property interests. Should subsidence in excess of the minimum threshold be observed, the SABGSA will first assess whether the subsidence may be due to (1) groundwater pumping and (2) elastic processes (subsidence that will recover with rising groundwater). If the subsidence is not elastic or is due to pumping, the SABGSA will undertake a program to correlate the observed subsidence with measured groundwater elevations. If subsidence is confirmed to be a result of groundwater extraction and property damage is observed, the SABGSA will implement additional monitoring of the elevation of benchmarks established at key locations in the Basin. The SABGSA will also accelerate implementation of projects and management actions that stabilize groundwater levels so that continued subsidence is mitigated.

4.9.2 Minimum Thresholds for Land Subsidence [§ 354.26(c) and 354.28(a),(b)(1),(c)(5)(A)(B),(d), and (e)]

§ 354.26 Undesirable Results.

(c) The Agency may need to evaluate multiple minimum thresholds to determine whether an undesirable result is occurring in the basin. The determination that undesirable results are occurring may depend upon measurements from multiple monitoring sites, rather than a single monitoring site.

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results. Minimum thresholds for land subsidence shall be supported by the following:

(A) Identification of land uses and property interests that have been affected or are likely to be affected by land subsidence in the basin, including an explanation of how the Agency has determined and considered those uses and interests, and the Agency's rationale for establishing minimum thresholds in light of those affects.

(B) Maps and graphs showing the extent and rate of land subsidence in the basin that defines the minimum threshold and measurable objectives.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

Section 354.28(c)(5) of the SGMA regulations states that "The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results."

The subsidence minimum threshold is as follows and summarized in Table 4-4:

- The rate of subsidence does not exceed 0.05 feet (0.6 inches) per year for 3 consecutive years measured at the UNAVCO CGPS Station ORES.

This minimum threshold was selected because undesirable results have not been observed in the last 20 years and this rate of subsidence would indicate an increased rate of subsidence compared to the average rate of subsidence measured at the UNAVCO CGPS Station ORES from 2000 to 2020 (0.04 feet or 0.5 inches per year).

Table 4-4. Land Subsidence Minimum Threshold

RMS ID	Minimum Threshold Rate of Land Subsidence (feet per year)
UNAVCO CGPS Station ORES	0.05[1]

Notes

[1] Land subsidence must also cause damage to groundwater supply, land uses, infrastructure, and/or property interests
CGPS = Continuous Global Positioning System
ORES = Name of UNAVCO CGPS Station
RMS = representative monitoring site
UNAVCO = University NAVSTAR Consortium

4.9.2.1 Relationship between Individual Minimum Thresholds and Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Subsidence minimum thresholds have little or no impact on other minimum thresholds, as described below.

- **Avoid Chronic Lowering of Groundwater Levels.** Subsidence minimum thresholds will not result in significant or unreasonable lowering of groundwater levels.
- **Avoid Chronic Reduction of Groundwater in Storage.** The subsidence minimum thresholds will not change the amount of groundwater pumping and will not result in a significant or unreasonable change of groundwater in storage.
- **Avoid Degraded Groundwater Quality.** The subsidence minimum thresholds will not change the groundwater flow directions or gradients of groundwater pumping and therefore and will not result in a significant or unreasonable change in groundwater quality.
- **Avoid Depletion of Interconnected Surface Waters.** The groundwater level subsidence minimum thresholds will not change the amount or location of groundwater pumping and will not result in a significant or unreasonable depletion of interconnected surface waters.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable in the Basin.

4.9.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

The ground surface subsidence minimum thresholds are set to prevent any long-term subsidence that could harm groundwater supply, land uses, infrastructure, and property interests. Currently, no neighboring groundwater basin as defined by DWR Bulletin 118 or SABGSA has been created for this region and therefore this section of the SGMA regulations is not applicable to the Basin or GSP.

4.9.2.3 Effects of Minimum Thresholds on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

The subsidence minimum thresholds are set to prevent subsidence that could harm groundwater supply, land uses (including agricultural, residential, rural residential, and town buildings), infrastructure (including LACSD wells, WWTP, and associated infrastructure), and property interests. Available data indicate that there is currently little subsidence occurring in the Basin that affects groundwater supply, land uses, infrastructure, and property interests. Therefore, there is no likely negative impact on any beneficial user.

4.9.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

There are no federal, state, or local regulations related to subsidence.

4.9.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Minimum thresholds will be assessed using UNAVCO CGPS station data (see Section 3.2.4).

4.9.3 Measurable Objectives for Land Subsidence [§ 354.30(a)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

4.9.3.1 Methodology for Setting Measurable Objectives

The measurable objectives are set based on maintaining current conditions and changes and are measured by UNAVCO CGPS station data.

4.9.3.2 Measurable Objectives for the Basin [§ 354.30(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

The measurable objectives for subsidence represent target subsidence rates in the Basin. Available information does not suggest the occurrence of significant and unreasonable subsidence in the Basin. Therefore, the measurable objective for subsidence is based on maintaining current conditions and average rate of subsidence measured at the UNAVCO CGPS Station ORES from 2000 to 2020 (0.5 inches per year) and is summarized in Table 4-5.

Table 4-5. Land Subsidence Measurable Objective

RMS ID	Measurable Objective Rate of Land Subsidence (feet per year)
UNAVCO CGPS Station ORES	0.04

Notes

CGPS = Continuous Global Positioning System
ORES = Name of UNAVCO CGPS Station
RMS = representative monitoring site
UNAVCO = University NAVSTAR Consortium

4.9.4 Interim Milestones for Land Subsidence [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the SABGSA anticipates moving from current conditions to meeting the measurable objectives. No significant or unreasonable effect has been observed in the Basin in association with land subsidence. Therefore, no interim milestones are being proposed.

4.10 Depletion of Interconnected Surface Water Sustainable Management Criterion

4.10.1 Undesirable Results for Surface Water Depletion [§ 354.26(a),(b)(1)(2), and (d)]

§ 354.26 Undesirable Results.

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

(b) The description of undesirable results shall include the following:

(1) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(2) The cause of groundwater conditions occurring throughout the basin that would lead to or has led to undesirable results based on information described in the basin setting, and other data or models as appropriate.

(d) An Agency that is able to demonstrate that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin shall not be required to establish criteria for undesirable results related to those sustainability indicators.

Conditions that may lead to an undesirable result for interconnected surface water in the Basin include the following:

- **Groundwater level declines** caused by groundwater pumping in the Basin could reduce the amount of groundwater discharging to interconnected surface water and Barka Slough resulting in an impact to GDEs.
- **Severe drought** that reduces mountain front recharge, streamflow percolation, percolation of direction precipitation, and recharge to the Paso Robles Formation and Careaga Sand; thus, lowering groundwater levels and reducing surface water flow into the Slough, resulting in an impact to GDEs. Short-term impacts due to drought are anticipated in the SGMA regulations with recognition that management actions need sufficient flexibility to accommodate drought periods and ensure short-term impacts can be offset by increases in groundwater levels or storage during normal or wet periods.

Locally defined significant and unreasonable conditions for depletion of interconnected surface water were assessed using several resources:

- Potential GDE identification utilizing the Natural Communities Commonly Associated with Groundwater (NCCAG) data set from DWR (see Figure 3-56) and The Nature Conservancy guidance for screening of potential GDEs (The Nature Conservancy, 2019)

- A biological assessment completed in 2019 by AECOM to evaluate the potential effects that the development of the Vandenberg Dunes Golf Courses Project located west of the Basin could have on federally and state listed species existing in environmental settings comparable and downgradient of Barka Slough (see Section 3.2.6; AECOM, 2019).
- Various studies in the area, including the Wetlands and Riparian Habitats Management Plan prepared for the Vandenberg Air Force Base (now the VSFB) (ManTech, 2010).
- Identification of interconnected surface water (see Section 3.2.5)
- Groundwater elevation monitoring data including calculations of vertical groundwater flow into the Slough (see Section 3.2.1.2)
- Available stream gage data (e.g., Casmalia stream gage)
- Water budget computations that include quantifications of groundwater discharge to surface water (see Section 3.3).

Avoiding adverse impacts on beneficial uses of interconnected surface water in the Basin and preserving existing habitat are the focus of this sustainability indicator because groundwater present in the Paso Robles Formation and Careaga Sand discharge into surface water that flows into the Slough. Direct uses of surface water (for recreation, irrigation, or municipal purposes) are not present or expected as a future significant beneficial use in the Basin, therefore the sustainability criterion for depletion of interconnected surface water is focused on avoiding impacts to GDEs and sensitive species. There is no intention at this time, nor a regulatory requirement, to create new habitat or restore habitat that existed prior to the enactment of SGMA in January of 2015. In conjunction with the TNC guidance, mapped GDEs in the watershed that include both aquatic and riparian habitat types are located in Barka Slough, the Las Flores watershed, and northeast of Los Alamos on Price Ranch (see Figure 3-56). Except for the Slough, without additional analysis, it is unknown whether the groundwater source of these springs or seeps is from the underlying principal aquifer or perched water within the channel alluvium. Therefore, until flow of groundwater is better understood in these areas, meaningful SMCs related to interconnected surface water and supporting associated GDEs cannot be developed. If analysis of these areas indicates interconnected surface water with the Paso Robles Formation or the Careaga Sand, SMCs will be developed pursuant to avoid undesirable results as described below. Planned additional analysis of these areas are described in Section 6.

Groundwater levels measured in wells located near the Slough indicate that groundwater levels have fallen below the Slough surface elevation in a number of locations since about 1983. In addition, upward vertical gradients within the Careaga Sand near the Slough (see Figure 3-71) have been reduced. This indicates that groundwater flow into the Slough has likely declined. Surface water also discharges into the Slough; there is a strong correlation between precipitation and measured flow at the Casmalia stream gage (11136100) located in San Antonio Creek west of Barka Slough. Available information shows that San Antonio Creek east of the Slough is intermittent and the Casmalia stream gage located 2.5 miles west of the Slough shows perennial flow. This indicates a probable groundwater contribution to the Slough. Without a stream gage at the east end of the Slough, it is not known what the surface water contribution is or whether surface water flow into the Slough has been decreasing. This is a data gap that will be addressed in the projects and management actions section of the GSP. Due to gaps in recorded data at the Casmalia stream gage (2003–2015) it is not possible to accurately determine the direct effect of pumping in the Basin on measured surface water flow using the Casmalia stream gage. Regardless, the existing condition supports significant habitat values. As a result, significant and unreasonable depletion of surface water and reduction of groundwater flowing into the Slough causing impacts to GDEs at the Slough would include the following undesirable result:

- Permanent loss or significant degradation of existing native riparian or aquatic habitat due to lowered groundwater levels and reduced surface water flow into Barka Slough caused by groundwater pumping.

A sustained decrease in surface water and groundwater flow into the Slough caused by pumping that results in groundwater levels dropping below root zones could result in permanent loss of GDEs and, as such, a monitoring program and management actions that are focused on preventing continued decline in groundwater levels are needed. Monitoring of groundwater levels in the Barka Slough area will continue to be conducted by the SABGSA as part of its Basin monitoring programs (see Section 5) to assess whether there is potential for a long-term decline in the health of the vegetation and eventual permanent habitat loss. Additional characterization of the nature, type, and extent of GDE communities in the Slough is needed.

The surface water component of flow into the Slough is equally as important as groundwater discharge into the Slough. Until new stream gages are installed that measure surface water flow entering and exiting the Slough, the Casmalia stream gage located downstream of the Slough will be monitored, as outlined in Section 5.

4.10.2 Minimum Thresholds for Surface Water Depletion [§ 354.28(a),(b)(1),(c)(6)(A)(B),(e), and (d)]

§ 354.28 Minimum Thresholds.

(a) Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.

(b) The description of minimum thresholds shall include the following:

(1) The information and criteria relied upon to establish and justify the minimum thresholds for each sustainability indicator. The justification for the minimum threshold shall be supported by information provided in the basin setting, and other data or models as appropriate, and qualified by the uncertainty in the understanding of the basin setting.

(c) Minimum thresholds for each sustainability indicator shall be defined as follows:

(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results. The minimum threshold established for depletions of interconnected surface water shall be supported by the following:

(A) The location, quantity, and timing of depletions of interconnected surface water.

(B) A description of the groundwater and surface water model used to quantify surface water depletion. If a numerical groundwater and surface water model is not used to quantify surface water depletion, the Plan shall identify and describe an equally effective method, tool, or analytical model to accomplish the requirements of this Paragraph.

(e) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish minimum thresholds related to those sustainability indicators.

(d) An Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence.

Section 354.28(c)(6) of the SGMA regulations states that "The minimum thresholds for depletion of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results."

The DWR BMPs indicate that a groundwater model should be used to estimate surface water depletion. Because the USGS model for the Basin is still under development and could not be used to estimate depletion, other methods were used, including analysis of surface water discharges leaving Barka Slough at the Casmalia stream gage and results from the water budget computations. Figure 4-2 shows the hydrograph for surface water flow measured at the Casmalia stream gage, located over 2.5 miles downstream of Barka Slough, outside of the Basin.

As shown on Figure 4-2, surface water flow measured at this gage shows significant variability resulting from climatic effects and that base flow has been fairly constant since 2015, with a geometric mean of 0.5 cubic feet per second (cfs) since 2015. There is no significant depletion of streamflow evident in the hydrograph for this period; however, it is possible that depletion may have occurred prior to 2015. There is a gap in data between 2003 and 2015.

Figure 4-3 shows the relationship between rainfall and groundwater discharge to surface water derived from the historical water budget (see Section 3.3). This figure also shows a strong correlation between rainfall and groundwater discharge to surface water. This is not unexpected because the methodology used to develop the groundwater discharge to surface water term in the water budget includes rainfall and streamflow as inflow terms in the water budget.

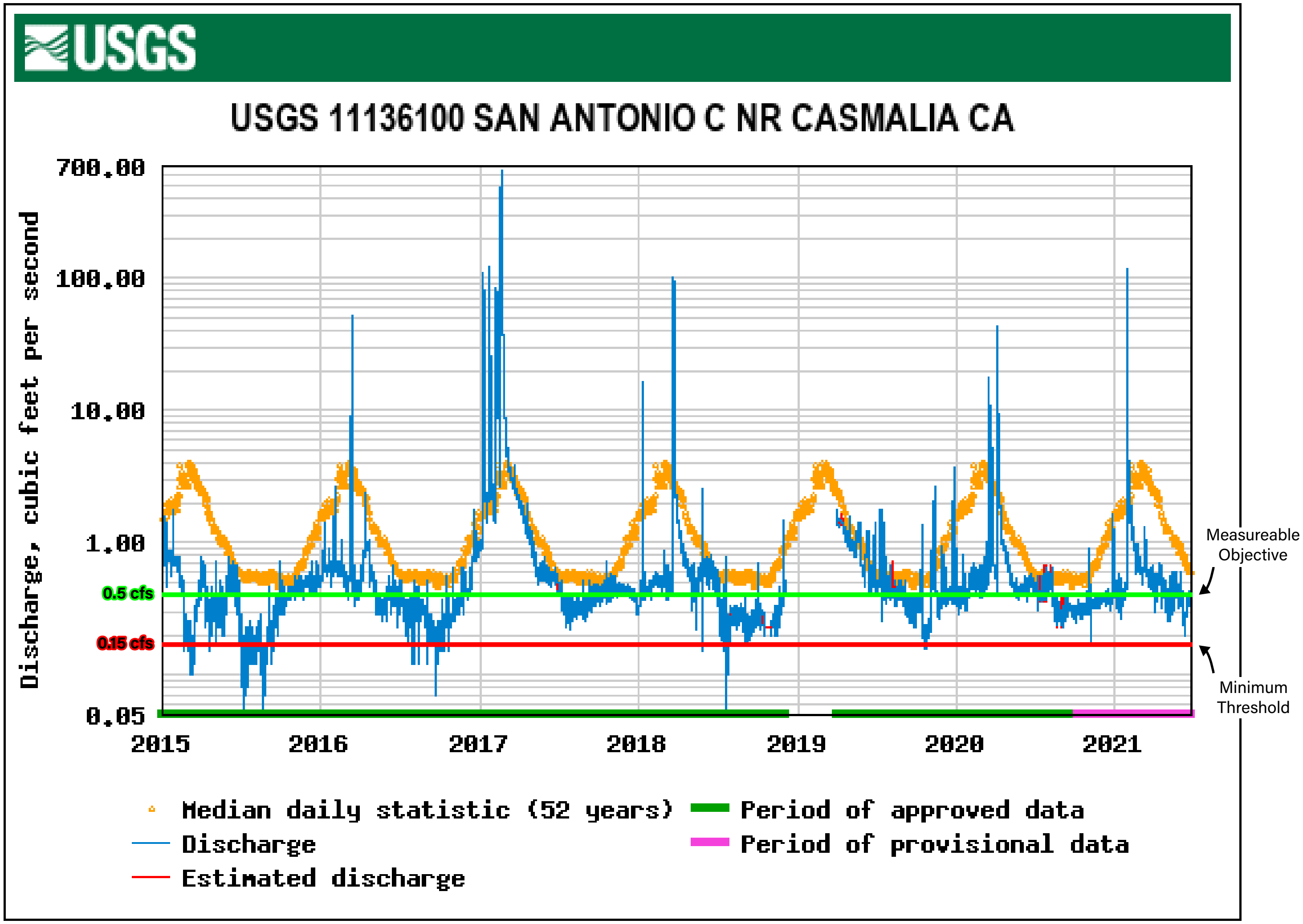

FIGURE 4-2

Casmalia Stream Gage Measured Flow

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

NOTE
cfs: cubic feet per second

Data Sources: USGS

GSI Water Solutions, Inc.

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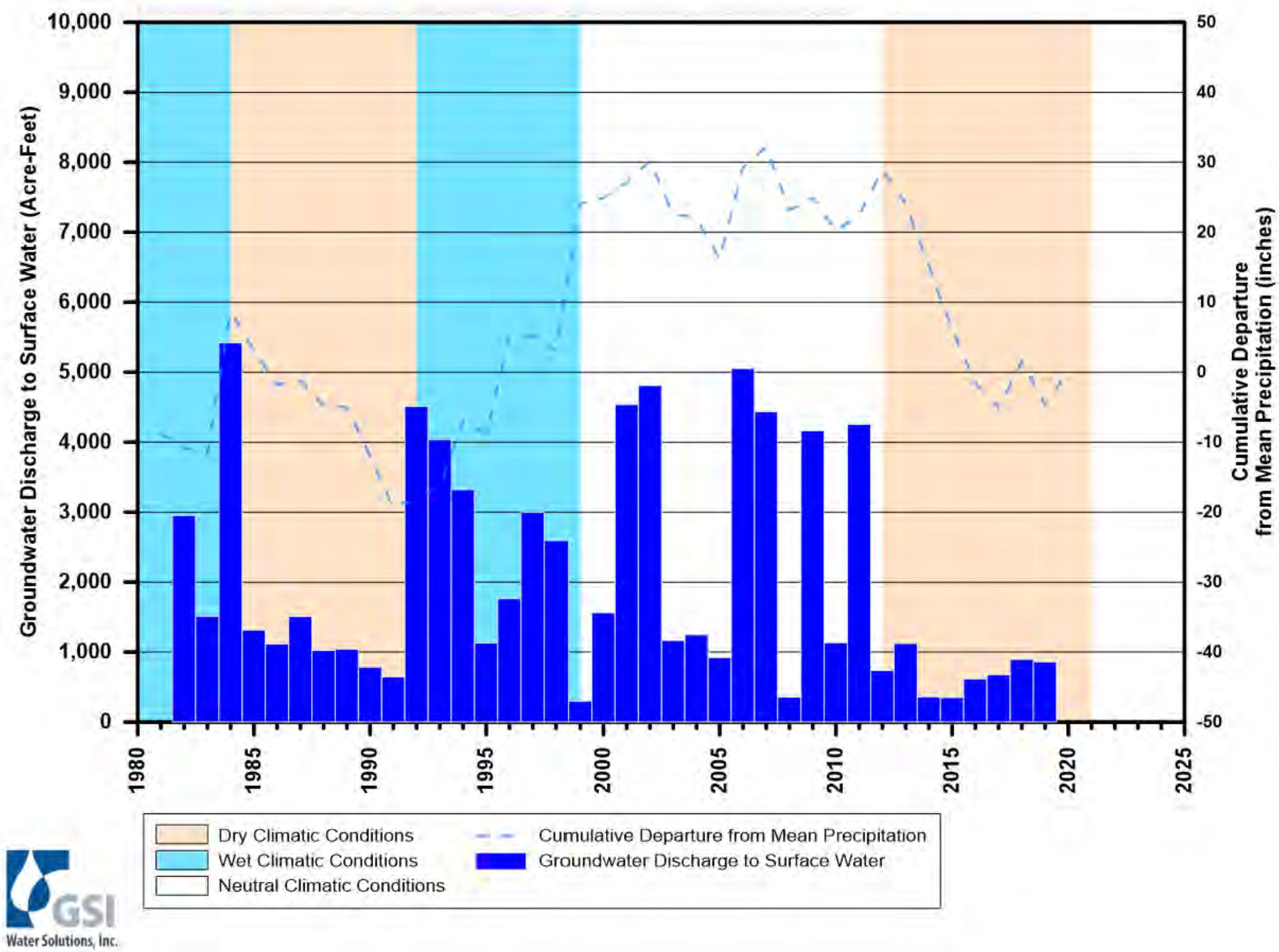


Figure 4-3. Groundwater Discharge to Surface Water at Barka Slough and Cumulative Departure from Mean Precipitation

Based on this evaluation, it is unclear to what extent groundwater pumping has caused surface water depletion; however, the observed reduction over time in the vertical gradients in wells completed in the Careaga Sand adjacent to the Slough (e.g., nested wells 16C2 and 16C4) indicate that there is less groundwater discharging into the Slough than in the past. Using Darcy's Law and assumed hydraulic characteristics and observed vertical gradients in the Careaga Sand beneath the Slough, the reduction in groundwater discharge to the Slough during the historical period is on the order of 350 AFY. While some of this is a result of drying conditions and reduced rainfall, the data indicate that some of the reduction in groundwater discharge may be caused by groundwater pumping in the Basin. This can be evaluated further once the USGS groundwater model becomes available.

Avoiding adverse impacts on beneficial uses of interconnected surface water in the Basin is the focus of this sustainability indicator. Because direct uses of surface water for recreation, irrigation, or municipal purposes are not present or expected in the future in the Basin, the minimum thresholds for depletion of interconnected surface water are focused on avoiding impacts to GDEs. The slough area is the only location in the Basin identified where groundwater is interconnected with surface water.

The Barka Slough exhibits a diverse and complex interaction between surface water and groundwater and determination of what portions of the Slough are sustained by surface water flows and areas sustained by groundwater is not straightforward. There is an approximately 25 to 50 feet thick confining layer of peat and clay beneath the Slough (Martin, 1985). Without an improved understanding of the slough water budget, it is not possible at this time to confidently establish a minimum threshold for depletion of interconnected surface water. Actions described in Section 6 are intended to stabilize groundwater levels in the Basin, which will likely result in avoiding impacts to GDEs present in the Slough.

Until more is known about the relationship between groundwater and surface water in the vicinity of the Slough and depletion can be quantified and monitored, an interim minimum threshold, based on the best available information, focusses on avoiding depletion and maintaining surface water and groundwater flow entering and leaving the Slough. The interim minimum threshold is presented below and summarized in Table 4-6:

- 0.15 cfs of surface water flow measured at the Casmalia stream gage west of the Slough. This threshold was selected based on the analysis of historical base flow at the Casmalia stream gage presented on Figure 4-2.

This is considered an interim threshold that is subject to change as more information is obtained in the future. Figure 4-4 shows the location of the Casmalia stream gage relative to Barka Slough.

Table 4-6. Depletion of Interconnected Surface Water Minimum Thresholds

RMS ID	Minimum Threshold
Casmalia stream gage[1]	0.15 cfs average base flow[2]

Notes

[1] See Figure 4-4 for the location of the Casmalia stream gage. Measurement location and minimum threshold may change if additional stream gages are installed.

[2] Measured over 3 consecutive months from June to September.
cfs = cubic feet per second
RMS = representative monitoring site

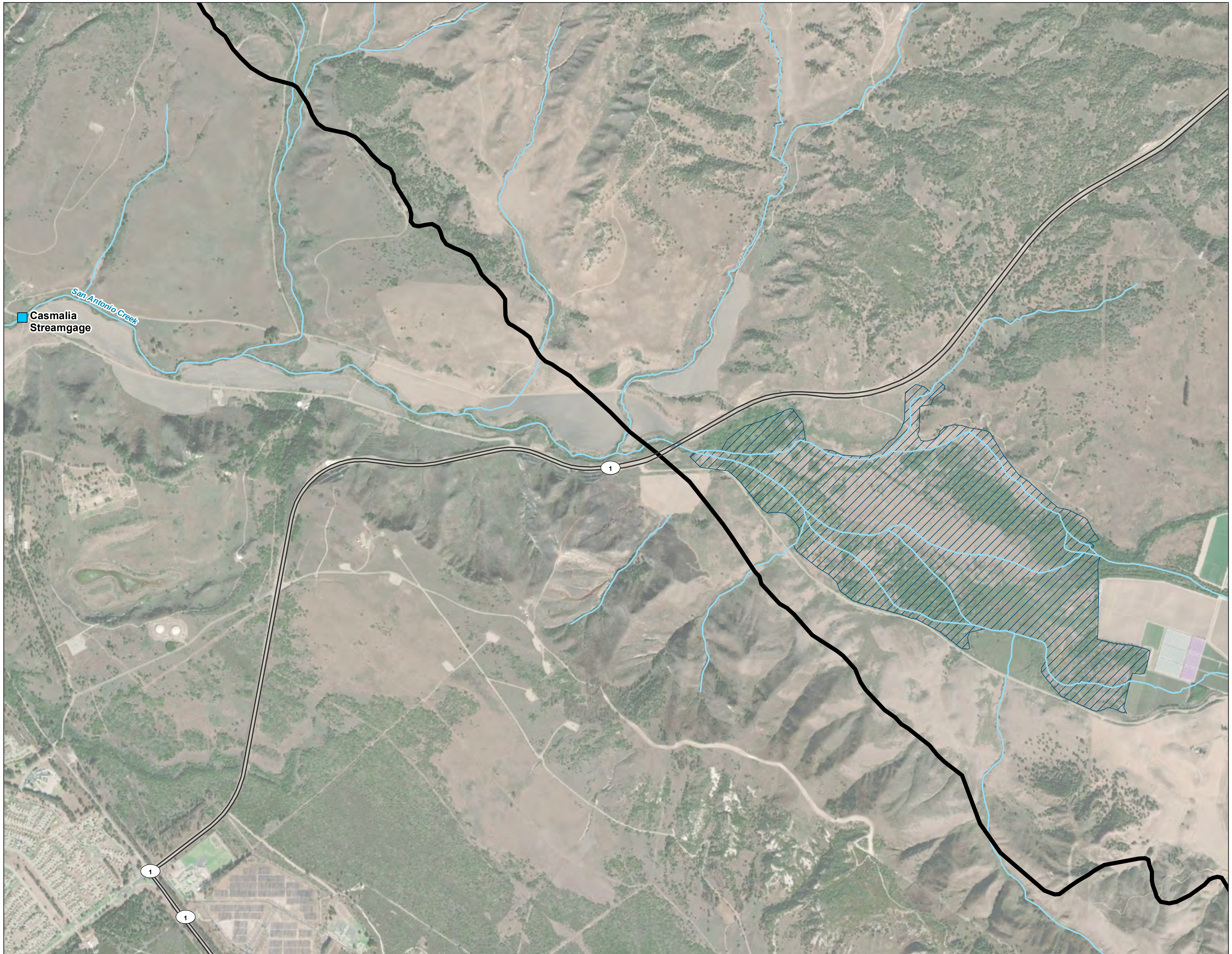


FIGURE 4-4

Interconnected Surface Water Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Streamgage

All Other Features

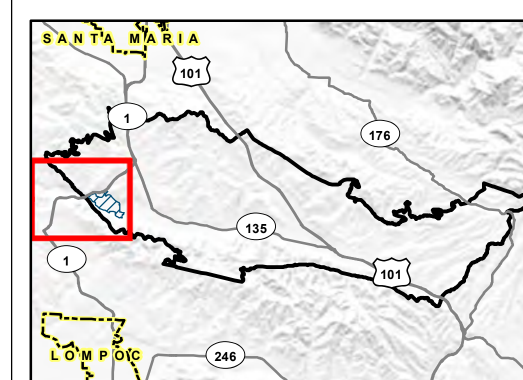
San Antonio Creek or Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary



N

0 1,000 2,000 3,000
Feet

Date: November 18, 2021
Data Sources: ESRI, DWR (2018), USGS (2020), Maxar Imagery (2020)

GSI Water Solutions, Inc.

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4.10.2.1 Relationship between Individual Minimum Thresholds and to Other Sustainability Indicators [§ 354.28(b)(2)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(2) The relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the Agency has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators.

Because of the interrelationship between groundwater level, changes in storage, and interconnected surface water, it is possible that one set of thresholds could affect the other set of thresholds for these indicators. The relationship between the depletion of interconnected surface water and the other sustainability indicators is presented below.

- **Avoid Chronic Lowering of Groundwater Levels.** The depletion of surface water minimum threshold is related to groundwater level minimum thresholds elsewhere in the Basin because they are interdependent. The relationship between Basin groundwater levels and groundwater discharge to the Slough is not well understood; additionally, it is unclear if the surface water depletion minimum threshold will drive the need to adjust the minimum threshold for chronic lowering of groundwater levels.
- **Avoid Chronic Reduction of Groundwater in Storage.** Nothing about the GDE minimum thresholds promotes groundwater pumping in excess of the sustainable yield. Therefore, the GDE minimum thresholds will not result in an exceedance of the groundwater in storage minimum threshold.
- **Avoid Degraded Groundwater Quality.** The GDE minimum thresholds will not change the groundwater flow directions or gradients, and therefore will not result in a significant or unreasonable change in groundwater quality.
- **Avoid Land Subsidence.** Nothing about the GDE minimum thresholds promotes a condition that will lead to additional subsidence. Therefore, the GDE minimum thresholds will not result in a significant or unreasonable level of subsidence.
- **Avoid Seawater Intrusion.** This sustainability indicator is not applicable to this Basin.

4.10.2.2 Effects of Minimum Thresholds on Neighboring Basins [§ 354.28(b)(3)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.

As discussed in Section 3.1, the Basin is a closed basin; therefore, groundwater is not accounted for as an inflow or an outflow component of the water budget. However, depletion of interconnected surface waters is directly related to removing groundwater from storage in the Basin and lowering of groundwater levels. Lowering groundwater levels reduces the discharge of groundwater to surface water in Barka Slough. Surface water in the Slough exits the Basin in San Antonio Creek and flows west toward the Pacific Ocean, becoming available to potential users outside the Basin. Currently, no groundwater basin as defined by DWR Bulletin 118 or SABGSA has been created for this region and, therefore, this section of the SGMA regulations is not applicable to the Basin or GSP.

4.10.2.3 Effects on Beneficial Uses and Land Uses [§ 354.28(b)(4)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(4) How minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.

Minimum thresholds relating to depletion of interconnected surface water have been selected to avoid impacts to GDEs in the Basin while providing a reliable and sustainable groundwater supply. The minimum thresholds for reduction of groundwater in storage and lowering of groundwater levels have been established to avoid undesirable results. For this reason, groundwater serving beneficial uses (including GDEs) and land uses will not be adversely affected.

4.10.2.4 Relevant Federal, State, or Local Standards [§ 354.28(b)(5)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(5) How state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the Agency shall explain the nature of and basis for the difference.

There are no federal, state, or local regulations related to interconnected surface water depletion other than those that are intended to protect aquatic and terrestrial threatened and endangered species. The thresholds and management actions described herein are intended to prevent impacts to these species and associated habitats.

4.10.2.5 Methods for Quantitative Measurement of Minimum Thresholds [§ 354.28(b)(6)]

§ 354.28 Minimum Thresholds.

(b) The description of minimum thresholds shall include the following:

(6) How each minimum threshold will be quantitatively measured, consistent with the monitoring network requirements described in Subarticle 4.

Continuous flow measurements at the Casmalia stream gage are the best indication of flow entering and existing Barka Slough as shown on Figure 4-4. Details of this monitoring program are presented in Section 5.

4.10.3 Measurable Objectives for Surface Water Depletion [§ 354.30(a),(b),(c),(d), and (g)]

§ 354.30 Measurable Objectives.

(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin within 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.

(b) Measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds.

(c) Measurable objectives shall provide a reasonable margin of operational flexibility under adverse conditions which shall take into consideration components such as historical water budgets, seasonal and long-term trends, and periods of drought, and be commensurate with levels of uncertainty.

(d) An Agency may establish a representative measurable objective for groundwater elevation to serve as the value for multiple sustainability indicators where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual measurable objectives as supported by adequate evidence.

(g) An Agency may establish measurable objectives that exceed the reasonable margin of operational flexibility for the purpose of improving overall conditions in the basin, but failure to achieve those objectives shall not be grounds for a finding of inadequacy of the Plan.

Groundwater and surface water exit the Basin as surface water flow from Barka Slough. Consequently, if surface water flow can be measured exiting the Basin, it is inferred that there is sufficient water available to GDEs in the Slough. If surface flow exiting Barka Slough ceased, there is a potential that there is no longer enough water, whether entering the Slough as groundwater or surface water, available to GDEs located in the Slough.

Figure 4-2 shows measured flow at the Casmalia stream gage between 2015 and 2021. The measurable objective for depletion of interconnected surface water is surface water flow measured at the Casmalia stream gage equal to the geometric mean flow (0.5 cfs) between 2015 and 2018 (since enactment of SGMA through the end of the historical and current water budget) (see Table 4-7). Figure 4-4 shows the location of the Casmalia stream gage in relation to Barka Slough. Daily measurements collected at the Casmalia stream gage will be averaged during each 5-year GSP update period (i.e., 2027, 2032, 2037, and 2042) and compared to the measurable objective.

Table 4-7. Depletion of Interconnected Surface Water Measurable Objective

RMS ID	Measurable Objectives
Casmalia stream gage	0.5[1]

Notes

[1] Value reported as geometric mean daily discharge measured in cubic feet per second at the Casmalia stream gage between 2015–2018.
RMS = representative monitoring site

4.10.4 Interim Milestones for Surface Water Depletion [§ 354.30(e)]

§ 354.30 Measurable Objective.

(e) Each Plan shall describe a reasonable path to achieve the sustainability goal for the basin with 20 years of Plan implementation, including a description of interim milestones for each relevant sustainability indicator, using the same metric as the measurable objective, in increments of five years. The description shall explain how the Plan is likely to maintain sustainable groundwater management over the planning and implementation horizon.

Interim milestones show how the SABGSA anticipates moving from current conditions to meeting the measurable objectives. Based on available information, there are no reported or observed significant or unreasonable effects related to depletion of interconnected surface water that is directly attributable to groundwater pumping. However, there are considerable uncertainties regarding the degree to which reduction of groundwater discharging to the Slough is impacting the Slough. Additional study and data collection is needed as described in Section 6.

4.11 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

AECOM. 2019. *Biological Assessment, Potential Effects to California Red-legged Frog, El Segundo Blue Butterfly, Tidewater Goby, Unarmored Threespine Stickleback, and Beach Layia, Vandenberg Dunes Golf Courses Project, Vandenberg Air Force Base, Santa Barbara County.* September 25.

DWR. 2018. 3-014 San Antonio Creek Valley Basin Boundaries. Prepared by the California Department of Water Resources.

DWR. 2017. *Best Management Practices for the Sustainable Management of Groundwater: DRAFT Sustainable Management Criteria.* Prepared by the California Department of Water Resources Sustainable Groundwater Management Program.

ManTech. 2010. Wetlands and Riparian Habitats Management Plan – Vandenberg Air Force Base, California. Prepared by ManTech SRS Technologies. March 2010.

Martin, P. 1985. *Development and Calibration of a Two-Dimensional Digital Model for the Analysis of the Ground-Water Flow System in the San Antonio Creek Valley, Santa Barbara County, California*. U.S. Geological Survey Water-Resources Investigations Report 84-4340.

Maxar. 2020. Base maps for California. Provided by Maxar Imagery.

The Nature Conservancy. 2019. *Identifying GDEs under SGMA, Best Practices for Using the NC Dataset.* July.

RWQCB. 2019. Water Quality Control Plan for the Central Coastal Basin, June 2019 Edition. California Environmental Protection Agency. Central Coast Regional Water Quality Control Board.

SWRCB. 2019. California Code of Regulations, Title 22. April 16. California State Water Resources Control Board.

USGS. 2020. The National Map, Data Download and Visualization Services. NHDPlus High Resolution Data Model v1.0. Provided by the U.S. Geological Survey. Available at https://www.usgs.gov/media/files/nhdplus-high-resolution-data-model-v10. (Accessed August 5, 2021.)

SECTION 5: **Monitoring Networks [Article 5, SubArticle 4]**

5.1 Introduction to Monitoring Networks [§ 354.32]

§ 354.32 Introduction to Monitoring Networks. This Subarticle describes the monitoring network that shall be developed for each basin, including monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network shall promote the collection of data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the basin and evaluate changing conditions that occur through implementation of the Plan.

This section describes existing monitoring networks and improvements to the monitoring networks that will be developed for the San Antonio Creek Valley Groundwater Basin (Basin). This section is prepared in accordance with the Sustainable Groundwater Management Act (SGMA) regulations § 354.32, § 354.34, § 354.36, § 354.38, and § 354.40 and includes monitoring objectives, monitoring protocols, assessment and improvement of monitoring networks, representative monitoring, and data reporting requirements.

The monitoring networks presented in this section are based on existing monitoring sites. During the 20-year Groundwater Sustainability Plan (GSP) implementation period, it may be necessary to expand the existing monitoring networks and identify or install more monitoring sites to fully demonstrate sustainability and improve the GSP model. Monitoring networks and data gaps are described for each of the five applicable sustainability indicators. Identified data gaps will be addressed during GSP implementation to improve the San Antonio Basin Groundwater Sustainability Agency's (SABGSA's) ability to track progress and demonstrate sustainability.

The groundwater monitoring network section of this GSP is largely based on historical groundwater data compiled by the U.S. Geological Survey (USGS) National Water Information System (NWIS) program, the USGS Groundwater Ambient Monitoring and Assessment (GAMA) Program, the California Statewide Groundwater Elevation Monitoring (CASGEM),[48] and quarterly groundwater monitoring completed by the SABGSA beginning the fourth quarter of 2019 to present.

[48] Available at NWIS https://maps.waterdata.usgs.gov/mapper/index.html; GAMA, https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/; and CASGEM, https://water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM, respectively (Accessed May 18, 2021.)

5.2 Monitoring Network Objectives and Design Criteria [§ 354.34(a),(b)(1),(b)(2),(b)(3),(b)(4),(d),(f)(1),(f)(2),(f)(3), and (f)(4)]

§ 354.34 Monitoring Network.

(a) Each Agency shall develop a monitoring network capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation.

(b) Each Plan shall include a description of the monitoring network objectives for the basin, including an explanation of how the network will be developed and implemented to monitor groundwater and related surface conditions, and the interconnection of surface water and groundwater, with sufficient temporal frequency and spatial density to evaluate the affects and effectiveness of Plan implementation. The monitoring network objectives shall be implemented to accomplish the following:

(1) Demonstrate progress toward achieving measurable objectives described in the Plan.

(2) Monitor impacts to the beneficial uses or users of groundwater.

(3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds.

(4) Quantify annual changes in water budget components.

(d) The monitoring network shall be designed to ensure adequate coverage of sustainability indicators. If management areas are established, the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the basin setting and sustainable management criteria specific to that area.

(f) The Agency shall determine the density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends based upon the following factors:

(1) Amount of current and projected groundwater use.

(2) Aquifer characteristics, including confined or unconfined aquifer conditions, or other physical characteristics that affect groundwater flow.

(3) Impacts to beneficial uses and users of groundwater and land uses and property interests affected by groundwater production, and adjacent basins that could affect the ability of that basin to meet the sustainability goal.

(4) Whether the Agency has adequate long-term existing monitoring results or other technical information to demonstrate an understanding of aquifer response.

The SGMA regulations require monitoring networks be developed to promote the collection of data of sufficient quality, frequency, and spatial distribution to characterize groundwater and related surface water conditions in the basin and to evaluate changing conditions that occur through implementation of the GSP. The monitoring network should accomplish the following:

- Demonstrate progress toward achieving measurable objectives described in the GSP
- Monitor impacts to the beneficial uses and users of groundwater
- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds
- Quantify annual changes in water budget components

The minimum thresholds and measurable objectives monitored by the networks are described in Section 4.

5.2.1 Monitoring Networks

Monitoring networks have been developed for each of the five sustainability indicators that are applicable to the Basin. These indicators are described in SGMA as conditions to be avoided:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Degraded water quality
- Land subsidence
- Depletion of interconnected surface water

The Basin is located approximately 8 miles inland from the Pacific Ocean and a bedrock high is located at the western end of the Basin. No exchange of groundwater, except in the form of groundwater discharge to surface water, has been identified at the western (downgradient) end of the Basin (see Section 3). Consequently, a sixth sustainability indicator, seawater intrusion, is not applicable in the Basin and this GSP does not describe monitoring for seawater intrusion.

The SGMA regulations allow the GSA to use existing monitoring sites for the monitoring network; however, some monitoring sites do not presently meet all SGMA requirements that include unique well identification number, well location, ground surface elevation, well depth, and perforated intervals. Currently, some wells in the groundwater level monitoring network do not have perforated interval information. Perforated interval and other monitoring well information will be obtained during GSP implementation.

The approach for establishing the monitoring networks for the Basin is to leverage historical or existing monitoring programs and incorporate, as needed, additional monitoring locations that have been made available by cooperating entities. The monitoring networks are limited to locations with data that are publicly available and not collected under confidentiality agreements. This section identifies data gaps in each monitoring network and proposes locations and methods for filling those data gaps.

5.2.2 Management Areas

At this time, management areas have not been defined for the Basin. If management areas are developed in the future, the monitoring networks will be reevaluated to ensure that there is sufficient monitoring to evaluate conditions in each management area.

5.3 Groundwater Level Monitoring Network [§ 354.34(e),(g)(1)(2)(3),(h), and (j)]

§ 354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

The minimum thresholds and measurable objectives for the chronic lowering of groundwater levels sustainability indicator are evaluated by monitoring groundwater levels at groundwater wells identified as representative monitoring sites (RMSs). The SGMA regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features.

Groundwater well construction information and water level data were obtained from the following public sources:

- USGS NWIS
- California Department of Water Resources (DWR) CASGEM
- DWR Online System for Well Completion Reports (OSWCR)
- The Los Alamos Community Services District (LACSD)

These data sources resulted in a data set of more than 200 wells, each analyzed using the following criteria to assess whether they would be included in the groundwater level monitoring network:

- **Include only currently measured wells:** To reduce the possibility of selecting a well that has not been monitored in many years or that may no longer be accessible, wells were excluded that did not have at least one groundwater level measurement from 2015 or later. Wells that have collapsed or have been destroyed since 2015 were also excluded. All the groundwater level monitoring data available for the Basin that met this criterion were provided by the USGS, DWR CASGEM, LACSD, or the GSA for a total of 55 wells.
- **Remove wells for which access agreements were denied by well owners:** The GSA was not able to obtain access agreements for five of the wells included in the USGS-led groundwater level monitoring program for the Basin. These wells are excluded from the existing groundwater level monitoring network. An effort is ongoing to reach out to well owners with pending well access agreements to discuss participation in the groundwater level monitoring network.[49] The groundwater level data that met this criterion resulted in a total of 50 wells, including wells with pending well access agreements.

The wells included in the groundwater level monitoring network are listed in Table 5-1 and shown on Figure 3-11. A subset of wells from the monitoring network has been selected as RMSs. RMSs are defined in the SGMA regulations as a subset of monitoring sites that are representative of conditions in the Basin. These RMS wells are evaluated in terms of sustainable management criteria (SMCs) in Section 4. The groundwater level RMS network is summarized in Table 5-1 and shown on Figure 5-1. RMSs with pending access agreements are noted in Table 5-1. Further rationale for selection of RMSs is provided in Section 4.4.

All but six wells in the groundwater level monitoring network are monitored by the GSA. Four of the six wells are monitored by the LACSD using pressure transducers coupled to a Supervisory Control and Data Acquisition (SCADA) system. Static water levels are provided to the GSA on a quarterly basis in association with the GSA's quarterly monitoring events. The remaining two wells are monitored by Santa Barbara County semiannually, in March and October, as part of the DWR CASGEM program. The most recent available measurements for all wells included in the groundwater level monitoring network were collected in 2019, 2020, or 2021.

Pressure transducers are installed in 10 wells in the groundwater level monitoring network. Each transducer is programmed to measure groundwater elevation once every 4 hours and is calibrated quarterly. Wells equipped with transducers are shown in Figure 5-2.

[49] To date, this outreach has resulted in the addition of several wells to the groundwater level monitoring network.

Table 5-1. Groundwater Level Monitoring Network

Well ID	Well Type	Well Depth (ft)	Screen Interval(s) (ft bgs)	Ground Elevation (ft NAVD 88)	Elevation Reference Point Description (ft NAVD 88)	First Date Measured	Last Date Measured	Years Measured	Total Number of Measurements	Screened Aquifer	RMS Well (Y/N)
13C1	Agricultural	1,070	—	776.8	777.8	2/25/2004	2/25/2021	17	30	Careaga Sand	Y
13Q1[2]	Agricultural	295	47-295	662.3	663.3	11/7/1957	10/5/2020	63	37	Paso Robles Formation	N
14L1	Monitoring	593	500-560	328.7	330.4	6/20/1980	2/25/2021	41	1958	Careaga Sand	N
16C2[1]	Monitoring	169	—	328.6	330.2	2/5/1970	2/26/2021	51	299	Careaga Sand	N
16C4[1]	Monitoring	560	—	328.6	330.0	2/5/1970	2/26/2021	51	298	Careaga Sand	N
16F1	Monitoring	57.8	—	276.4	280.5	8/1/1978	2/26/2021	43	149	Careaga Sand	N
16G3	Monitoring	55.5	—	294.5	297.5	2/25/1976	2/26/2021	45	179	Careaga Sand	Y
17E1[3]	Monitoring	89	—	243	247.1	2/25/1976	2/25/2021	45	180	Careaga Sand	N
17H1[3]	Monitoring	61	—	260	264.6	3/26/1976	2/26/2021	45	139	Careaga Sand	N
17K2[3]	Monitoring	60	—	260	264.3	9/26/1978	2/25/2021	42	148	Careaga Sand	N
17Q1[3]	Monitoring	48	—	270	275.0	9/26/1978	2/25/2021	42	121	Careaga Sand	N
20Q2[2]	Agricultural	—	—	406.4	407.9	1/16/1958	6/25/2019	61	130	Paso Robles Formation	Y
21A1	Monitoring	271	—	301	304.0	12/16/1977	2/25/2021	43	1056	Careaga Sand	N
22J1[2,3]	Agricultural	—	—	1,435	1436.0	3/22/1990	6/26/2019	29	33	Careaga Sand	N
22K3[2]	Agricultural	250	—	453.2	453.3	11/5/1971	10/5/2020	49	44	Paso Robles Formation	Y
22M1[2,3]	Agricultural	—	—	1,268	1268.4	1/19/2018	6/26/2019	1	5	Careaga Sand	N
22N1[2,3]	Agricultural	175	—	1,201	1201.7	1/5/2017	6/26/2019	2	5	Paso Robles Formation	N
24 E1[2,3]	Agricultural	580	310-570	350	351.3	6/3/1977	6/25/2019	42	99	Careaga Sand	Y
25D1[2]	Agricultural	700	268-700	764.9	766.4	4/22/1977	6/26/2019	42	102	Careaga Sand	Y
2M1	Agricultural	750	240-500	419.4	420.0	6/15/1977	2/25/2021	44	105	Paso Robles Formation	Y
2N1[3]	Agricultural	980	290-960	827	827.3	3/14/2017	2/25/2021	4	8	Careaga Sand	N
2R1[3]	Agricultural	370	220-320	776	778.0	11/5/2019	2/25/2021	1	5	Careaga Sand	N
30D1[2, 3]	Agricultural	895	265-895	540	541.0	6/16/1977	6/26/2019	42	869	Paso Robles Formation	Y
34P1	Monitoring	222.5	—	452.5	455.0	8/9/1979	2/25/2021	42	97	Careaga Sand	Y
4-Deer Field[3]	Agricultural	490	—	639	639.4	1/25/2018	2/25/2021	3	11	Careaga Sand	N
4-Deer Highway	Agricultural	349	—	689.2	689.7	12/1/1955	2/25/2021	65	13	Careaga Sand	N
LACSD 3a[3]	Municipal	521	180-510	589	589.9	11/17/2010	6/25/2020	10	214	Paso Robles Formation	N
LACSD 4[3]	Municipal	535	230-530	604	605.0	3/28/1994	6/25/2020	26	467	Paso Robles Formation	Y
LACSD 5[3]	Municipal	1,010	502-952	560.2	561.9	1/31/2007	6/25/2020	13	266	Paso Robles Formation	N
LACSD 6[3]	Municipal	1,005	190-950	566	568.1	12/18/2019	6/25/2020	1	10	Paso Robles Formation	N
Mesa Vineyard	Agricultural	—	—	805	806.8	11/5/2019	2/25/2021	1	6	Careaga Sand	N
SACC 1	Monitoring	980	920-940	586.1	585.1	9/8/2016	2/25/2021	4	26	Paso Robles Formation	Y
SACC 2	Monitoring	720	700-720	586.1	585.1	9/23/2016	2/25/2021	4	25	Paso Robles Formation	N
SACC 3	Monitoring	530	510-530	586.1	585.1	9/8/2016	2/25/2021	4	27	Paso Robles Formation	N
SACC 4	Monitoring	325	305-325	586.1	585.1	9/8/2016	2/25/2021	4	27	Paso Robles Formation	N
SACC 5[1]	Monitoring	120	100-120	586.2	586.1	3/13/2017	2/26/2021	4	384	Paso Robles Formation	N

Well ID	Well Type	Well Depth (ft)	Screen Interval(s) (ft bgs)	Ground Elevation (ft NAVD 88)	Elevation Reference Point Description (ft NAVD 88)	First Date Measured	Last Date Measured	Years Measured	Total Number of Measurements	Screened Aquifer	RMS Well (Y/N)
SACR 1	Monitoring	690	670-690	363	361.9	9/21/2016	2/25/2021	4	25	Careaga Sand	Y
SACR 2	Monitoring	540	520-540	363	361.9	9/21/2016	2/25/2021	4	25	Paso Robles Formation	N
SACR 3	Monitoring	350	330-350	363	361.9	9/21/2016	2/25/2021	4	25	Paso Robles Formation	Y
SACR 4	Monitoring	220	200-220	363	361.9	9/21/2016	2/25/2021	4	25	Paso Robles Formation	N
SACR 5[1]	Monitoring	110	90-110	362.5	365.4	1/4/2017	2/26/2021	4	386	Paso Robles Formation	N
SAGR[1]	Monitoring	90	70-90	329.6	329.7	3/8/2016	2/26/2021	5	387	Paso Robles Formation	N
SAHC[1]	Monitoring	90	70-90	453.2	455.3	3/8/2016	2/26/2021	5	185	Careaga Sand	Y
SAHG[1]	Monitoring	75	55-75	320.6	323.6	3/13/2017	2/26/2021	4	387	Paso Robles Formation	N
SALA[1]	Monitoring	90	70-90	596.5	596.5	3/13/2017	2/26/2021	4	276	Paso Robles Formation	N
SALS[1]	Monitoring	70	50-70	459.5	459.5	3/13/2017	2/26/2021	4	383	Paso Robles Formation	Y
SASA[1]	Monitoring	65	45-65	309.7	311.8	3/8/2016	2/26/2021	5	390	Careaga Sand	N
Schaff Well	Agricultural	669	—	598	599.5	3/10/2017	2/25/2021	4	13	Careaga Sand	N
White Hawk 1	Agricultural	559.5	—	800.6	802.4	11/5/2019	2/25/2021	1	5	Careaga Sand	N
White Hawk 4[3]	Agricultural	820	180-800	781	781.7	3/15/2018	2/25/2021	3	8	Careaga Sand	N

Notes

[1] Pressure transducer installed in well.
[2] Pending access agreement.
[3] Ground surface elevation and reference point elevation exceeding 0.5 ft accuracy
— = No data available
bgs = below ground surface
ft = foot or feet
N = No
NAVD 88 = North American Vertical Datum of 1988
RMS = representative monitoring site
Y = Yes

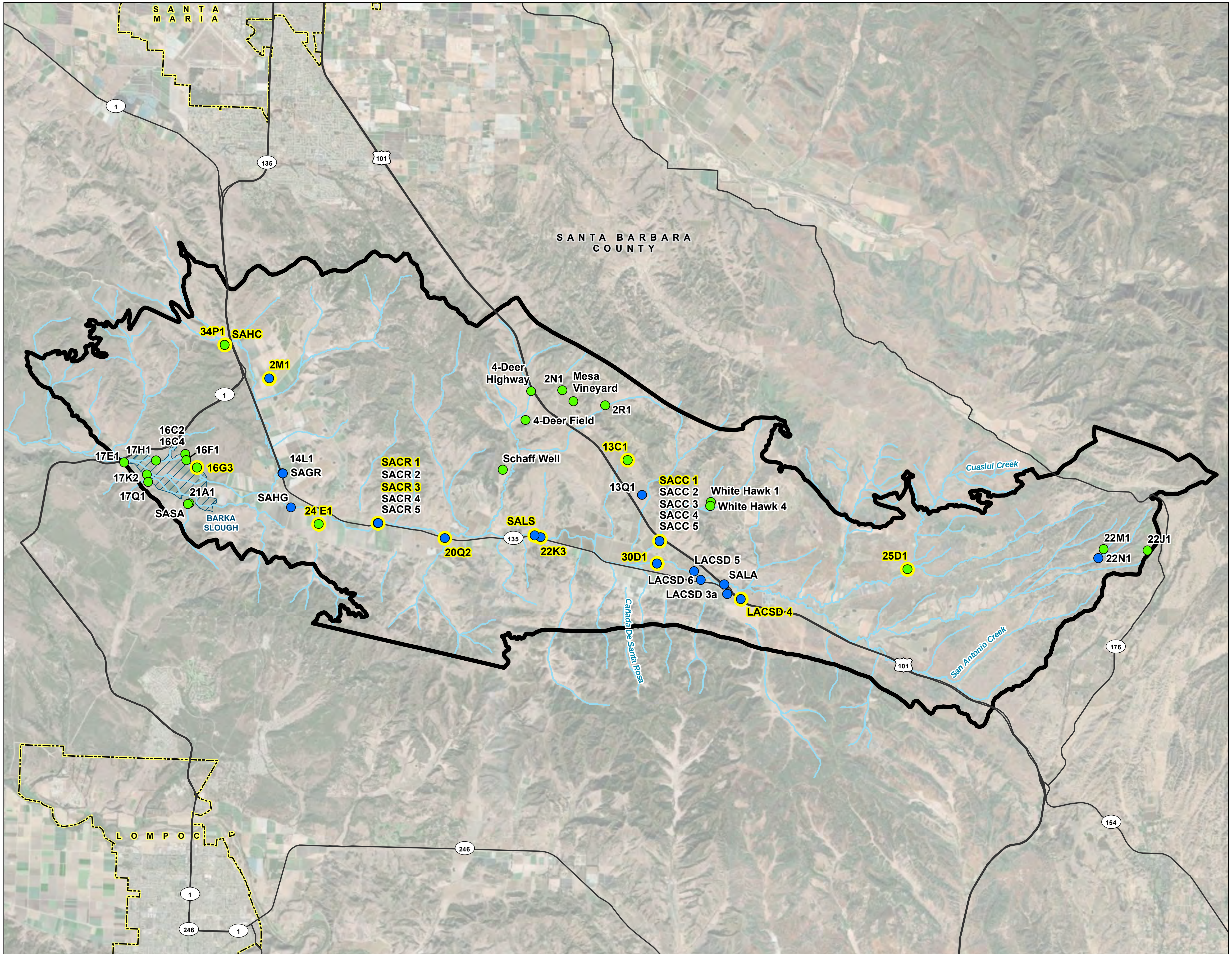

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FIGURE 5-1

Groundwater Level Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Representative Well

Wells (by screened aquifer)

Paso Robles Formation

Careaga Sand

All Other Features

San Antonio Creek or Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

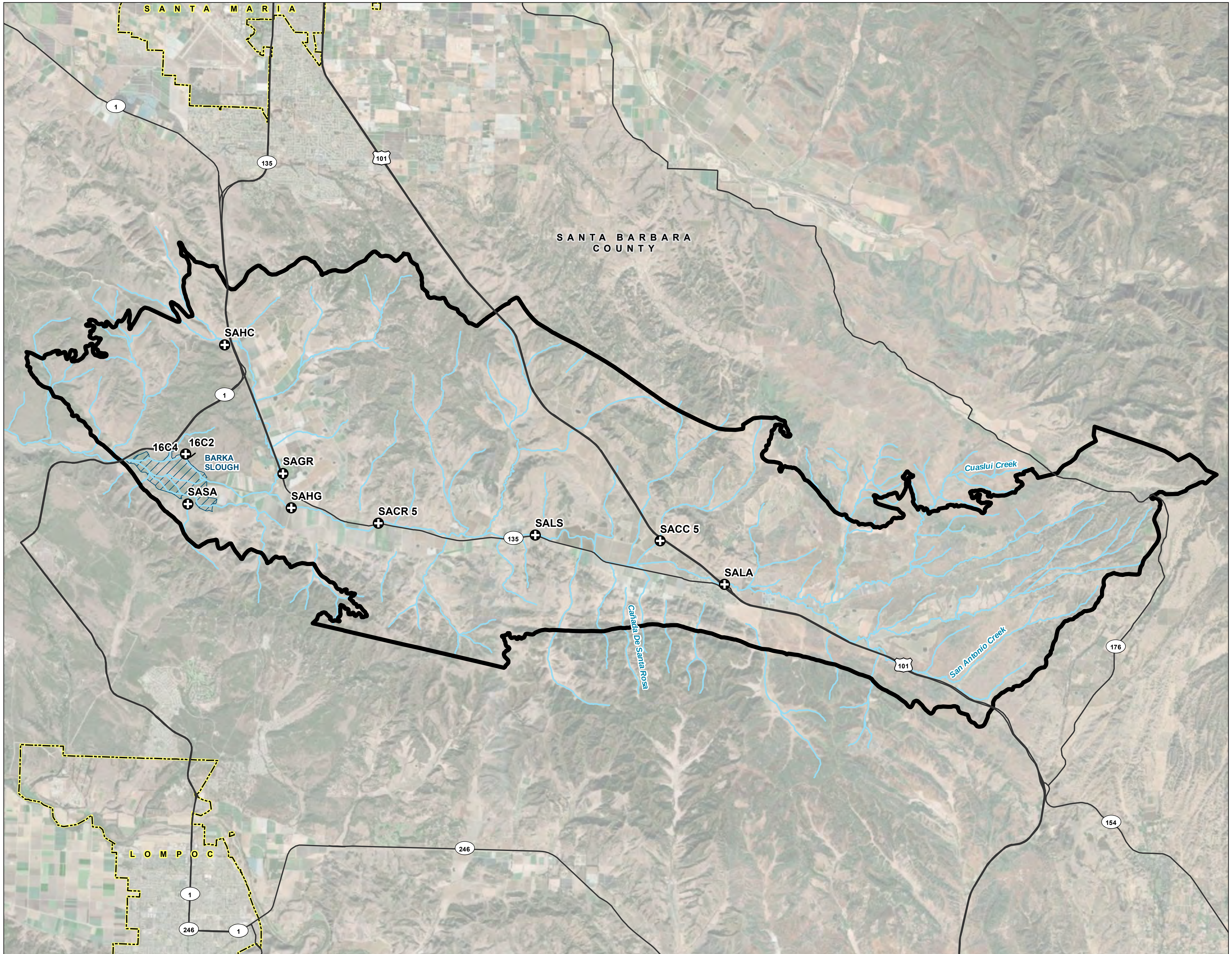
GSI Water Solutions, Inc.

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019), Maxar imagery (2020)

FIGURE 5-2

Wells with Transducers Installed

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



LEGEND

- Well with Transducer

All Other Features

- San Antonio Creek or Tributary
- Major Road
- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- City Boundary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018b), Maxar imagery (2020)

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5.3.1 Monitoring Protocols [§ 354.34(i)]

§ 354.34 Monitoring Network.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

The GSA adopted monitoring protocols using guidelines in the SGMA regulations and DWR best management practices (BMPs) on monitoring protocols (DWR, 2016a). The following information or procedure is collected and documented for each monitoring site:

- Long-term access agreements. Access agreements include year-round site access to allow for increased monitoring frequency.
- A unique well identifier that includes a general written description of the site location, date established, access instructions and point of contact, type of information to be collected, latitude, longitude, and elevation. The written description for each monitoring location also tracks all modifications to the site in a modification log.

Protocols for measuring groundwater levels include:

- Groundwater level data are taken from the correct location and correlated to a unique well identifier.
- Groundwater level data are accurate and reproducible
- Groundwater level data collection protocols are completed in accordance with the data quality objectives (DQOs) process defined by the U.S. Environmental Protection Agency (EPA) *Guidance on Systematic Planning Using the Data Quality Objective Process* (EPA, 2006)
- All salient information is recorded to correct, if necessary, and compare data
- A data collection and management quality assurance/quality control (QA/QC) program is implemented to ensure data integrity. QA/QC protocols include ensuring that the well is not pumping at the time a depth to water measurement is taken, confirming that the depth to water measurement is a static water level measurement by collecting two consecutive measurements, and comparing the depth to water measurement to historical trends and flagging inconsistencies. Additionally, the sampler removes the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement is taken after a period of time to allow the water level to equilibrate.
- Quarterly groundwater levels are collected within as short a time as possible, preferably within a 1- to 2-day period.
- Depth to groundwater is measured relative to an established reference point (RP) on the well casing. The RP is usually identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention, in open casing monitoring wells, the RP is located on the north side of the well casing. If no mark is apparent, the person performing the measurement measures the depth to groundwater from the north side of the top of the well casing. RP descriptions are included in the Data Management System (DMS). The elevation of the RP of each well is surveyed to the North American Vertical Datum of 1988 (NAVD 88). The elevation of the RP is accurate to within 0.5 foot.

- Depth to water measurements are collected in accordance with protocols described in "Measuring Water Levels by Use of an Electric Tape" (USGS, 2010). Groundwater levels are measured to the nearest 0.01 foot relative to the RP. The water level meter is decontaminated prior to initial use and after measuring each well in accordance with the *National Field Manual for the Collection of Water-Quality Data* (USGS, 2004).
- Transducer data are:
  - Downloaded on a quarterly basis
  - Calibrated on a quarterly basis using a depth-to-water measurement
  - Compensated using a barometric pressure sensor

Protocols for the manual collection of groundwater levels are included in Appendix G. Protocols for the collection of groundwater levels obtained by pressure transducers are included in Appendix G.

5.3.2 Assessment and Improvement of Monitoring Network [§ 354.38(a),(b),(c)(1)(A)(B),(c)(2),(d),(e)(1)(2)(3)(4), and § 354.34(c)(1)(A)(B)]

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(1) Chronic Lowering of Groundwater Levels. Demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features by the following methods:

(A) A sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals to characterize the groundwater table or potentiometric surface for each principal aquifer.

(B) Static groundwater elevation measurements shall be collected at least two times per year, to represent seasonal low and seasonal high groundwater conditions.

The GSA identified data gaps using guidelines in the SGMA regulations and DWR BMPs on monitoring networks (DWR, 2016b) and § 354.38 of the regulations. Table 5-2 compares the suggested attributes of a groundwater level monitoring network from the DWR BMPs to the attributes of the current network and identifies data gaps.

The SGMA regulations require a sufficient density of monitoring wells to characterize the groundwater table or potentiometric surface for each principal aquifer. Professional judgment is also used to determine an adequate level of monitoring density.

The DWR BMPs (2016b) cite a well density range of 0.2 to 10 wells per 100 square miles, with a median of 5 wells per 100 square miles. The Basin is approximately 105 square miles, and the groundwater level monitoring network consists of 23 wells in the Paso Robles Formation Aquifer and 27 wells in the Careaga Sand, which equates to approximately 22 wells and 26 wells per 100 square miles for well density in the Paso Robles Formation and Careaga Sand, respectively.

Although the existing groundwater level monitoring network satisfies the well density guidance cited in the DWR BMPs, there are areas identified within the Basin (see Figure 5-3) where the addition of monitoring wells would improve the hydrogeologic conceptual model (HCM) discussed in Section 3.1. Two areas with low well density were identified for both principal aquifers in the Basin: the eastern uplands and the central to northwestern uplands. Based on the State Water Resources Control Board (SWRCB) Irrigated Lands Regulatory Program (ILRP), private agricultural supply wells have been identified in the eastern uplands area. An effort will be made during GSP implementation to contact well owners of wells in the eastern uplands area to determine if they can be included in the monitoring program. Including these additional wells in the groundwater level monitoring network would minimize the uncertainty of groundwater elevation trends and benefit sustainable management of the Basin. Two wells in the central to northwestern uplands area, completed in the Careaga Sand, were previously monitored by the USGS or GSA. However, well access has been denied by the well owners. An effort will be made by the GSA to negotiate access to these wells.

Table 5-2. Summary of Best Management Practices, Groundwater Level Monitoring Well Network, and Data Gaps

Best Management Practice (DWR, 2016b)	Current Monitoring Network	Data Gap
Groundwater level data will be collected from each principal aquifer in the basin.	Groundwater level data are collected from 23 wells in the Paso Robles Formation and 27 wells in the Careaga Sand as part of the groundwater level monitoring network.	There is a low density of monitoring points identified in two areas in the Paso Robles Formation and two areas in the Careaga Sand shown on Figure 5-3. The GSA has been contacting well owners in these areas to determine if wells can be added to the groundwater level monitoring network.
Groundwater level data must be sufficient to produce seasonal maps of groundwater elevations throughout the basin that clearly identify changes in groundwater flow direction and gradient (Spatial Density).	The groundwater level monitoring network is sufficiently distributed to identify changes in groundwater flow direction and gradient throughout the Basin.	Some wells used to prepare groundwater elevation contour maps (see Section 3.2) lack WCRs. For wells without available WCRs, well depth information, well coordinates, and the USGS Geohydrologic Framework Model (USGS, 2020a) were used to determine an aquifer of completion. Well construction information will be obtained from video surveys as funding allows.
Groundwater levels will be collected during the middle of October and March for comparative reporting purposes, although more frequent monitoring may be required (Frequency).	All wells in the groundwater level monitoring network with executed well access agreements are monitored on a quarterly basis. Ten of the wells are measured once every 4 hours by pressure transducers.	None identified.

Best Management Practice (DWR, 2016b)	Current Monitoring Network	Data Gap
Data must be sufficient for mapping groundwater depressions, recharge areas, and along margins of basins where groundwater flow is known to enter or leave a basin.	The groundwater level monitoring network is sufficiently distributed to map groundwater depressions, recharge areas, and along margins of the Basin where groundwater flow is known to enter or leave a Basin (i.e., Barka Slough).	None identified.
Well density must be adequate to determine changes in storage.	The groundwater level monitoring network is sufficiently distributed and meets DWR well density requirements to determine changes of groundwater in storage.	None identified.
The elevation of the RP of each well is surveyed to NAVD 88. The elevation of the RP is accurate to within 0.5 ft.	Thirty-four wells in the groundwater level monitoring network have RP elevations surveyed to within 0.5 ft accuracy. These elevations were surveyed by the USGS.	Sixteen wells in the groundwater level monitoring network have RP elevations exceeding 0.5 ft accuracy. Wells with access agreements will be surveyed in 2022.

Notes

ft = foot or feet
NAVD 88 = North American Vertical Datum of 1988
RP = reference point
USGS = U.S. Geological Survey

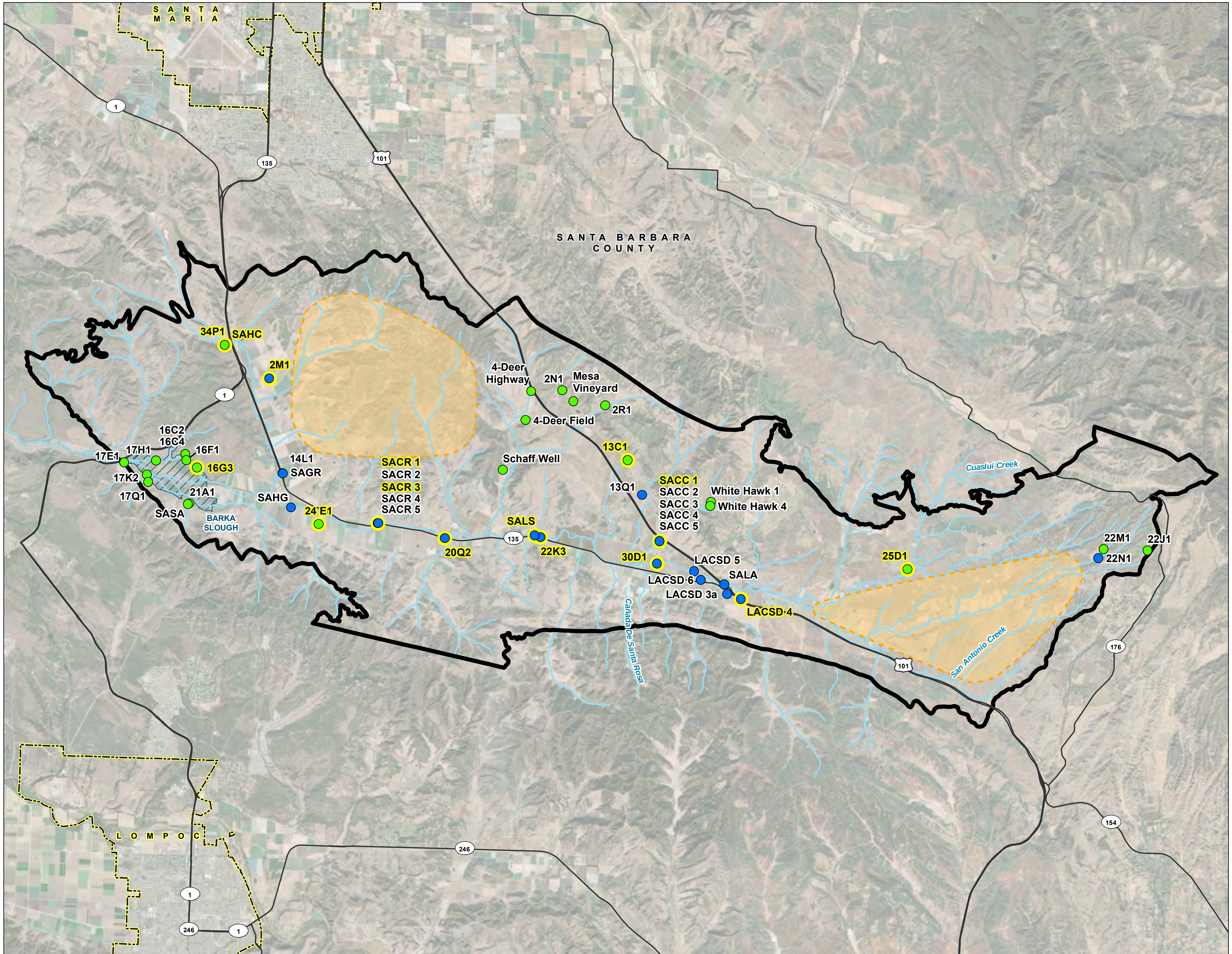

FIGURE 5-3

Groundwater Level Monitoring Network - Low Density Areas

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

- Data Gap Area
- Representative Well

Wells (by screened aquifer)

- Paso Robles Formation
- Careaga Sand

All Other Features

- San Antonio Creek or Tributary
- Major Road
- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019), Maxar imagery (2020)

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Although well completion reports (WCRs) are available online via DWR's OSWCR database, the WCR identification numbers are unknown for many of the wells in the groundwater level monitoring network and therefore it is not possible to always identify the associated WCRs. The known WCRs, with redacted ownership information, are provided in Appendix G. In lieu of WCRs, well depth and well coordinate information provided by USGS NWIS were used in conjunction with the USGS Geohydrologic Framework Model (USGS, 2020a) to determine an aquifer of completion. Well construction information will be incorporated into the database as available. Alternatively, if well construction information cannot be found for a particular well, specifically an RMS well, then another well in the monitoring network with well construction information and representative of groundwater conditions in that area will be selected to replace the well in the RMS monitoring network. If funding is available, the GSA is also considering conducting video surveys of certain RMSs in order to document well construction.

Ground surface elevations and reference point elevations accurate to within 0.5 feet (ft) are not available for a total of 16 wells: four wells with pending access agreements, four wells recently added to the monitoring network, four wells recently cleared of vegetation in Barka Slough (Slough), and the four LACSD wells. The GSA will continue to pursue access agreements. When access agreements are obtained, ground surface elevations and RP elevations will be surveyed and incorporated into the database. A survey of wells with access agreements and an RP elevation accuracy of greater than 0.5 ft will be conducted in 2022.

There may be opportunities to optimize the groundwater level monitoring network in the Basin. The number of wells included in the groundwater level monitoring network will be evaluated during each 5-year GSP interim period. Hydrograph signatures from wells included in the groundwater level monitoring network will be compared for redundancy.

5.4 Groundwater Storage Monitoring Network [§ 354.34(e),(g)(1)(2)(3),(h), and (j)]

§ 354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

This GSP adopts groundwater levels as a proxy for assessing change in groundwater storage (see Section 4). The groundwater level monitoring network described in Section 5.3 was used to create historical groundwater elevation contour maps and calculate change of groundwater in storage for each principal aquifer (see Section 3.2). A total of approximately 50 wells were used for these groundwater elevation analyses. The locations of these wells are shown on Figure 3-11 and are listed in Table 5-1.

5.4.1 Monitoring Protocols [§ 354.34(i)]

§ 354.34 Monitoring Network.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

The groundwater level monitoring network will be used as a proxy for the groundwater storage monitoring network. Therefore, the protocols described in Section 5.3.1 for the groundwater level monitoring network are representative of protocols for the groundwater storage monitoring network. Protocols for the manual collection of groundwater levels are included in Appendix G. Protocols for the collection of groundwater levels obtained by pressure transducers are included in Appendix G.

5.4.2 Assessment and Improvement of Monitoring Network [§ 354.38(a),(b),(c)(1)(2),(d),(e)(1)(2)(3)(4), § 354.34(c)(2)]

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(2) Reduction of Groundwater Storage. Provide an estimate of the change in annual groundwater in storage.

The groundwater level monitoring network will be used as a proxy for the groundwater storage monitoring network. Therefore, the data gaps discussed in Section 5.3.2 for the groundwater level monitoring network are representative of data gaps in the groundwater storage monitoring network.

5.5 Seawater Intrusion Monitoring Network [§ 354.34(c) 3),(e),(g)(1)(2)(3),(h),(i),(j) and § 354.38(a),(b),(c)(1)(2),(d),(e)(1)(2)(3)(4)]

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(3) Seawater Intrusion. Monitor seawater intrusion using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

The Basin is located approximately 8 miles inland from the Pacific Ocean and a bedrock high is located at the western end of the Basin. No exchange of groundwater, except in the form of groundwater discharge to surface water, has been identified at the western (downgradient) end of the Basin (see Section 3). Consequently, the seawater intrusion sustainability indicator is not applicable in the Basin and this GSP does not describe monitoring for seawater intrusion.

5.6 Degraded Water Quality Monitoring Network [§ 354.34(e),(g)(1)(2)(3),(h), and (j)]

§ 354.34 Monitoring Network.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing supply wells. The SGMA regulations require sufficient spatial and temporal data in each principal aquifer to determine groundwater quality trends for water quality indicators to address known water quality issues.

There are no known contaminant plumes in the Basin (see Section 3.2.3), therefore only nonpoint source and naturally occurring constituents of concern are present in the Basin.

According to the California Department of Conservation, Geologic Energy Management Division online Well Finder, or WellSTAR, tool, nine named oil and gas fields are within or adjacent to the Basin: Cat Canyon, Zaca, Barham Ranch, Los Alamos, Lompoc, Harris Canyon (abandoned), Careaga, Orcutt, and Four Deer (abandoned) (see Figure 3-47).[50] The USGS, in cooperation with the SWRCB, initiated the California Oil, Gas, and Groundwater (COGG) Program in 2015.[51] The objective of the COGG Program is to determine where and to what extent groundwater quality may be adversely impacted by proximal oil and gas development activities (Davis, et al., 2018). Results and interpretations from the COGG Program are not yet available for review, as of second quarter 2021. If results and interpretations become available during the implementation period of this GSP, the GSA will consider these findings during GSP 5-year interim periods as part of the overall groundwater quality monitoring program.

[50] Available at https://www.conservation.ca.gov/calgem/Pages/WellFinder.aspx. (Accessed May 3, 2021.)
[51] Description available at https://webapps.usgs.gov/cogg/. (Accessed May 18, 2021.)

Existing groundwater quality monitoring programs in the Basin and groundwater quality distribution and trends are described in Section 3.2.3. Identified constituents of concern are based on state and federal regulatory standards (maximum contaminant levels [MCLs] and secondary MCLs [SMCLs]) for drinking water established by the SWRCB Division of Drinking Water (DDW) and the EPA, respectively.[52] For agricultural uses, constituents of concern are based on Basin water quality objectives (WQOs) presented in the *Water Quality Control Plan for the Central Coastal Basin* (Basin Plan) (RWQCB, 2019). No minimum thresholds have been established for regulated contaminants because state regulatory agencies, including the Central Coast Regional Water Quality Control Board (RWQCB) and the Department of Toxic Substances Control, have the responsibility and authority to regulate and direct actions that address contamination. Minimum thresholds and measurable objectives pertaining to salts and nutrients (total dissolved solids [TDS], chloride, sulfate, boron, sodium, and nitrate) have been established based upon WQOs established in the Basin Plan by the RWQCB.

Constituents of concern for drinking water will be assessed at public water supply wells as part of the SWRCB DDW public supply well water quality program. Constituents of concern for agricultural and domestic use will be assessed as part of the state ILRP and reported on the state GeoTracker website. According to the RWQCB proposed Ag Order 4.0, beginning in 2022, all growers enrolled in the ILRP must conduct annual sampling of all on-farm domestic drinking water supply and irrigation wells between March 1 and May 31 of each year. All groundwater samples must be collected by a qualified third party using proper sample collecting and handling methodologies. All groundwater monitoring data sampled to meet the minimum groundwater monitoring requirements of the Order will be submitted electronically to the SWRCB's GeoTracker database by the testing laboratory (RWQCB, 2021). Additionally, all growers enrolled in the ILRP are required to implement groundwater trend monitoring work plans either individually or as part of a cooperative regional monitoring program. Work plans for groundwater trend monitoring must be submitted by a date dependent on the phase area. The work plan due date is September 1, 2027, for the Basin.

Wells included in the groundwater quality monitoring network are listed in Table 5-3 and shown on Figure 5-4. All the wells from the GSP groundwater water quality monitoring network are RMS wells. The groundwater quality monitoring network includes eight municipal drinking water supply wells that were identified by reviewing data available from the SWRCB DDW in the SWRCB's GAMA database. Selected wells were sampled for at least one of the constituents of concern during 2015 or more recently. The eight wells are listed in Table 5-3 and shown on Figure 5-4. Four of the municipal drinking water supply wells are completed in the Paso Robles Formation, and four are completed in the Careaga Sand. The wells completed in the Paso Robles Formation are owned and operated by the LACSD and located near Los Alamos. The wells completed in the Careaga Sand are owned and operated by Vandenberg Space Force Base and located on the on the north side of Barka Slough.

[52] The list of MCLs and SMCLs is available at https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.html. (Accessed May 3, 2021.)

Table 5-3. Groundwater Quality Monitoring Network

Well ID	Well Type	Well Depth (ft bgs)	Screen Interval(s) (ft bgs)	First Sampling Event Date	Last Sampling Event Date	Number of Sampling Events	Principal Aquifer
4210002-004	Municipal	535	230-530	11/21/1988	5/5/2021	80	Paso Robles Formation
4210002-007	Municipal	962	502-952	11/9/2006	5/5/2021	35	Paso Robles Formation
4210002-009	Municipal	510	180-510	9/21/2010	5/5/2021	30	Paso Robles Formation
4210002-012	Municipal	959	190-950	6/5/2019	5/5/2021	8	Paso Robles Formation
4210700-001	Municipal	—	162-	6/27/1989	4/21/2021	109	Careaga Sand
4210700-002	Municipal	—	160-	4/10/1984	4/21/2021	102	Careaga Sand
4210700-003	Municipal	—	220-	3/6/1984	4/21/2021	109	Careaga Sand
4210700-016	Municipal	—	200-	6/3/1996	4/21/2021	90	Careaga Sand
AGC100000001-CCGC_0581	Agricultural	—	—	6/23/2015	6/23/2015	1	Unknown
AGL020000787-OFFICE_D	Domestic	—	—	8/24/2015	11/29/2017	4	Unknown
AGL020000787-WELL2_WH	Agricultural	—	—	5/23/2017	11/29/2017	2	Unknown
AGL020000788-#1 OLD	Agricultural	—	—	12/26/2012	10/30/2017	4	Unknown
AGL020000788-#2 NEW	Agricultural	—	—	12/26/2012	10/30/2017	4	Unknown
AGL020000976-DW1	Domestic	370	220-320	11/29/2012	11/15/2017	4	Unknown
AGL020000976-IW3	Agricultural	—	—	11/29/2012	11/15/2017	4	Unknown
AGL020000990-AG WELL	Agricultural	—	—	11/29/2012	4/25/2017	3	Unknown
AGL020000990-DOMESTIC WELL	Domestic	—	—	11/29/2012	4/25/2017	3	Unknown
AGL020001186-CARRARI	Agricultural	—	—	7/28/2014	4/5/2018	3	Unknown
AGL020001186-DANS HOUSE	Domestic	—	—	7/28/2014	4/5/2018	3	Unknown
AGL020001194-LOS ALAMOS	Agricultural	—	—	7/28/2014	4/5/2018	3	Unknown
AGL020001197-DON MIGUEL	Agricultural	—	—	7/28/2014	4/5/2018	3	Unknown
AGL020001199-RONS HOUSE	Domestic	—	—	7/28/2014	4/5/2018	3	Unknown
AGL020001230-DOMESTIC WELL	Domestic	—	—	2/7/2013	11/29/2017	4	Unknown
AGL020001230-WELL #6	Agricultural	—	—	2/7/2013	11/29/2017	4	Unknown
AGL020003431-DOM/IRR	Domestic	—	—	12/2/2013	8/3/2017	3	Unknown
AGL020003506-RANCH11_IR	Agricultural	—	—	12/2/2013	11/13/2017	3	Unknown
AGL020003593-WELL 1	Agricultural	—	—	12/12/2012	1/4/2018	3	Unknown
AGL020003826-BEVENS WELL	Agricultural	—	—	1/31/2013	11/15/2017	4	Unknown
AGL020003826-BEVENS WELL 2	Agricultural	—	—	1/31/2013	11/15/2017	4	Unknown
AGL020003826-MONIGHETTI	Agricultural	—	—	1/31/2013	11/15/2017	4	Unknown
AGL020004324-GEOFFREY_D	Domestic	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004324-GEOFFREY_I	Agricultural	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004328-MISSIONP_I	Agricultural	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004330-MISSIONT_D	Domestic	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004330-MISSIONT_I	Agricultural	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004333-JFWNEELY_I	Agricultural	—	—	7/23/2018	7/23/2018	1	Unknown

Well ID	Well Type	Well Depth (ft bgs)	Screen Interval(s) (ft bgs)	First Sampling Event Date	Last Sampling Event Date	Number of Sampling Events	Principal Aquifer
AGL020004334-SAINZ_DOM	Domestic	—	—	7/23/2014	11/27/2017	2	Unknown
AGL020004336-BARHAMV_D	Domestic	370	260-360	7/23/2014	11/27/2017	3	Unknown
AGL020004336-BARHAMV_I	Agricultural	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004336-BARHAMV2_D	Domestic	—	—	1/23/2014	11/27/2017	3	Unknown
AGL020004388-DW	Domestic	—	—	12/12/2012	10/2/2018	3	Unknown
AGL020004388-WELL 1	Agricultural	—	—	7/9/2013	10/16/2018	2	Unknown
AGL020004388-WELL 3	Agricultural	—	—	7/9/2013	10/2/2018	2	Unknown
AGL020004388-WELL 4	Agricultural	—	—	7/9/2013	10/2/2018	2	Unknown
AGL020004396-DW	Domestic	525	345-445	12/12/2012	10/2/2018	4	Unknown
AGL020004507-3207_I	Agricultural	—	—	1/23/2014	8/28/2017	3	Unknown
AGL020004507-3507_I	Agricultural	—	—	1/23/2014	8/28/2017	3	Unknown
AGL020004512-LOS ALAMOS #1	Agricultural	—	—	12/21/2012	11/13/2017	4	Unknown
AGL020004512-LOS ALAMOS #5	Agricultural	—	—	12/21/2012	11/7/2017	4	Unknown
AGL020004520-LOMA VERDE #1	Agricultural	—	—	12/21/2012	11/7/2017	4	Unknown
AGL020004541-EL CAMINO #1	Agricultural	—	—	12/21/2012	11/7/2017	4	Unknown
AGL020004541-EL CAMINO DW #1	Domestic	—	—	12/21/2012	11/7/2017	4	Unknown
AGL020004845-RANCH1_IRR	Agricultural	—	—	12/4/2013	6/26/2017	3	Unknown
AGL020004945-WELL 1	Agricultural	—	—	11/25/2012	2/22/2019	5	Unknown
AGL020004945-WELL 2	Agricultural	—	—	11/5/2018	11/5/2018	1	Unknown
AGL020004975-RANCH7_IRR	Agricultural	—	—	12/4/2013	6/26/2017	4	Unknown
AGL020007205-DOMESTIC	Domestic	—	—	6/29/2017	6/29/2017	1	Unknown
AGL020007472-MAIN WELL	Agricultural	—	—	7/1/2015	7/1/2015	1	Unknown
AGL020007578-DOMESTIC	Domestic	—	—	9/19/2012	12/4/2017	4	Unknown
AGL020007578-PRIMARY AG	Agricultural	—	—	9/19/2012	12/4/2017	4	Unknown
AGL020008902-DOMESTIC	Domestic	—	—	9/5/2012	11/28/2017	5	Unknown
AGL020008902-WELL 4	Agricultural	—	—	5/28/2013	6/29/2017	3	Unknown
AGL020008902-WELL 5	Agricultural	—	—	11/28/2017	11/28/2017	1	Unknown
AGL020010504-WELL 1	Agricultural	—	—	12/21/2012	12/28/2017	4	Unknown
AGL020010504-WELL 2	Agricultural	—	—	12/21/2012	12/28/2017	5	Unknown
AGL020011702-DOMESTIC	Domestic	—	—	12/11/2013	11/28/2017	4	Unknown
AGL020012002-WELL 13	Agricultural	250	160-240-	9/5/2012	5/23/2017	3	Unknown
AGL020014928-IRRIGATION	Agricultural	—	—	12/2/2013	8/3/2017	3	Unknown
AGL020020322-ALISOS_IRR	Agricultural	—	—	12/4/2013	3/19/2019	4	Unknown
AGL020022802-RANCH9_IRR	Agricultural	—	—	6/21/2017	11/29/2017	2	Unknown
AGL020026466-WELL6_IRR	Agricultural	—	—	5/22/2017	5/22/2017	1	Unknown
AGL020026804-R4-W-1	Agricultural	—	—	6/6/2017	6/6/2017	1	Unknown
AGL020027576-AW GLAD	Agricultural	—	—	6/21/2017	11/29/2017	2	Unknown

Well ID	Well Type	Well Depth (ft bgs)	Screen Interval(s) (ft bgs)	First Sampling Event Date	Last Sampling Event Date	Number of Sampling Events	Principal Aquifer
AGL020027596-PH #1	Agricultural	—	—	6/15/2017	12/1/2017	2	Unknown
AGL020027597-WELL 1	Agricultural	—	—	10/30/2015	12/1/2017	3	Unknown
AGL020027908-R2 W1 MONIG	Agricultural	—	—	12/21/2017	12/21/2017	1	Unknown
AGL020027908-R2 W2 MONIG	Agricultural	—	—	12/21/2017	12/21/2017	1	Unknown
AGL020027910-GLAD_WELL_3	Agricultural	—	—	5/23/2017	1/4/2018	2	Unknown
AGL020027955-RANCH36_D	Domestic	—	—	4/27/2016	8/28/2017	3	Unknown
AGL020028062-3RAN2701_I	Agricultural	—	—	8/2/2017	8/2/2017	1	Unknown
AGL020028148-WHITE48	Agricultural	—	—	5/24/2017	12/28/2017	4	Unknown
AGL020028151-HARRIS51	Agricultural	—	—	5/24/2017	5/24/2017	1	Unknown
AGL020028275-SHOKV DOM	Domestic	—	—	5/11/2018	9/25/2018	2	Unknown
AGL020028275-SHOKV IRR	Agricultural	—	—	5/11/2018	9/25/2018	2	Unknown
AGL020028322-GLAD_WELL_11	Agricultural	—	—	5/23/2017	1/4/2018	2	Unknown
AGL020029934-WELL 1 IRR	Agricultural	—	—	11/7/2017	11/7/2017	1	Unknown
AGL020033821-NOLANAG#1_IRR	Agricultural	—	—	7/11/2018	10/26/2018	2	Unknown
AGL020033821-NOLANAG#5_IRR	Agricultural	—	—	12/20/2018	12/20/2018	1	Unknown
AGL020033821-NOLANAG#6_IRR	Agricultural	—	—	12/20/2018	12/20/2018	1	Unknown

Notes

Refer to Figure 5-4 for well locations.
— = No data available
bgs = below ground surface
ft = feet
Source: Data are available from the Groundwater Ambient Monitoring and Assessment (GAMA) Program: https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/

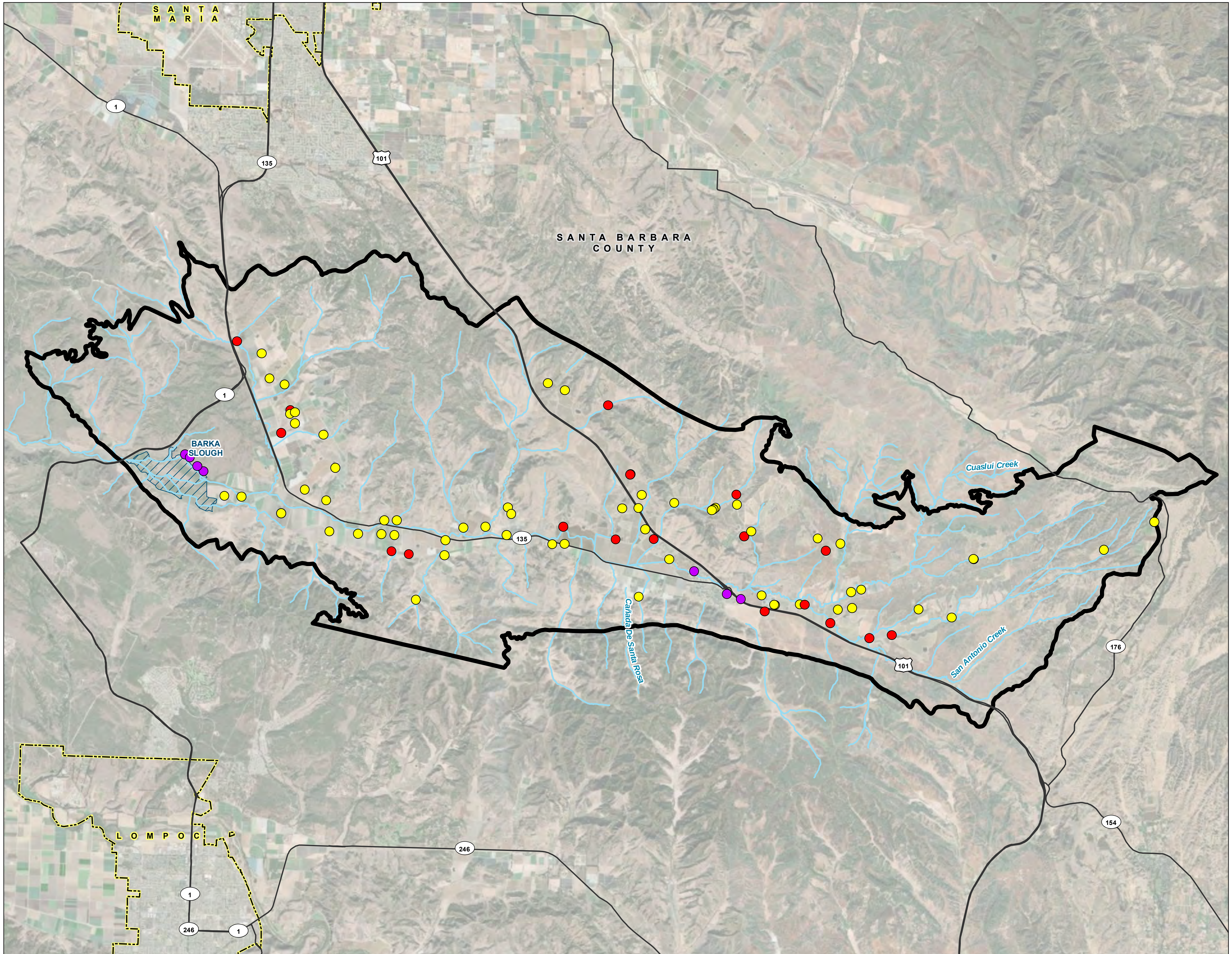

FIGURE 5-4

Groundwater Quality Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Well Type

- Agricultural
- Domestic
- Municipal

All Other Features

- San Antonio Creek or Tributary
- Major Road
- San Antonio Creek Valley Groundwater Basin
- Barka Slough
- City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 18, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section5\Figure5_4_Groundwater_Quality_Monitoring_Network.mxd

The agricultural supply wells and domestic supply wells included in the groundwater quality monitoring network were identified by reviewing data available from the ILRP located in the SWRCB's GAMA database. Selected wells were sampled in 2015 or more recently. There is a total of 81 ILRP wells in the groundwater quality monitoring network; 21 wells were determined to be domestic supply wells based on their GAMA ID, and 60 wells were determined to be agricultural supply wells. Well construction information is unknown for the majority ILRP wells. Some well construction information has been compiled for the domestic wells using OSWCR. The agricultural supply wells and associated domestic supply wells are listed in Table 5-3 and shown on Figure 5-4.

A groundwater quality monitoring event was completed by the USGS in 2017 as part of its Groundwater Supply Availability Study (USGS, 2021). For the purposes of this GSP, the 2017 monitoring event is considered a baseline survey of water quality in the Basin around the time SGMA was enacted. The wells included in the 2017 USGS monitoring event are observation wells constructed by the USGS with available well completion information and are not included in the SWRCB DDW public supply well water quality program or ILRP; and therefore, are not included in the groundwater quality monitoring network. The information collected from the 2017 USGS monitoring event was used to determine groundwater quality trends for each principal aquifer. Groundwater quality results from the 2017 USGS monitoring event are presented in Section 3.2.3. Well completion reports and geophysical logs are available for the USGS wells and are included as Appendix G.

5.6.1 Monitoring Protocols [§ 354.34(i)]

§ 354.34 Monitoring Network.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

Water quality samples are currently being collected in accordance with the SWRCB DDW for municipal drinking water supply wells and ILRP requirements for agricultural and domestic wells. Beginning in 2022, ILRP data will be collected under Central Coast RWQCB Ag Order 4.0. Copies of these monitoring and reporting programs are included in Appendix G and incorporated herein as monitoring protocols. These protocols will continue to be followed during GSP implementation for the groundwater quality monitoring.

5.6.2 Assessment and Improvement of Monitoring Network [§ 354.38(a),(b),(c)(1)(2),(d),(e)(1)(2)(3)(4) and § 354.34(c)(4)]

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(4) Degraded Water Quality. Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.

Groundwater quality data do not indicate a need for additional monitoring locations. Current programs provide adequate spatial and temporal coverage for the purposes for the GSP. There is adequate spatial coverage in the groundwater quality monitoring network to assess impacts, if any, to beneficial uses and users. Table 5-4 summarizes the recommendations for groundwater quality monitoring from DWR BMPs, the current groundwater quality monitoring network, and data gaps. Well construction information for 77 of 89 wells in the groundwater quality monitoring network is unknown. This is a data gap that will be addressed during GSP implementation by using OSWCR and by continued outreach by the GSA to groundwater users in the Basin.

Table 5-4. Summary of Best Management Practices, Groundwater Quality Monitoring Well Network, and Data Gaps

Best Management Practice (DWR, 2016a)	Current Monitoring Network	Data Gap
Monitor groundwater quality data from each principal aquifer in the basin that is currently, or may be in the future, impacted by degraded water quality. The spatial distribution must be adequate to map or supplement mapping of known contaminants. Monitoring should occur based upon professional opinion, but generally correlate to the seasonal high and low groundwater level, or more frequent as appropriate.	Public databases provide adequate spatial and temporal water quality data to identify and evaluate water quality trends in principal aquifers in the Basin.	The current monitoring network contains adequate spatial distribution to map or supplement mapping of any known contaminants. Well construction information for 77 of 89 wells in the monitoring network is unknown. Well construction information will be developed as funding allows.
Collect groundwater quality data from each principal aquifer in the basin that is currently, or may be in the future, impacted by degraded water quality. Agencies should use existing water quality monitoring data to the greatest degree possible. For example, these could include ILRP, GAMA, existing RWQCB monitoring and remediation programs, and drinking water source assessment programs.	The water quality monitoring network includes eight municipal wells (monitored by the SWRCB DDW program) and 81 IRLP wells within the Basin that have been regularly sampled for groundwater quality since at least 2015. Four of the municipal wells are completed in the Paso Robles Formation and four municipal wells are completed in the Careaga Sand. Well construction information for the majority of wells in the IRLP is unknown.	The current monitoring network utilizes existing water quality monitoring data from the SWRCB DDW program and ILRP. Wells included in these programs provide adequate spatial distribution to map water quality in principal aquifers in the Basin. Well construction information for 77 of 89 wells in the groundwater quality monitoring network is unknown. Well construction information will be developed as funding allows.
Define the three-dimensional extent of any existing degraded water quality impact.	Historical water quality data provides adequate spatial distribution and coverage of principal aquifers (including multiple-zone completion wells) to define the three-dimensional extent of existing degraded water quality impacts.	Well construction information for 77 of 89 wells in the GSP water quality monitoring network is unknown. Well construction information will be developed as funding allows.

Best Management Practice (DWR, 2016a)	Current Monitoring Network	Data Gap
Data should be sufficient to assess groundwater quality impacts to beneficial uses and users.	The water quality monitoring network provides sufficient water quality data, spatial distribution, and coverage of principal aquifers to assess potential impacts to beneficial uses and users of groundwater in the Basin.	Well construction information for 77 of 89 wells in the current water quality monitoring network is unknown. Well construction information will be developed as funding allows.
Data should be adequate to evaluate whether management activities are contributing to water quality degradation.	Projects and management actions proposed for implementation by the GSA will be evaluated for potential impacts to all five sustainability indicators applicable to the Basin. Existing groundwater quality monitoring programs (SWRCB DDW and ILRP), spatial distribution of monitored wells, and coverage of principal aquifers will provide adequate data to evaluate whether management activities are contributing to water quality degradation throughout the GSP implementation period. Additionally, select projects and management actions (e.g., recharge of treated wastewater) may be subject to further regulatory review, such as the California Environmental Quality Act.	None identified.

Notes

DDW = Division of Drinking Water

GSA = Groundwater Sustainability Agency

GSP = Groundwater Sustainability Plan

ILRP = Irrigated Lands Regulatory Program

SWRCB = State Water Resources Control Board

5.7 Land Subsidence Monitoring Network [§ 354.34(c)(5),(e),(g)(1)(3),(h), and (j)]

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(5) Land Subsidence. Identify the rate and extent of land subsidence, which may be measured by extensometers, surveying, remote sensing technology, or other appropriate method.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

Locally defined significant and unreasonable conditions for land subsidence are (1) land subsidence rates exceeding rates observed from 2000 through 2020 at the University NAVSTAR Consortium (UNAVCO) Continuous Global Positioning System (CGPS) Station ORES in the town of Los Alamos, near Los Alamos Park; and (2) land subsidence that causes damage to groundwater supply, land uses, infrastructure, and property interests. Currently, ground surface elevation is being monitored at one CGPS site (ORES) in the Basin as reported by UNAVCO from its Data Archive Interface.[53] Since the beginning of data collection in 2000, the net vertical displacement is negative (-0.82 ft). This means that the land surface elevation has decreased (negative displacement) 0.82 ft in the last 20 years. The Basin is located near the intersection of the Coastal Ranges and Transverse Ranges California Geomorphic Provinces. Consequently, the Basin is in a very tectonically active region. The 0.82 ft of vertical displacement measured at the UNAVCO station could be due to tectonic activity, groundwater extraction, oil and gas extraction, or a combination of the three. In addition, Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR shows that significant land subsidence did not occur during the period between June 2015 and June 2019 (available InSAR data period of record) in the Basin (see Section 3.2.4).

[53] The UNAVCO Data Archive Interface is available at http://www.unavco.org/data/data.html. (Accessed May 3, 2021.).

5.7.1 Monitoring Protocols [§ 354.34(g)(2), (i)]

§ 354.34 Monitoring Network.

(g) Each Plan shall describe the following information about the monitoring network:

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

The DWR BMPs note that no standard operating procedures exist for collecting land subsidence data (DWR, 2016b). UNAVCO CGPS and DWR InSAR data will continue to be monitored annually throughout the GSP implementation period. If additional relevant data sets become available, they will be evaluated and incorporated into the monitoring program. Should potential land subsidence be observed at rates exceeding the minimum threshold (see Section 4.9.2), the GSA will first assess whether the subsidence may be due to (1) groundwater pumping (2) elastic processes (subsidence that will recover with rising groundwater) (3) oil and gas extraction or (4) tectonic activity. If subsidence is observed, approaches the minimum threshold, causes undesirable results, and appears to be related to groundwater pumping, the GSA will undertake a program to install land surface elevation benchmarks at critical infrastructure locations, and monitor subsidence with measured land surface elevations on an annual basis.

5.7.2 Assessment and Improvement of Monitoring Network [§ 354.38(a),(b),(c)(1)(2),(d), and (e)(1)(2)(3)(4)]

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

The subsidence minimum thresholds are set to avoid subsidence that could harm groundwater supply, land uses, infrastructure, and property interests. Available data indicate that there is currently little subsidence occurring in the Basin that affects groundwater supply, land uses, infrastructure, and property interests. If an undesirable result occurs, the land subsidence monitoring network may be expanded to include additional monitoring stations near areas identified as having critical infrastructure, oil and gas extraction, or significant groundwater pumping.

5.8 Depletion of Interconnected Surface Water Monitoring Network [§ 354.34(c)(6)(A,B,C,D),(e),(g)(1)(2)(3),(h), and (j)]

§ 354.34 Monitoring Network.

(c) Each monitoring network shall be designed to accomplish the following for each sustainability indicator:

(6) Depletions of Interconnected Surface Water. Monitor surface water and groundwater, where interconnected surface water conditions exist, to characterize the spatial and temporal exchanges between surface water and groundwater, and to calibrate and apply the tools and methods necessary to calculate depletions of surface water caused by groundwater extractions. The monitoring network shall be able to characterize the following:

(A) Flow conditions including surface water discharge, surface water head, and baseflow contribution.

(B) Identifying the approximate date and location where ephemeral or intermittent flowing streams and rivers cease to flow, if applicable.

(C) Temporal change in conditions due to variations in stream discharge and regional groundwater extraction.

(D) Other factors that may be necessary to identify adverse impacts on beneficial uses of the surface water.

(e) A Plan may utilize site information and monitoring data from existing sources as part of the monitoring network.

(g) Each Plan shall describe the following information about the monitoring network:

(3) For each sustainability indicator, the quantitative values for the minimum threshold, measurable objective, and interim milestones that will be measured at each monitoring site or representative monitoring sites established pursuant to Section 354.36.

(h) The location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used.

§ 354.34 Monitoring Network.

(g) Each Plan shall describe the following information about the monitoring network:

(1) Scientific rationale for the monitoring site selection process.

(2) Consistency with data and reporting standards described in Section 352.4. If a site is not consistent with those standards, the Plan shall explain the necessity of the site to the monitoring network, and how any variation from the standards will not affect the usefulness of the results obtained.

(j) An Agency that has demonstrated that undesirable results related to one or more sustainability indicators are not present and are not likely to occur in a basin, as described in Section 354.26, shall not be required to establish a monitoring network related to those sustainability indicators.

Based on the USGS National Hydrography Dataset (NHD), all the streams in the Basin are classified as intermittent and suspected to be losing streams, except for stream channels located in Barka Slough, which are classified as perennial and suspected to be gaining streams (see Figure 3-53). Ephemeral surface water flows in the Basin make it difficult to assess the interconnectivity of surface water and groundwater and to quantify the degree to which surface water depletion has occurred. According to the USGS NHD, three springs or seeps were identified in the Basin (see Figure 3-9). Based on the location of these three springs or seeps, they appear to be overlying the Paso Robles Formation. Two additional springs or seeps and associated groundwater-dependent ecosystems (GDEs) were identified by a local landowner, the Natural Communities data set (DWR, 2020), and the Cachuma Resource Conservation District (CRCD, 2003) (see Section 3.2.6). The two springs or seeps are located northeast of Los Alamos on Price Ranch within a tributary to San Antonio Creek and in the Las Flores watershed, a tributary to San Antonio Creek, in the low-lying grassland areas immediately west of U.S. Highway 101 (CRCD, 2003) (see Figure 3-56). Based on location, the spring or seep located in the Las Flores watershed overlies the Paso Robles Formation and the Price Ranch spring or seep is located near the contact between the Paso Robles Formation and the Careaga Sand. Without additional analysis, it is unknown whether the groundwater source of these springs or seeps is from the underlying principal aquifer or perched water within the channel alluvium. Therefore, until flow of groundwater is better understood in these areas, a representative monitoring network related to interconnected surface water at these locations cannot be developed. If analysis of these areas indicates interconnected surface water with the Paso Robles Formation or the Careaga Sand, a monitoring network will be developed in accordance with protocols described in Section 5.8.1. Planned additional analysis of these areas are described in Section 6.

Interconnected surface water and groundwater within the Paso Robles Formation and Careaga Sand is indicated by discharge of groundwater into Barka Slough and by the perennial classification of streams in that area. See Figure 3-31 for a conceptual model of groundwater flow as it reaches Barka Slough.

Groundwater levels measured in wells completed in the Careaga Sand located near Barka Slough indicate that groundwater levels have fallen below the Slough elevation in a number of locations since about 1983. In addition, upward vertical gradients within the Careaga Sand near the Slough (see Figure 3-71) have decreased; indicating groundwater flow into the Slough has likely declined. Surface water also discharges into the Slough. It is unknown whether surface water flow into the Slough has been decreasing due to the lack of a stream gage at the east end of the Slough. This is a data gap that will be addressed in the projects and management actions section of the GSP (see Section 6).

Currently no stream gage exists where surface water flow enters or exits the Slough. The Casmalia stream gage is located more than 2.5 miles west of the Slough. The SABGSA intends to install two surface water gages on San Antonio Creek: one upstream and one downstream of Barka Slough to measure surface water inflow and outflow to the Slough and assess surface water depletion and potential for impacts to Barka Slough. Until those gages are installed, the Casmalia gage located 2.5 miles downstream of Barka Slough will be used to assess surface water depletion and impacts to Barka Slough. Monitoring of groundwater levels in monitoring wells completed in the Careaga Sand surrounding the Barka Slough area will also continue to be conducted by the GSA as part of the groundwater level monitoring network (see Section 5.3). The SABGSA is going to assess the feasibility of installing shallow piezometers within the sediments underlying Barka Slough if access can be achieved and maintained through the dense vegetation and if CDFW will permit the piezometer installation and monitoring within the Slough. If achievable, the piezometers will provide important data regarding the elevation of the water table relative to the plant rooting depths in the Slough. It is anticipated that these data will be used to better define the water budget at the Slough and to determine if SMCs for this indicator should be adjusted.

It is apparent that there is a connection between Basin groundwater levels and the Slough; however, there is considerable uncertainty about how much lower groundwater levels can go in the Basin without causing significant and unreasonable impacts to the Slough. To address this uncertainty, additional work is planned, including:

- Characterization of the nature, type, and extent of the GDEs in the Slough,
- Installation of surface water gages in the east and west end of the Slough,
- Evaluation of the Slough water budget and effects of the water level minimum thresholds on surface water depletion using the USGS groundwater model when it is available.

These actions are described in Section 6.

The interconnected surface water monitoring network is summarized below, and the location of the Casmalia stream gage in relation to Barka Slough is shown on Figure 4-1:

- Surface water flow exiting Barka Slough will be measured using the Casmalia stream gage (Station 11136100)
- Surface water flow entering and leaving the Slough will be monitored when new surface water gages are installed
- Groundwater vertical flux will be measured using continuously monitored nested well set 16C2 and 16C4

If observations and data collected as part of the interconnected surface water monitoring network (preceding bulleted statements) indicate the minimum thresholds for the interconnected surface water sustainability indicator (see Section 4) are being approached or reached, an Enhanced Vegetation Index (EVI) analysis (consistent with the EVI analysis discussed in Section 3.2) will be completed to assess the condition of the vegetation in Barka Slough to determine if GDEs may be impacted.

5.8.1 Monitoring Protocols [§ 354.34(i)]

§ 354.34 Monitoring Network.

(i) The monitoring protocols developed by each Agency shall include a description of technical standards, data collection methods, and other procedures or protocols pursuant to Water Code Section 10727.2(f) for monitoring sites or other data collection facilities to ensure that the monitoring network utilizes comparable data and methodologies.

Casmalia stream gage is monitored and maintained by the USGS. Measured stream flow recorded at the stream gage will be reviewed on a quarterly basis and included in the Basin's groundwater level monitoring program quarterly reports. Groundwater vertical gradient will be calculated from continuously monitored nested well set 16C2 and 16C4. Therefore, the protocols described in Section 5.3.1 for the groundwater level monitoring network are representative of protocols for the interconnected surface water network. Protocols for the collection of groundwater levels obtained by pressure transducers are included in Appendix G. If it is feasible to install shallow piezometers in the Slough, the monitoring protocols for groundwater levels will also be followed.

5.8.2 Assessment and Improvement of Monitoring Network [§ 354.38(a),(b),(c)(1),(c)(2),(d),(e)(1),(e)(2),(e)(3), and(e)(4)]

§ 354.38 Assessment and Improvement of Monitoring Network.

(a) Each Agency shall review the monitoring network and include an evaluation in the Plan and each five-year assessment, including a determination of uncertainty and whether there are data gaps that could affect the ability of the Plan to achieve the sustainability goal for the basin.

(b) Each Agency shall identify data gaps wherever the basin does not contain a sufficient number of monitoring sites, does not monitor sites at a sufficient frequency, or utilizes monitoring sites that are unreliable, including those that do not satisfy minimum standards of the monitoring network adopted by the Agency.

(c) If the monitoring network contains data gaps, the Plan shall include a description of the following:

(1) The location and reason for data gaps in the monitoring network.

(2) Local issues and circumstances that limit or prevent monitoring.

(d) Each Agency shall describe steps that will be taken to fill data gaps before the next five-year assessment, including the location and purpose of newly added or installed monitoring sites.

(e) Each Agency shall adjust the monitoring frequency and density of monitoring sites to provide an adequate level of detail about site-specific surface water and groundwater conditions and to assess the effectiveness of management actions under circumstances that include the following:

(1) Minimum threshold exceedances.

(2) Highly variable spatial or temporal conditions.

(3) Adverse impacts to beneficial uses and users of groundwater.

(4) The potential to adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of sustainability goals in an adjacent basin.

There are currently no stream gages immediately east or west of Barka Slough. As discussed in Section 3.3, estimated volumes of surface water flow entering and exiting the Slough are based on the USGS Basin Characterization Model (BCM) and surface water flow volumes recorded at the Casmalia stream gage. Likewise, groundwater discharging to surface water in the Slough was calculated using the USGS BCM, surface water flow volumes recorded at the Casmalia stream gage, and Darcian flux calculations. Two locations have been identified for installation of a stream gage to supplement characterization of spatial and temporal exchanges between surface water and groundwater relative to Barka Slough. A stream gage downstream of the confluence of San Antonio Creek and Harris Canyon Creek and upstream of the Slough would enable direct quantification of surface water entering the Slough. The addition of a stream gage at this location would supplement the water budget and the ability to assess the interconnected surface water SMCs described in Section 4.10. DWR has evaluated locations downstream of the confluence of Harris Canyon Creek and San Antonio Creek and did not find any of the sites suitable for gaging. Cross sections of the two locations have been collected by Santa Barbara County and included in Appendix G. A stream gage at the west end of Barka Slough (where surface water discharges from the Basin) near California State Highway 1 would provide a more direct quantification of surface water discharge exiting the Slough than using the Casmalia stream gage. The addition of a stream gage at this location would supplement the water budget and the ability to assess the interconnected surface water SMCs described in Section 4.10. The USGS evaluated these locations and submitted a proposal to the GSA to install and maintain stream gages.

Installation of shallow piezometers and/or soil moisture probes (streambed electrical resistance sensors [SERS]) in select locations in the interior of the Slough are also being considered to measure groundwater elevation and soil moisture, respectively, in the sediments underlying Barka Slough. These data would be monitored to evaluate water levels or soil moisture compared to rooting depths of plants present in the Slough. Feasibility of the installation and on-going monitoring as well as the efficacy and permanence of the piezometers and SERS is being evaluated.

5.9 Representative Monitoring Sites [§ 354.36(a),(b)(1),(b)(2), and (c)]

§ 354.36 Representative Monitoring. Each Agency may designate a subset of monitoring sites as representative of conditions in the basin or an area of the basin, as follows:

(a) Representative monitoring sites may be designated by the Agency as the point at which sustainability indicators are monitored, and for which quantitative values for minimum thresholds, measurable objectives, and interim milestones are defined.

(b) Groundwater elevations may be used as a proxy for monitoring other sustainability indicators if the Agency demonstrates the following:

(1) Significant correlation exists between groundwater elevations and the sustainability indicators for which groundwater elevation measurements serve as a proxy.

(2) Measurable objectives established for groundwater elevation shall include a reasonable margin of operational flexibility taking into consideration the basin setting to avoid undesirable results for the sustainability indicators for which groundwater elevation measurements serve as a proxy.

(c) The designation of a representative monitoring site shall be supported by adequate evidence demonstrating that the site reflects general conditions in the area.

Minimum thresholds and measurable objectives are established at RMSs (also referred to as representative wells) that are deemed to be representative of local and basin wide groundwater conditions in each principal aquifer. Representative wells for the groundwater level monitoring network were selected from a subset of the wells that have been monitored over time in the Basin and have the following characteristics:

- They have known well construction information and are screened exclusively within either the Paso Robles Formation or the Careaga Sand.
- They are spatially distributed to provide information across most of the Basin.
- They have recent monitoring data and a reasonably long record of data (period of record) so that trends can be determined.
- They have hydrograph signatures that are representative of wells in the surrounding area.

The RMS network for groundwater level monitoring consists of 15 wells (8 wells in the Paso Robles Formation and 7 wells in the Careaga Sand) that will be used to help identify chronic reductions in groundwater levels and storage. One representative well is an observation well located adjacent to Barka Slough in the vicinity of the Vandenberg Space Force Base wellfield near the west end of the Basin. One representative well is a municipal drinking water supply well operated by the LACSD. Five representative wells are production wells used for agricultural irrigation. While not ideal for use as monitoring wells, these five production wells are currently included as RMSs because of their location in the Basin, available well construction information, and long period of record (see Table 5-1). These five wells have been matched individually with nearby observation wells (non-pumping wells) that provide comparable spatial coverage of the Basin, have known well construction and aquifer completion data, but do not have a long period of record. Therefore, the five sets of paired wells will continue to be monitored until the period of record for the observation wells is adequate to identify trends in groundwater elevations and confirm that the observation wells are representative of the pumping well that will be eventually replaced in the monitoring program.

Minimum thresholds and measurable objectives for chronic lowering of groundwater levels are presented in Section 4.5, and minimum thresholds and measurable objectives for reduction of groundwater in storage are presented in Section 4.6. The potential for impacts to GDEs for the chronic lowering of groundwater levels sustainability indicator are discussed in Section 4.5 and for the depletion of interconnected surface water sustainability indicator in Section 4.10.

RMS wells are included in the broader GSP groundwater quality monitoring program that includes municipal wells monitored for DDW compliance and agricultural and domestic wells that are sampled as part of the ILRP. Data from RMS wells are evaluated in terms of SMCs presented in Section 4. The groundwater quality network is indicated in Table 5-3 and shown in Figure 5-4. Minimum thresholds and measurable objectives for degraded groundwater quality are discussed in Section 4.8.

5.10 Reporting Monitoring Data to the Department (Data Management System) [§ 354.40]

§ 354.40 Reporting Monitoring Data to the Department. Monitoring data shall be stored in the data management system developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

The SGMA regulations state that a GSP must adhere to the following guidelines for a DMS:

- Article 3, Section 352.6: Each Agency shall develop and maintain a data management system that is capable of storing and reporting information relevant to the development or implementation of the GSP and monitoring of the Basin.
- Article 5, Section 354.40: Monitoring data shall be stored in the DMS developed pursuant to Section 352.6. A copy of the monitoring data shall be included in the Annual Report and submitted electronically on forms provided by the Department.

SGMA-related data for the Basin is being incorporated into the DMS (currently under development). The GSA and entities that collect and report data within the Basin will have access to the DMS and authorization to upload data into the DMS. The data and information stored in the DMS will be checked for quality. The DMS will manage and present the data in a centralized environment to enable utilization of the data by the SABGSA Board and GSP consultant. The data will be used to support GSP development, demonstrate progress towards Basin sustainability, and will be used to communicate with basin stakeholders and the state. The data that will be housed in the DMS are listed in Table 5-5.

Data sources used to populate the DMS are listed in Table 5-6. Categories marked with an X indicate data sets that are publicly accessible. Data are compiled and reviewed to comply with the DQO process defined by EPA guidance (EPA, 2006). The review includes the following:

- Identifying data that is inconsistent with preceding data collected over the period of record or not representative of area conditions based on adjacent measurements collected during the same event.
- Removing or flagging inconsistent data. This applies to historical water level data, water quality data, and water level over time data.

Table 5-5. Overview of Data Management System

Data	Description
Groundwater Levels	Water level data, well construction information, and salient information related to measurements
Groundwater Storage	Groundwater storage monitoring network sites
Water Quality	Water quality well and station data as reported by the SWRCB DDW and ILRP
Land Subsidence	Land subsidence data from the UNAVCO CGPS ORES and InSAR data
Interconnected Surface Water	Data related to the interconnected surface water sustainability indicator such as groundwater levels, stream gages, visual streamflow observations, and precipitation stations.
Water use data	Irrigation, municipal, and domestic water use estimates

Notes
CGPS = Continuous Global Positioning System
DDW = Division of Drinking Water
ILRP = Irrigated Lands Regulatory Program
InSAR = Interferometric Synthetic Aperture Radar
SWRCB = State Water Resources Control Board
UNAVCO = University NAVSTAR Consortium

Table 5-6. Summary of Data Management System Data Sources

Data Sets	Well and Site Info	Well Construction	Aquifer Properties and Lithology	Water Level	Pumping	Recharge	Water Quality
DWR (CASGEM)	X	X	—	X	—	—	—
DWR Well Completion Report Map Application	X	X	X	—	X	—	—
USGS NWIS	X	X	—	X	—	—	—
USGS SAB Study	X	X	X	—	—	—	—
LACSD	X	X	X	X	X	—	—
SRWCB GeoTracker[1]	X	X	—	—	—	—	X
GeoTracker GAMA [2]	X	X	—	—	—	—	X

Notes

[1] Available at https://geotracker.waterboards.ca.gov/

[2] Available at https://gamagroundwater.waterboards.ca.gov/gama/gamamap/public/

— = not applicable
CASGEM = California Statewide Groundwater Elevation Monitoring
DWR = California Department of Water Resources
GAMA = Groundwater Ambient Monitoring and Assessment
LACSD = Los Alamos Community Services District
NWIS = National Water Information System
SAB = San Antonio Basin
SWRCB = State Water Resources Control Board
USGS = U.S. Geological Survey

5.11 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

Davis, T.A, M.K Landon, and G.L Bennett. 2018. Prioritization of Oil and Gas Fields for Regional Groundwater Monitoring Based on Preliminary Assessment of Petroleum Resource Development and Proximity to California's Groundwater Resources. Scientific Investigation Report 2018-5065.

DWR. 2016a. *Best Management Practices for the Sustainable Management of Groundwater – Monitoring Protocols, Standards, and Sites*.

DWR. 2016b. *Best Management Practices for the Sustainable Management of Groundwater – Monitoring Networks and Identification of Data Gaps*.

DWR. 2018a. San Antonio Creek Valley Groundwater Basin Bulletin 118 Update 2016. Prepared by the California Department of Water Resources.

DWR. 2018b. 3-014 San Antonio Creek Valley Basin Boundaries. Prepared by the California Department of Water Resources.

EPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objective Process*. Prepared by the U.S. Environmental Protection Agency.

Maxar. 2020. Base maps for California. Provided by Maxar Imagery.

RWQCB. 2019. Water Quality Control Plan for the Central Coastal Basin. June.

RWQCB. 2021. Proposed General Waste Discharge Requirements for Discharges from Irrigated Lands. April.

The Nature Conservancy, 2019. Identifying GDEs Under SGMA, Best Practices for using the TNC Dataset.

USGS. 2004. *National Field Manual for the Collection of Water Quality Data*. U.S. Geological Survey.

USGS. 2010. Measuring Water Levels by Use of an Electric Tape. U.S. Geological Survey.

USGS. 2020a. Geohydrologic Framework Model: Section Locations and Sections. U.S. Geological Survey.

USGS. 2020b. The National Map, Data Download and Visualization Services. NHDPlus High Resolution Data Model v1.0. Provided by the U.S. Geological Survey. Available at https://www.usgs.gov/media/files/nhdplus-high-resolution-data-model-v10. (Accessed August 5, 2021.)

USGS. 2021. San Antonio Creek Water Availability. U.S. Geological Survey (USGS). Available at https://ca.water.usgs.gov/projects/san-antonio-creek/san-antonio-creek-water-quality.html. (Accessed May 3, 2021.)

SECTION 6: **Projects and Management Actions [Article 5, SubArticle 5]**

6.1 Introduction [§ 354.42, 354.44(a),(c), and (d)]

§ 354.42 Introduction to Projects and Management Actions. This Subarticle describes the criteria for projects and management actions to be included in a Plan to meet the sustainability goal for the basin in a manner that can be maintained over the planning and implementation horizon.

§ 354.44 Projects and Management Actions

(a) Each Plan shall include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin.

(c) Projects and management actions shall be supported by best available information and best available science.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

Sustainable Groundwater Management Act (SGMA) regulations require each Groundwater Sustainability Plan (GSP) to include a description of projects and management actions necessary to achieve the basin sustainability goals and to respond to changing conditions in the basin discussed. This section describes the projects and management actions, which can be implemented in a phased manner, that will allow the San Antonio Creek Valley Groundwater Basin (Basin), as part of GSP implementation, to attain sustainability in accordance with § 354.42 and § 354.44 of the SGMA regulations. In this GSP, groundwater management actions generally refer to activities that support groundwater sustainability through policy and regulations without infrastructure; projects are defined as activities supporting groundwater sustainability that require infrastructure.

The identified management actions and potential future projects are classified using a tiered system, with the implementation of Tier 1 management actions to be initiated within 1 year of GSP adoption by the San Antonio Basin Groundwater Sustainability Agency (SABGSA). Because the SABGSA desires to begin addressing the observed water level declines and the storage deficit soon after adoption of the GSP, Tier 2 management actions will also be initiated. The Tier 3 and 4 management actions and priority projects will be considered for implementation in the future as conditions in the Basin dictate, and as the effectiveness of the lower tiered initiatives are assessed.

Based on the results of the comprehensive multi-phased analysis that was performed in conjunction with the development of this GSP, the SABGSA concluded that the sustainability goals described in this GSP and required under the provisions of SGMA, can be achieved through the implementation of the management actions and priority projects described in Sections 6.3 through 6.10. Although several Tier 4 projects were identified for potential future consideration, the SABGSA does not plan to initiate the construction of any non-priority project infrastructure for the specific goal of achieving sustainability until such time that evidence exists that the effects of the implemented management actions and priority projects are proving insufficient. Non-priority projects were identified for possible future consideration. These possible future projects are assigned Tier 4 status and are briefly described in Section 6.11.

The SABGSA member agencies plan to continually monitor and assess the sustainable management criteria (SMCs) (see Section 4) and under conditions where minimum thresholds are projected to be reached, the SABGSA will perform assessments to determine if the trends are caused by groundwater pumping, caused by drought conditions, or both. If a determination is made that the trends toward reaching minimum thresholds are a direct consequence of groundwater pumping in the Basin, then the SABGSA member agencies will initiate the implementation of higher tier management actions and projects. Conversely, if the SABGSA determines that the degraded conditions in the Basin are due to sustained drought conditions, then the SABGSA will continue to monitor conditions and implement Tier 1 and, possibly, Tier 2 management actions but may elect not to implement higher tier management actions and/or projects until it is determined that the declining conditions in the Basin will not recover after the drought conditions cease.

Management actions and projects discussed in this section are developed to address sustainability goals, measurable objectives, and undesirable results identified for the Basin in Section 4. Inclusion of management actions and projects in this GSP does not forego obligations under local, state, or federal regulatory programs. While the SABGSA has an obligation to oversee progress towards groundwater sustainability, it is not the primary regulator of land use, water quality, or environmental project compliance. It is the responsibility of the implementing agency to ensure that it is working with outside regulatory agencies to keep its projects and management actions in compliance with all applicable laws. Nevertheless, the SABGSA may choose to collaborate with regulatory agencies on specific overlapping interests, such as water quality monitoring and oversight of projects developed within the Basin.

The management actions and projects in this GSP are designed to achieve several outcomes, including:

- Achieving groundwater sustainability by meeting basin-specific SMCs by actions that will allow the Basin to achieve sustainability within 20 years of plan submittal.
- Support the environmental health of the Barka Slough (Slough).
- Providing equity between who benefits from projects and who pays for projects.
- Providing a source of funding for SABGSA operations, management actions and project implementation, and basin monitoring.
- Providing controls and incentives to constrain groundwater pumping within limits so that the Basin is operated within its sustainable yield on a long-term basis.

The management actions and projects included in this section outline a framework for achieving sustainability; however, many details must be negotiated before any of the management actions and projects can be implemented. Costs for implementing projects and management actions are in addition to the agreed-upon funding to sustain the operation of the SABGSA, and the funding needed for monitoring and reporting. The collection of management actions and projects included in this section demonstrate that sufficient options exist to reach sustainability. Not all management actions and projects have to be implemented to attain sustainability, and they have not yet all been agreed upon by stakeholders. Therefore, the projects and management actions included here should be considered a list of prioritized options that will be refined during GSP implementation.

SGMA regulations § 354.44 require that each management action and conceptual project described in the GSP include a discussion about:

- Relevant measurable objectives it would address
- The expected benefits of the action
- The circumstances under which management actions or projects will be implemented
- How the public will be noticed
- Relevant regulatory and permitting considerations
- Implementation schedules
- Legal authority required to take the actions
- Estimated costs

A summary of the management actions and projects that have been identified by the SABGSA are listed below.

Management Actions

- Address Data Gaps
  - Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density
  - Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction
  - Install Stream Gages and Shallow Piezometers at Barka Slough
  - Los Alamos Community Services District (LACSD) Wellfield Pumping Coordination/Offsite Well Impact Mitigation
  - Review/Update Water Usage Factors and Crop Acreages and Update Water Budget
  - Survey and Investigate Potential Groundwater Dependent Ecosystems (GDEs) in the Basin
  - Review U.S. Geological Survey (USGS) Groundwater Model/Update Hydrogeologic Conceptual Model (HCM)
- Groundwater Pumping Fee Program
- Well Registration Program and Well Meter Installation Program
- Water Use Efficiency Programs
- Groundwater Base Pumping Allocation (BPA) Program
- Groundwater Extraction Credit (GEC) Marketing and Trading Program
- Voluntary Agricultural Crop Fallowing Programs

Projects

- Non-Native/Invasive Species Eradication
- Barka Slough Augmentation Project with Groundwater Supplies
- Watershed Management Projects, Including Controlled Burns
- Distributed Storm Water Managed Aquifer Recharge (DSW-MAR) Basins (In-Channel and Off-Stream Basins)
- LACSD Wastewater Treatment Facility (WWTF) Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse
- SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program

- Vandenberg Space Force Base (VSFB), previously Vandenberg Air Force Base (VAFB), Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)
- Barka Slough Augmentation Project with State Water Project (SWP) or Banked Supplemental Water Supplies
- In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers
- SABGSA to provide Technical Assistance and Financial Incentives for High Tunnel (“Hoop Houses”) Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge
- Additional Projects for Potential Future Consideration by SABGSA
  - Development of Water Supply Wells in Bedrock Formations
  - Use of Treated Oilfield Produced Water for Irrigation
  - Water Exchanges to Secure Other Agency State Water Project Allocations

Table 6-1 presents a summary of the benefits, cost, reliability, and permitting requirements for management actions and projects presented in this GSP. These actions and projects are itemized by tier designation to provide the clearest description of when management actions and potential future projects will be considered by the SABGSA for implementation to reach sustainability. The SABGSA will perform annual assessments of the effectiveness of the implemented projects and management actions and utilize adaptive management strategies to re-evaluate the implementation sequencing and priorities, as deemed appropriate. As part of the development of the projects and management actions, the SABGSA will incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results. At any point, the SABGSA may choose to implement individual projects or programs listed in subsequent tiers, if it is determined that it would be beneficial to do so. A brief description of each tier is presented below, followed by more detailed discussion of each management action and project.

Table 6-1. Summary of Benefits, Cost, Reliability, and Permitting Requirements for Management Actions and Projects

	Implementation Tier Level	Relevant Measurable Objective Benefits: Groundwater Levels	Reduction in Storage	Water Quality	Depletion of Interconnected Surface Water	Subsidence	Required Permits	Pumping Reduction Outcome Reliability	Estimated Implementation Cost	Benefit : Cost Ratio
Management Actions										
Address Data Gaps										
Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density	1	N/A	N/A	N/A	N/A	N/A	Santa Barbara County (if a new well)	N/A	$20,000 to $200,000	Moderate - High
Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction	1	N/A	N/A	N/A	N/A	N/A	None	N/A	$25,000 to $75,000	High
Install Stream Gages at Barka Slough	1	N/A	N/A	N/A	N/A	N/A	Santa Barbara County, CDFW	N/A	$75,000 to $125,000	High
LACSD Wellfield Pumping Coordination/ Offsite Well Impact Mitigation	1	X	X	N/A	N/A	N/A	None	N/A	$15,000 to $30,000	High
Review/Update Water Usage Factors and Crop Acreages and Update Water Budget	1	N/A	N/A	N/A	N/A	N/A	None	N/A	$20,000 to $30,000	High
Survey and Investigate Potential GDEs in the Basin and further characterize Barka Slough	1	N/A	N/A	N/A	N/A	N/A	None	N/A	$50,000 to $75,000	High
Review USGS Groundwater Model/ Update Hydrologic Conceptual Model, Develop Water Budget for Barka Slough	1	N/A	N/A	N/A	N/A	N/A	None	N/A	$50,000 to $100,000	High
Groundwater Pumping Fee Program	1	X	X	X	X	X	Proposition 26/218 or Local Ballot Initiative	Moderately Reliable	$100,000 to $200,000	Moderate - High
Well Registration and Well Meter Installation Programs	1	X	X	X	X	X	None	Moderately Reliable	$75,000 to $150,000	Moderate - High
Water Use Efficiency Programs	1	X	X	X	X	X	None	Moderately Reliable	$50,000 to $125,000	Moderate - High
Groundwater BPA Program	2	X	X	X	X	X	None	Highly Reliable	$75,000 to $150,000	Moderate - High
Groundwater Extraction Credit (GEC) Marketing and Trading Program	2	X	X	X	X	X	None	Highly Reliable	$150,000 to $200,000	Moderate - High
Voluntary Agricultural Crop Fallowing Programs	2	X	X	X	X	X	None	Highly Reliable	$75,000 to $150,000	Moderate - High

	Implementation Tier Level	Relevant Measurable Objective Benefits: Groundwater Levels	Reduction in Storage	Water Quality	Depletion of Interconnected Surface Water	Subsidence	Required Permits	Pumping Reduction Outcome Reliability	Estimated Implementation Cost	Benefit : Cost Ratio
Projects										
Non-Native/Invasive Species Eradication	3	X	X	N/A	X	X	Santa Barbara County, CDFW, CEQA	Moderately Reliable	>$200,000	Moderate
Barka Slough Augmentation Project with Groundwater Supplies Using Existing Wells	3	X	X	N/A	X	X	Santa Barbara County, RWQCB, DWR, USACE, CDFW, CEQA	Moderately Reliable	$200,000 - >$1,000,000	Low - Moderate
Watershed Management Projects, Including Controlled Burns	3	X	X	X	X	X	Santa Barbara County, CDFW, CEQA	Highly Variable	>$200,000	Moderate
Distributed Storm Water Managed Aquifer Recharge (DSW-MAR) Basins (In-Channel and Off-Stream Basins)	4	X	X	X	X	X	Santa Barbara County, RWQCB, DWR, USACE, CDFW, CEQA	Highly Variable	>$1,000,000	Low - Moderate
LACSD WWTF Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse	4	X	X	N/A	X	X	Santa Barbara County, RWQCB, DWR, CDFW, CEQA	Moderately Reliable	>$5,000,000	Low
SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program	4	X	X	X	X	X	Santa Barbara County, CEQA	Highly Variable	>$200,000	Moderate
VSFB Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)	4	X	X	N/A	X	X	Santa Barbara County, RWQCB, DWR, USACE, CDFW, USAF, CEQA	Moderately Reliable	>$5,000,000	Low
Barka Slough Augmentation Project with SWP or Banked Supplemental Water Supplies	4	X	X	N/A	X	X	Santa Barbara County, RWQCB, DWR, USACE, CDFW, CEQA	Moderately Reliable	>$1,000,000	Low
In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers	4	X	X	N/A	X	X	Santa Barbara County, RWQCB, DWR, CDFW, CEQA	Moderately Reliable	>$5,000,000	Low
SABGSA to Provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses") Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge	4	X	X	N/A	X	X	Santa Barbara County, RWQCB, CEQA	Moderately Reliable	>$200,000	Moderate

Implementation Tier Level	Relevant Measurable Objective Benefits: Groundwater Levels	Reduction in Storage	Water Quality	Depletion of Interconnected Surface Water	Subsidence	Required Permits	Pumping Reduction Outcome Reliability	Estimated Implementation Cost	Benefit : Cost Ratio

Notes

BPA = Base Pumping Allocation
CDFW = California Department of Fish and Wildlife
CEQA = California Environmental Quality Act
DSW-MAR = Distributed Storm Water Managed Aquifer Recharge
DWR = California Department of Water Resources
GDE = groundwater dependent ecosystem
LACSD = Los Alamos Community Services District
N/A = not applicable
RWQCB = Regional Water Quality Control Board
SWP = State Water Project
SABGSA = San Antonio Basin Groundwater Sustainability Agency
USACE = U.S. Army Corps of Engineers
USAF = U.S. Air Force
USGS = U.S. Geological Survey
VSFB = Vandenberg Space Force Base (previously Vandenberg Air Force Base)
WWTF = Wastewater Treatment Facility

Tier 1 Management Actions

The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. These management actions are focused primarily on filling identified data gaps, developing funding for SABGSA operations and future basin monitoring, registering and metering wells, and developing new and expanding existing water use efficiency programs for implementation within the Basin. As a critical element of GSP implementation, the Groundwater Pumping Fee Program is included as a Tier 1 management action to provide the SABGSA with a source of funding for operation and the continued monitoring of conditions in the Basin. The ancillary benefits include the generation of funding for the SABGSA to invest in the management actions and priority projects described in this GSP, and future projects, should they be deemed feasible.

A key aspect of Tier 1 management actions is addressing data gaps that are necessary to reduce uncertainty (e.g., how much surface water is entering and leaving the Slough relative to groundwater) and improve understanding of basin conditions so that better information is available to the SABGSA for managing the Basin and considering the efficacy of the initial SMCs that have been selected.

The SABGSA member agencies will monitor the effectiveness of these Tier 1 management actions on an annual basis to determine if they will be sufficient to achieve groundwater basin sustainability. The overall effectiveness of individual management actions will also be evaluated annually to determine if continued investment in those actions is warranted or if other actions should be considered. If progress toward reaching measurable objectives is not achieved after implementing Tier 1 management actions, then the SABGSA will perform an evaluation of basin conditions. If it is determined that water level declines during a period of extended drought is expected to reverse before undesirable results are reached, then the SABGSA may defer implementing higher tier management actions and projects. If the downward trend toward undesirable results continues and is determined to be the result of groundwater pumping, then higher tiered management actions and, if warranted, future projects, will be implemented.

Tier 2 Management Actions

The SABGSA member agencies will initiate work on Tier 2 management actions within 3 years of GSP adoption and will be available for implementation to allow time for funding to be secured and for implementation of Tier 1 management actions that are necessary to effectively implement Tier 2 actions (e.g., metering program). Tier 2 management actions include the development and implementation of a Groundwater BPA Program, a GEC Marketing and Trading Program, and Voluntary Agricultural Crop Fallowing Programs. As one of the central tools to achieving sustainability within the Basin, the Groundwater BPA Program will allow the SABGSA to manage the volume of groundwater that is extracted on an annual basis and implement, if necessary, an allocation schedule which may be adjusted every 1 to 2 years until a trend towards sustainability is achieved. The GEC Marketing and Trading Program and the Voluntary Agricultural Crop Fallowing Programs will provide flexibility for groundwater pumpers to adjust their operations and business models to allow for enhanced water conservation, voluntary fallowing of irrigated agricultural croplands, and promotion of beneficial uses of water and land uses by providing for the potential to monetize voluntary water conservation and the elimination of water intensive uses. In combination, the Tier 2 management actions will result in the avoidance of undesirable results, including chronic lowering of groundwater levels, reduction of groundwater in storage, and potentially degraded water quality. Tier 2 management actions are planned to be initiated within approximately 3 years of GSP adoption because accurate flow monitoring is necessary, and time is needed for the Tier 1 well metering program to be fully implemented.

The SABGSA member agencies will monitor the effectiveness of these Tier 2 management actions to determine if they will be sufficient to achieve groundwater basin sustainability. The overall effectiveness of individual Tier 2 management actions will also be evaluated annually to determine if continued investment in those actions is warranted or if other actions should be considered. If it appears that progress toward reaching measurable objectives is not achieved because of implementing the Tier 2 management actions, then the SABGSA will perform an evaluation of basin conditions. If it is determined that groundwater level declines observed during a period of extended drought are expected to reverse before undesirable results are reached, then the SABGSA may defer implementing higher tier management actions and projects. If the downward trend toward undesirable results continues and is determined to be the result of groundwater pumping, then potential future projects may be implemented.

Tier 3 Priority Projects

Activities in Tier 3 include priority projects that the SABGSA member agencies may initiate work on within 5 years of GSP adoption and will be available for implementation if the management actions implemented previously either fail to be implemented or do not avoid undesirable results. The Tier 3 priority projects include non-native/invasive species eradication projects; watershed management projects, including potential controlled burns; and the Barka Slough augmentation project which will provide groundwater supplies which are pumped from the Basin to support the Barka Slough GDE.

Tier 4 Non-Priority Projects

In this GSP, all non-priority projects that were identified and evaluated are classified as Tier 4. The SABGSA does not plan to initiate the construction of any Tier 4 project infrastructure, for the specific goal of achieving basin sustainability, until such time that evidence exists that the effects of the implemented management actions are proving insufficient. Although the SABGSA has no near-term plans to initiate construction of any specific non-priority projects for the purposes of achieving basin sustainability, there may be interest in proceeding with the study, planning and preliminary design/engineering, and permitting phases for a number of projects that were identified by the SABGSA for potential future consideration.

As work on supplemental water supply and resource management efforts is ongoing, it may be the case that additional projects will be identified and added to the list in future GSP updates.

6.2 Management Action Implementation Approach [§ 354.44(b)(6)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(6) An explanation of how the project or management action will be accomplished. If the project or management actions rely on water from outside the jurisdiction of the Agency, an explanation of the source and reliability of that water shall be included.

Using authorities outlined in §§ 10725 to 10726.9 of the California Water Code, the SABGSA will ensure the maximum degree of local control and flexibility consistent with this GSP to commence management actions. Because the amount of groundwater pumping in the Basin in recent years is more than the estimated basin yield of about 8,900 acre-feet per year (AFY), as discussed in Section 3.3, and groundwater levels are declining in certain areas, the SABGSA will begin to implement Tier 1 management actions within 1 year after GSP adoption. The effect of the management actions will be reviewed annually, and additional higher tiered management actions and priority projects will be implemented as necessary to avoid undesirable results. A graphical depiction of the implementation sequence is presented in Figure 6-1.

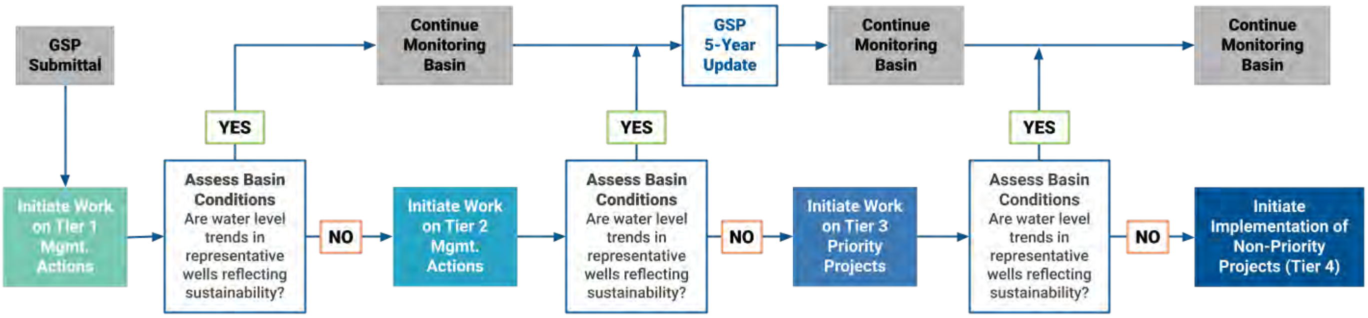

Figure 6-1. Implementation Sequence for Management Actions and Projects

In general, basin-wide management actions will apply to all areas within the Basin and reflect basic GSP implementation requirements, such as extraction measurement, monitoring, reporting and outreach, necessary studies and early planning work, monitoring and filling data gaps, annual reports and GSP updates, and implementing an allocation program that includes limitations on groundwater pumping aimed at both keeping groundwater levels stable and avoiding undesirable results. The SABGSA anticipates that new policies, ordinances, and regulations will be required in advance of the implementation of some of the planned management actions. Because developing and adopting these policies and regulations will require substantial negotiations between the SABGSA member agencies and stakeholders, efforts to define and gain approvals for the scope and detail associated with a regulation will begin soon after GSP adoption. Public meetings and hearings will be held during the process of determining when and where in the basin management actions and priority projects are to be implemented to maximize benefits to the Basin. Some of these may require California Environmental Quality Act (CEQA) compliance and legal support and guidance. A proportional and equitable approach to funding implementation of the GSP and any optional actions will be developed in accordance with all State laws and applicable public process requirements. During these meetings and hearings, input from the public, interested stakeholders, and groundwater pumpers will be considered and incorporated into the decision-making process. The SABGSA will annually assess the effectiveness that management actions and priority projects have achieved in stabilizing groundwater levels and meeting the basin sustainability goals described in this GSP and will reassess the need for continuing and/or expanding these actions. At a minimum, the reassessment process will be done annually as part of the annual reporting process or as part of the required 5-year review and report to California Department of Water Resources (DWR).

6.3 Tier 1 Management Action 1 – Address Data Gaps [§ 354.44(b)(1), (d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

The SGMA regulations require identification of data gaps and a plan for filling them (§ 354.38). In conjunction with the development of this GSP, data was collected and reported for each of the five sustainability indicators that are relevant to:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Degraded water quality
- Land subsidence
- Depletion of interconnected surface water

As part of the process, it was determined that specific data gaps exist and require additional investigation. The SABGSA has determined that the initial management actions that will be undertaken will be for the purposes of filling the identified data gaps and will include the following activities:

- Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density
- Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction
- Install Stream Gages at Barka Slough
- Implement LACSD Wellfield Pumping Coordination/Offsite Well Impact Mitigation
- Review/Update Water Usage Factors and Crop Acreages and Update Water Budget
- Survey and Investigate Potential GDEs in the Basin and further Characterize Barka Slough
- Review USGS Groundwater Model/Update HCM and Develop Water Budget for Barka Slough

Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density

The SGMA regulations require a sufficient spatial coverage and density of monitoring wells to characterize the groundwater table or potentiometric surface for each principal aquifer. Professional judgment is also used to determine an adequate level of monitoring density.

While there is no definitive rule on well density, the best management practices from DWR (2016) cites a range of 0.2 to 10 wells per 100 square miles, with a median of 5 wells per 100 square miles from various cited studies. The Basin is approximately 105 square miles, and the groundwater level monitoring network consists of 23 wells in the Paso Robles Formation Aquifer and 27 wells in the Careaga Sand, which equates to approximately 22 wells and 26 wells per 100 square miles for well density in the Paso Robles Formation and Careaga Sand, respectively.

Although the existing groundwater level monitoring network satisfies the well density guidance cited by DWR (2016), there are areas identified within the Basin (see Figure 5-3) where the addition of monitoring wells would substantially improve the understanding of groundwater conditions as discussed in Section 3.2. This is important information that the SABGSA needs to inform its management decisions. Two low density areas in both principal aquifers were identified in the Basin: the eastern uplands and the central to northwestern uplands. Based on the State Water Resources Control Board (SWRCB) Irrigated Lands Regulatory Program (ILRP), private agricultural supply wells have been identified in the eastern uplands area. An effort will be made during GSP implementation to contact well owners of wells in the eastern uplands area to determine if they can be included in the monitoring program. Including these additional wells in the groundwater level monitoring network would minimize the uncertainty of groundwater elevation trends and benefit sustainable management of the Basin. Two wells in the central to northwestern uplands area, completed in the Careaga Sand, were previously monitored by the USGS or SABGSA. However, well access has been denied by the well owners. An effort will be made by the SABGSA to negotiate access to these wells.

The proposed strategy for adding monitoring wells and representative monitoring sites (RMS) to the monitoring network will be to first incorporate existing wells to the extent possible. Owners of all candidate existing wells will be contacted to determine interest in participating in the monitoring program. Wells considered for incorporation into the monitoring network will be inspected to ensure they are adequate for monitoring and to determine depth, perforated intervals, and aquifer designation. Access agreements will be secured with well owners to ensure that data can be reported from the wells.

If an existing well cannot be identified or permission to use data from an existing well cannot be secured to fill a data gap, then consideration will be given to installing a new monitoring well and/or RMS. The SABGSA will obtain required permits and access agreements before drilling new wells. The SABGSA will retain the services of licensed geologists or engineers and qualified drilling companies for drilling new wells. The SABGSA will also evaluate the availability of grant funds through DWR for new monitoring wells. Once drilled, the new wells will be tested as necessary and equipped for monitoring. All well construction information, including the aquifer that is being monitored, will be registered with the well.

Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction

The SABGSA has determined that there are wells that are now included in the GSP Monitoring Well Network that do not have adequate documentation regarding the reference point elevation, depth, geologic formations intersected, casing characteristics, screened intervals, pump setting, and/or well construction details. To address this data gap, the SABGSA will identify those wells lacking this information, obtain permission from well owners, and perform reference point surveys and video logging to ascertain well construction details, and the location of well production zones. The information gained will be incorporated into the monitoring well network.

A survey of the reference point elevations is needed for all existing wells that are now, or will be in the future, included in the basin monitoring program. This is needed because not all wells in the program have been surveyed and because different vertical elevation datums have been used in the past. The planned reference point survey will be performed using high-resolution Global Positioning System (GPS) equipment to ensure that all groundwater level data are referenced to the same vertical datum in the future.

Concurrent with the reference point surveys, the SABGSA will perform video surveys on all wells to be included in the GSP Monitoring Well Network. During these surveys, SABGSA representatives will interview each well owner regarding the maintenance history, operational issues or events, surface issues that may affect the well, and water quality within the well. The objective of the video survey work and owner interview is to assess the characteristics of each well regarding the following criteria:

- Depth
- Screened interval
- Material type and condition of the casing and screen
- Presence of scaling, sediment, or bacteria
- Well integrity
- Color and clarity of the water
- Gas intrusion
- Water quality
- Other similar observations that may relate to potential water-quality issues
- Historical pumping rate and pumping levels so that any depletion of supply can be identified in the future
- Specific capacity

Note that some information may be unobtainable due to well construction or other factors.

All relevant information acquired on wells will be added to the Data Management System (DMS). All wells in the monitoring well network and wells identified as RMSs, including those used for water quality monitoring, will be registered under the GSP Well Registration Program. During the reference point elevation and well video survey process, if other public or agricultural supply wells are identified that are deemed to improve the network, they may be added to the network.

Install Stream Gages at Barka Slough

As discussed in Section 4.10, all the streams in the Basin are classified as intermittent and suspected to be losing streams, except for stream channels located immediately upstream and within the Barka Slough, which are classified as perennial and suspected to be gaining streams. Interconnected surface water and groundwater within the Careaga Sand is indicated by discharge of groundwater into Barka Slough and by the perennial classification of streams in that area.

Groundwater levels measured in wells located in the vicinity of Barka Slough indicate that groundwater levels have fallen below the Slough ground surface elevation in several locations since about 1983. In addition, upward vertical gradients within the Careaga Sand near the Slough have decreased (see Figure 3-71), which indicate that groundwater flow into the Slough has likely declined.

Surface water also discharges into the Slough. The surface water component of flow into the Slough is equally as important as groundwater discharge into the Slough. Currently, no stream gage exists where surface water flow enters or exits the Slough. The Casmalia stream gage is located more than 2.5 miles west of the Slough and there are groundwater uses between the Slough and the Casmalia gage. Due to a lack of local stream gage data, the presence or absence of surface water flow entering and exiting the Slough is unknown and specifically whether surface water flow into the Slough has been decreasing. Thus, there is considerable uncertainty regarding the sources and quantities of water supporting the Slough and how SMCs should be set in this area (see Section 4).

Two locations have been identified for installation of a stream gage to supplement characterization of spatial and temporal exchanges between surface water and groundwater relative to Barka Slough. A stream gage downstream of the confluence of San Antonio Creek and Harris Canyon Creek and upstream of the Slough would enable direct quantification of surface water entering the Slough.

Additionally, a stream gage at the west end of Barka Slough (where surface water discharges from the Basin), near California State Highway 1, would provide a more direct quantification of surface water discharge exiting the Slough. The addition of a stream gage at this location would inform the water budget for the Slough and improve the ability to assess the interconnected surface water SMCs described in Section 4.10. The SABGSA is in the process of identifying willing landowners who will provide access to the gage(s) and is working with the USGS for assistance.

Measurement of groundwater levels within the Barka Slough sediments would aid in understanding the water budget and groundwater conditions within the Slough. If it is determined that access can be obtained and maintained and CDFW is willing to permit this activity, the SABGSA is considering the installation of shallow piezometers within the Barka Slough sediments to allow monitoring of groundwater levels within the root zone of the plants in the Slough. The feasibility and permit requirements for this activity requires further evaluation.

LACSD Wellfield Pumping Coordination/Offsite Well Impact Mitigation

The LACSD provides potable water supply to approximately 1,800 residents. The source of the water is supplied from four municipal wells that are located within the LACSD boundary. The wells range in depth from approximately 500 feet (ft) to 800 ft. Each of the wells is completed in the Paso Robles Formation. The combined pumping from the subject wells is approximately 250,000 gallons per day (gpd). Each of the wells is operated through a Supervisory Control and Data Acquisition (SCADA) system. One feature of the SCADA system is that it provides continuous information on static and pumping depths within the subject wells. The LACSD's water wells are equipped with variable frequency drives that allow the LACSD to control the pumping rate at the wells and adjust accordingly to the community's water needs.

As described in Section 3.2.1.1, low groundwater elevation contour lines near the town of Los Alamos indicate a groundwater pumping center may exist in this area. Based on the review of available well location data, it appears that the LACSD municipal wells are located in an area that coincide with the presence of numerous agricultural irrigation wells. Pumping from this area of concentrated wells appears to be resulting in a localized and lower groundwater levels in the aquifer. Static and pumping levels in LACSD wells are close to the top of well screens. The LACSD has been reviewing its pumping schedules and initiated discussions with the surrounding agricultural pumpers to explore the potential for implementing a coordinated pumping schedule program to assess the feasibility of distributing pumping from all wells in the affected area to address this localized issue and raise static and pumping levels at LACSD wells.

The SABGSA has identified this as a data gap and plans to initiate a study to evaluate the localized impacts in the Basin which are occurring from the existing pumping operations and explore strategies for implementing a groundwater pumping management program to improve the conditions in the Basin and mitigate the impacts to the LACSD water supply system.

Review/Update Water Usage Factors and Crop Acreages and Update Water Budget

As described in Section 3.3, in 2020 there was approximately 13,459 acres of irrigated cropland within the Basin that accounts for an estimated 62 percent (average 17,300 AFY) of the groundwater pumped from the basin annually. This volume of water pumped is based primarily on estimates. In the absence of metered pumping records, agricultural irrigation pumping was estimated using periodic land use survey data (from 1959, 1968, 1977, 1986, 1996, 2006, 2016, and 2020) provided by the USGS (USGS, 2020) and the Santa Barbara County Agricultural Commissioner, Weights and Measures Department (Santa Barbara County, 2020) to determine crop types and acreages. Crop-specific water duty factors for the Basin were derived from the Groundwater Production Information and Instructions pamphlet prepared by Santa Ynez River Valley Water Conservation District (SYRWCD, 2010). Some crop duty factors were adjusted based on feedback from some growers in the Basin. These crop-specific water duty factors were applied to the acreage associated with agricultural land use type in the land survey data provided by USGS and Santa Barbara County for the Basin. Land use surveys were not available for every year, so spatial-temporal interpolations were made between the land use surveys for the intervening years.

While the accuracy of the land use mapping of irrigated crops for the recent years are acceptable for the GSP, uncertainty remains in the estimates of water use from these irrigated lands and hence the assumed amount of pumping needed to meet the crop water requirement. The uncertainty of this groundwater budget component is considered moderate. To address this uncertainty and increase the accuracy of the annual groundwater pumping estimates and basin water budget calculations in future years until a metering program is fully implemented, the SABGSA has identified this as a data gap and plans to review and update water usage factors and crop acreages, which will be incorporated into future refinements in the basin water budget.

Survey and Investigate Potential GDEs and Further Characterize Barka Slough

As described in Section 3.2.6, a preliminary assessment was performed to evaluate the potential that GDEs are present within the Basin. The assessment methodology was based on guidance developed by The Nature Conservancy (TNC, 2019). Based on the results of the screening level assessment, it was determined that GDEs exist within the Barka Slough and some additional isolated areas within the Basin. Although mapping of GDEs and potential GDEs has been the primary focus of this GSP, no biological or habitat surveys were completed to verify the existence of the potential GDEs or to characterize GDEs in Barka Slough in preparation of the GSP. As described above, the SABGSA plans to install stream gages to develop a better understanding of the surface water/groundwater interaction and further assess the Barka Slough water budget.

At present there is insufficient data available to confirm the nature and spatial extent of GDEs within Barka Slough and elsewhere and the degree to which they are supported by surface water and/or groundwater. To address this uncertainty, the SABGSA has identified this as a data gap and plans to perform a habitat survey in Barka Slough and further investigate potential GDEs elsewhere in the Basin. This information will be used to further identify GDEs that can be affected by pumping and groundwater management activities and to understand groundwater and surface water conditions in Barka Slough so that SMCs can be updated to avoid impacts to GDEs.

Review USGS Groundwater Model/Update HCM, Develop Water Budget for Barka Slough

As of this writing in 2021, a groundwater model developed by the USGS was being calibrated as part of a multi-year groundwater basin study. The groundwater model and related information was not made available for use in the preparation of this GSP and therefore, it was necessary to use a spreadsheet tool to develop the water budgets for the Basin and to assess projects and management actions needed to bring the Basin into sustainability. While a groundwater model would be preferred, the spreadsheet tool can be used for this purpose in accordance with § 354.18 of the SGMA regulations.

Utilizing the spreadsheet tool, water budget components for the Basin were developed using various publicly available data sets organized in a tabular accounting methodology by water year. Table 3-14 presents a summary of the data sources used for developing the water budgets and a description of each data set's qualitative data rating.

A qualitative discussion of the estimated level of uncertainty associated with each data source is described in Table 3-14 and for each water budget term. This discussion focuses on the level of uncertainty and the confidence in the data, as well as the assumptions and interpretations of the information used to develop the water budgets. The level of uncertainty can significantly affect the SABGSA's ability to sustainably manage the Basin. The calculated and modeled values are generally of medium quality. Data derived from other sources, including water duty factors for irrigated crops for the estimation of agricultural pumping and related irrigation return flow, are less certain and therefore of medium/low quality (with the highest uncertainty). In addition, there is considerable uncertainty about how much groundwater and surface water are discharging into Barka Slough and how pumping in the Basin may impact the Slough.

To address this uncertainty, improve the accuracy of the annual groundwater pumping estimates and basin water budget calculations in future years, and assess the water budget for Barka Slough, the SABGSA plans to review and utilize the USGS Basin Groundwater Model when the model is made available by the USGS.

6.3.1 Relevant Measurable Objective(s) for Addressing Data Gaps [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

Each of the management actions described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of the groundwater conditions in the Basin, the interconnected surface water systems in critical areas of the Basin, and the agricultural water demands in the Basin, from a spatial and temporal perspective. The information that will be gained through these management actions will provide the basis for future refinements in the basin HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). Although extremely valuable and important for making management decisions, the implementation of these management actions will not have any direct impact on meeting any of the measurable objectives as described in Section 4 of this GSP.

6.3.2 Implementation Triggers for Addressing Data Gaps [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management actions described in this section are deemed critical for the successful implementation of the GSP and are included in the Tier 1 implementation category. Activities in Tier 1 are management actions that the SABGSA member agencies plan to initiate work on within 1 year of GSP adoption. The subject management actions are not directly linked to any of the defined SMCs as defined in this GSP (see Section 4) other than additional data will be used to consider modifications to SMCs in the future.

6.3.3 Public Notice Process for Addressing Data Gaps [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

Public outreach meetings, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the groundwater pumpers and other stakeholders of the current and projected basin conditions and the need for addressing data gaps. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to provide input and comments on how the management actions related to addressing data gaps are being implemented in the Basin. Information on how progress towards achieving an enhanced understanding of groundwater conditions in the Basin, amount of pumping, the interconnected surface water systems in critical areas of the Basin, the nature and extent of GDEs, and the agricultural water demands in the Basin will also be provided through annual GSP reports and links to relevant information on SABGSA and member agency websites. Specific well owners, to be identified by the SABGSA, will be contacted directly to discuss specific management actions, including the potential for adding additional existing wells to the monitoring and/or RMS network. Additionally, specific well owners to be identified by the SABGSA will be contacted directly to obtain access to wells for performing reference point elevation and video surveys to determine operational status, construction details, and aquifer designation. Lastly, the well registration and metering program will be developed with stakeholder input.

6.3.4 Overdraft Mitigation for Addressing Data Gaps [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

Each of the management actions described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of groundwater pumping, the groundwater conditions in the Basin, the interconnected surface water systems in critical areas of the Basin, the nature and extent of GDEs, and the agricultural water demands in the Basin, from a spatial and temporal perspective. The information that will be gained through these management actions will provide the basis for future refinements in the basin HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). Although extremely valuable and important, the implementation of these management actions will not have any direct impact on the mitigation of the estimated storage deficit as described in Section 3.3 of this GSP, other than metering of wells has been shown to reduce overall groundwater production in other basins.

6.3.5 Permitting and Regulatory Process for Addressing Data Gaps [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

The SABGSA anticipates that well construction permits will be required to be obtained from Santa Barbara County Department of Public Health Environmental Health Services for any new wells that are drilled. Because well drilling permits are a ministerial action in Santa Barbara County, which historically have been exempt from CEQA requirements, the SABGSA would not need to prepare CEQA documentation prior to construction of monitoring wells. Well drilling would not trigger the National Environmental Policy Act unless federal funding or permits are required for implementation of this management action, which is not considered to be the case.

No permitting or regulatory processes are required for the implementation of the remaining management actions that are associated with filling data gaps.

6.3.6 Implementation Timeline for Addressing Data Gaps [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management actions described in this section are deemed critical for the successful implementation of the GSP and are included in the Tier 1 implementation category. Activities in Tier 1 are management actions that the SABGSA member agencies plan to initiate work on within 1 year of GSP adoption.

6.3.7 Anticipated Benefits for Addressing Data Gaps [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

The management actions described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of groundwater conditions in the Basin, the effect of pumping on interconnected surface water and potential impacts on GDEs in Barka Slough, and the agricultural water demands in the Basin, from a spatial and temporal perspective. The information that will be gained through these management actions will provide improved understanding of the condition of the Basin and allow for future refinements in the HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). In addition, the information acquired though the implementation of the management actions described in this section will help guide the SABGSA in determining the optimal strategy for sequencing the implementation of the higher tiered management actions, priority projects, and potential future non-priority projects (if needed) which are described in Sections 6.4 through 6.10. The information will also help the SABGSA understand whether the SMCs are set at appropriate levels.

6.3.8 Legal Authority for Addressing Data Gaps [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

SGMA regulations require identification of data gaps and a plan for filling them (§ 354.38).

6.3.9 Cost and Funding for Addressing Data Gaps [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

For budgetary planning purposes, the following estimates are provided for each of the identified data gaps:

- Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density
  - Budgetary Estimate: $20,000 to $200,000
- Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction
  - Budgetary Estimate: $25,000 to $75,000
- Install Stream Gages at Barka Slough
  - Budgetary Estimate: $75,000 to $125,000
- LACSD Wellfield Pumping Coordination/Offsite Well Impact Mitigation
  - Budgetary Estimate: $15,000 to $30,000
- Review/Update Water Usage Factors and Crop Acreages and Update Water Budget
  - Budgetary Estimate: $20,000 to $30,000
- Survey and Investigate Potential GDEs in the Basin and Further Characterize Barka Slough
  - Budgetary Estimate: $50,000 to $75,000
- Review USGS Groundwater Model/Update HCM and Develop Water Budget for Barka Slough
  - Budgetary Estimate: $50,000 to $100,000

6.3.10 Drought Offset Measures for Addressing Data Gaps [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

Each of the management actions described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of groundwater conditions in the Basin, the interconnected surface water system in critical areas of the Basin, and the agricultural water demands in the Basin, from a spatial and temporal perspective. The information that will be gained through these management actions will provide the basis for future refinements in the HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). Although extremely valuable and important, the implementation of these management actions will not have any direct impact regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

6.4 Tier 1 Management Action 2 – Groundwater Pumping Fee Program [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

As part of the GSP implementation process, the SABGSA will explore various financing options to cover its operational costs and to generate funding for monitoring of the Basin and the implementation of management actions and potential future projects. Based on the results of these efforts, the SABGSA may adopt a management action to levy groundwater pumping fees for the purposes of generating funding for the SABGSA operations and the ongoing monitoring of the condition of the Basin and funds for the development and implementation of the identified management actions and potential projects. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. The SABGSA will consider an investigative study to determine the most effective and equitable fee and incentive structure. In conjunction with the development of the

Groundwater Pumping Fee Program, the SABGSA will ensure that any charges that the SABGSA plans to place on groundwater extraction will be carefully reviewed by legal counsel to determine if those charges are appropriate, and what regulatory/statutory processes will be required for them. They will also be reviewed so that they are consistent with the fee structure that the San Antonio Basin Water District has in place. The following potential fee structures and incentives would affect groundwater users differently, so a composite fee and incentives structure may also be considered.

- **Per Parcel Fee:** This fee is envisioned to be a regulatory fee charged at a uniform amount to all parcel owners within the Basin. A regulatory fee can be assessed with SABGSA approval rather than through an election. Benefits of a parcel fee include that it would spread the cost of the SABGSA administration and the implementation of selected management actions and potential future projects to all parcel owners, which would distribute the cost relatively equally. This approach has several issues though, including the fact that some parcels in the Basin may not use groundwater directly. There may also be concerns about the constitutionality of assessing this fee, as it could be considered a tax and subject to legal challenge.
- **Parcel Fee and Groundwater Extraction Based Fee:** This fee structure would provide for an assessment of a small fee on all parcels, and then distribute the remaining costs based on groundwater extraction. It is considered because it would provide for the distribution a small amount of cost to all parcel owners, recognizing the benefits to all for sustainably managed groundwater, but it would also provide for charging the direct users of groundwater proportionally to their actual use. This fee is compelling for the reasons listed but has similar issues regarding constitutionality concerns as the per parcel fee.
- **Parcel Tax:** This approach would constitute a voter-approved parcel tax, and require the initiative be decided through an election process. It would be similar to the per parcel fee structure but would not have the same legal concerns. It has similar benefits that the per parcel fee structure would provide such that the costs associated with GSP implementation be kept relatively low and evenly distributed, however, this approach will require voter approval by a two-thirds majority. Additionally, placing a parcel tax measure on the ballot would substantially increase costs to the SABGSA. The SABGSA would also have to incur costs associated with polling and the creation and distribution of educational materials. Finally, a campaign would be required (which could not be undertaken by the SABGSA itself), and there is no guarantee of success at the polls.
- **Fee on Groundwater Extraction:** This approach would provide for fees to be assessed on all groundwater users based on actual groundwater extraction but would not include the levy of a parcel fee. This approach has the benefit of having a direct nexus between the regulated activity (pumping groundwater) and the regulatory fee. It would provide for directly measuring the extraction by all water service providers, as well as agricultural groundwater pumpers. Currently, only municipal and other public water supply systems, along with a portion of the agricultural pumpers in the Basin, meter and report their groundwater usage. Under this system, meters will be required to be installed on all non-de minimis wells, or the adoption of an alternative groundwater extraction measurement methodology to be approved by the SABGSA. Lastly, this approach would require a different approach for de minimis users (residential users that use under 2 AFY).
- **Member Agency Funding:** Another option for funding the implementation of the GSP would be member agency funding. This method has inherent difficulties related to the gathering of appropriate data to be used in making equitable fee calculations during the program development process. Local government agencies who are SABGSA member agencies would have to continue funding the SABGSA past GSP development. This approach would require universal member agency approval and cost sharing agreement and requires many landowners that use little to no groundwater to pay for the management of the Basin, while other large groundwater pumpers may not pay an equitable share of the GSP implementation costs.

- **Fee on Estimated Groundwater Extraction:** This approach relies on estimating groundwater use across the Basin and applying a fee based on estimated usage. This approach is similar in concept to the fee on measured groundwater use except that the installation of meters on all wells would not be required. It has similar benefits as the fee on groundwater use but does not suffer from the drawbacks with needing to measure groundwater use of all kinds. The issues with this approach include challenges associated with formulating a reasonable basis of estimating groundwater use based on estimates of crop water use and acreage estimated using satellite imagery. These methods for estimating water use have fairly high levels of uncertainty. It may be necessary for the SABGSA to use this approach until a metering program is fully in place.

The Groundwater Pumping Fee Program will be developed as part of a portfolio of management actions, which may also include the Well Registration and Well Metering Installation Programs; Voluntary Agricultural Crop Fallowing Programs; Groundwater BPA Program; and the GEC Marketing and Trading Program. The fees to be levied for groundwater pumping will likely be in addition to a tiered base fee structure that will be levied against all groundwater pumpers in the Basin, including de minimis (less than 2 AFY) pumpers. The base fees will provide funding for the general administration and operation of the SABGSA. The groundwater pumping fees to be collected would also be used to fund the costs of SABGSA operations, monitoring of the Basin, and for the implementation of the management actions described in this GSP. If the implementation of the management actions proves insufficient to achieve basin sustainability, then the fees may also be used for the funding of the projects identified as Tier 3 alternatives. De minimus pumpers will not be metered and will not be required to pay an extraction-related pumping fee.

6.4.1 Relevant Measurable Objective(s) for the Groundwater Pumping Fee Program [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The primary benefits that result from the implementation of the Groundwater Pumping Fee Program will be to provide a source of funding to the SABGSA for administration, operation, and continued monitoring of the condition of the Basin. Secondarily, the measurable objectives benefiting from the implementation of the Groundwater Pumping Fee Program include:

- **Groundwater Elevation Measurable Objectives:** The Groundwater Pumping Fee Program will focus on creating financial incentives for pumpers to reduce pumping, which will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of the Groundwater Pumping Fee Program will focus on motivating pumpers to reduce pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.

- **Land Subsidence Measurable Objectives:** The Groundwater Pumping Fee Program will focus on reducing pumping, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** The Groundwater Pumping Fee Program will focus on reducing pumping which will result in higher groundwater elevations which will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and total dissolved solids (TDS) infiltrating to the aquifer.

6.4.2 Implementation Triggers for the Groundwater Pumping Fee Program [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management action described in this section is deemed critical for the successful implementation of the GSP and is included in the Tier 1 implementation category. The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. As part of program development, the SABGSA will determine the most effective and equitable fee and incentive structure. In conjunction with the development of the Groundwater Pumping Fee Program, the SABGSA will ensure that any charges that the SABGSA plans to place on groundwater extraction will be carefully reviewed by legal counsel to determine if those charges are appropriate, and what regulatory/statutory processes will be required for them. Prerequisites of levying groundwater pumping fees will be the installation of flow meters or other quantification methods for groundwater users (excluding de minimis users) as described in Section 6.5. Metering will be required with implementation of this GSP with all non-de minimis wells in the Basin to be equipped with meters, or an approved alternative form of extraction measurement, within 12 months of GSP acceptance by DWR. Once fully implemented, the Groundwater Pumping Fee Program will result in immediate benefit to the Basin by providing needed funds for SABGSA administration and operation, along with funding to support ongoing monitoring of the Basin. Additionally, funds may be available for management action and priority project implementation and for potential future projects, if necessary. The program will be ongoing throughout the GSP implementation period and will be modified as annual adjustments to the pumping allocations are made.

6.4.3 Public Notice Process for the Groundwater Pumping Fee Program [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

The Groundwater Pumping Fee Program will be developed in an open and transparent process. Targeted outreach meetings and technical workshops, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform all groundwater pumpers and other stakeholders about the details of the Groundwater Pumping Fee Program. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to learn about the programs as well as the opportunity to provide input and comments on how the pumping fee program will being implemented in the Basin. The targeted public outreach meetings and technical workshops will be supplemented with informational mailers to be sent to all well owners and growers in the Basin and informational press releases will be distributed to local media. If deemed valuable, SABGSA representatives may work directly with individual well owners to explain program requirements and help with program implementation. The Groundwater Pumping Fee Program will also be promoted through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.4.4 Overdraft Mitigation for the Groundwater Pumping Fee Program [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

The development and implementation of the Groundwater Pumping Fee Program will provide the SABGSA with funding necessary for SABGSA administration and operation, as well as for implementing the management actions and for future projects, if necessary, as described in this GSP. The implementation of these management actions and future projects, if necessary, will directly result in a reduction of the volume of groundwater that will be pumped from the Basin and consequently mitigation of the estimated storage deficit within the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions.

6.4.5 Permitting and Regulatory Process for the Groundwater Pumping Fee Program [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

SGMA's enabling legislation included establishing California Water Code § 10730. This legislation states that:

> *A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de Minimis extractor unless the agency has regulated the users pursuant to this part.*

Some elements of the Groundwater Pumping Fee program may be subject to CEQA and Proposition 218 requirements. The program will be developed in accordance with all applicable groundwater laws and respect all groundwater rights.

6.4.6 Implementation Timeline for the Groundwater Pumping Fee Program [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management action described in this section is deemed critical for funding the operations of the SABGSA and for the successful implementation of this GSP and is included in the Tier 1 implementation category. The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. This phase is anticipated to take from 12 to 18 months. Metering will be required with implementation of this GSP with all non-de minimis wells in the Basin to be equipped with meters, or an SABGSA approved alternative method of extraction measurement, within 12 months of GSP acceptance by DWR. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program will result in immediate benefit to the Basin. The program will be ongoing throughout the GSP implementation period with periodic fee structure reviews to occur as annual adjustments to the pumping allocations are made and the effectiveness of the implemented management actions, and potential projects, are assessed.

6.4.7 Anticipated Benefits for the Groundwater Pumping Fee Program [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

The primary purpose of the program will be to provide a source of funding for SABGSA operations and basin future monitoring. Funding may also be used for the development and implementation of management actions and potential future projects.

As a critical element of the GSP implementation, the Groundwater Pumping Fee Program is expected to mitigate a portion of the estimated storage deficit by motivating groundwater users to reduce pumping or pump groundwater supplies in a sustainable fashion. In 2018, there was an estimated 7,329 acres of irrigated cropland in the Basin with a corresponding water demand of approximately 14,545 AFY. Assuming a groundwater pumping fee program would result in a 5 percent reduction in basin-wide agricultural pumping on an annual basis, the resulting benefit would be approximately 725 AFY.

The Groundwater Pumping Fee Program will contribute to the avoidance of undesirable results, including chronic lowering of groundwater levels, reduction of groundwater in storage, and potentially degraded water quality. The benefits to the Basin may vary significantly depending upon levied fees, water year, and available transfers/banked groundwater extraction credits, as described in Management Action 7 (see Section 6.9).

6.4.8 Legal Authority for the Groundwater Pumping Fee Program [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

SGMA's enabling legislation included establishing California Water Code § 10730. This legislation states that:

> *A groundwater sustainability agency may impose fees, including, but not limited to, permit fees and fees on groundwater extraction or other regulated activity, to fund the costs of a groundwater sustainability program, including, but not limited to, preparation, adoption, and*

amendment of a groundwater sustainability plan, and investigations, inspections, compliance assistance, enforcement, and program administration, including a prudent reserve. A groundwater sustainability agency shall not impose a fee pursuant to this subdivision on a de Minimis extractor unless the agency has regulated the users pursuant to this part.

6.4.9 Cost and Funding for the Groundwater Pumping Fee Program [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Planning-level development cost for establishing the Groundwater Pumping Fee Program is estimated to be approximately $100,000 to $200,000 and separate from development of this GSP.

Potential sources of funding for the Groundwater Pumping Fee Program components include state grants, contributions from SABGSA member agencies, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.4.10 Drought Offset Measures for the Groundwater Pumping Fee Program [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The development and implementation of the mandatory Groundwater Pumping Fee Program within the Basin will result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. This program will also provide financial incentives to basin pumpers to reduce groundwater extractions.

As monitoring of the groundwater levels in the Basin occurs in the future, the SABGSA will quantify the beneficial impact that the implemented management actions are having on the condition of the Basin which will allow for future refinements in the basin water budget. The information acquired will be critical to the SABGSA in making informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought can offset by increases in groundwater levels or storage during other periods.

6.5 Tier 1 Management Action 3 – Well Registration and Well Meter Installation Programs [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

In conjunction with the pumping fee program, the SABGSA will require that all groundwater production wells, including wells used by de minimis pumpers, be registered with the SABGSA. If the wells have a meter, the meter should be calibrated on a regular schedule in accordance with manufacturer standards and any programs developed by the SABGSA. Well registration is intended to establish a relatively accurate count of all the active wells, including an accurate location of each well, in the Basin. Well metering is intended to improve estimates of the amount of groundwater extracted from the Basin. SGMA does not authorize GSAs to require metering of de minimis (and domestic) well users, and therefore well metering will be limited to non-de minimis wells.

The information to be acquired through the well registration program can be used by the SABGSA for the purposes of potential risk and impact assessment with regard to the water supply adequacy and water quality for domestic and community drinking water wells within the Basin. If the information obtained through the well registration program indicates that there is a potential for adverse impacts to the future water supply adequacy or water quality of domestic and/or community drinking water supply wells then the SABGSA can elect to develop and implement a Drinking Water Well Impact Mitigation Program.

The SABGSA will require all non-de minimis groundwater pumpers to report extractions annually and use a water-measuring method satisfactory to the SABGSA in accordance with Water Code § 10725.8. For the purposes of this management action, de minimis users shall be defined as "a pumper who extracts, for domestic purposes, two acre-feet or less (of groundwater) per year." It is anticipated that the SABGSA will develop and adopt guidelines and a regulatory framework to implement this program, which may also include a system for reporting and accounting for water conservation initiatives, voluntary irrigated land fallowing (temporary and permanent), storm water capture projects, or other activities that individual pumpers may elect to implement. The information collected will be used to account for pumping that would have otherwise occurred, to provide additional information to be used by the SABGSA for analyzing projected basin conditions, updating the HCM, and completing annual reports and 5-year GSP assessment reports for DWR.

The existing water supply wells that are operated by the LACSD are currently fully metered and groundwater extractions are reported at least annually to the Regional Water Quality Control Board (RWQCB). However, extraction measurements by private well owners within the Basin have not been heretofore required.

Extractions from these wells, which are used primarily for irrigated agricultural operations, will be required to be metered and extractions reported.

Agriculture irrigators have voiced concerns regarding the costs associated with the requirement for meters. Although the cost associated with installing and maintaining meters is a legitimate concern, meters can improve the overall management of water and improve the efficiency of the groundwater supply system, over the long term, and the resulting improvement of water efficiency provides a return on the investment. Research and on-the-ground observations have demonstrated that greater water use efficiency directly benefits pumpers by lowering pumping and distribution costs and reducing water use. Research at the Irrigation Technology Center at Texas A&M University has demonstrated that water measurement by itself can reduce crop irrigation water use by 10 percent. When measurement was combined with education about proper on-farm irrigation management, water use was reduced by 20 to 40 percent (TWRI, 2001).

As a Tier 1 management action, the SABGSA plans to initiate a pilot program to determine the most feasible means of complying with SGMA's measurement provision within 1 year of GSP adoption. The measurement alternatives and data processing methods to be evaluated may include the following:

- Use of power records to correlate energy usage with volume of water pumped
- Conventional mechanical or magnetic flow meters
- Automated meter infrastructure systems

Although the SABGSA does not have permitting authority for issuing permits for new well construction within the Basin (permits for new wells are required to be obtained from the Santa Barbara County Department of Public Health Environmental Health Services), the SABGSA will require registration of all new wells and the installation of meters on those wells and may require a CEQA analysis before the new well can be placed into operation. For the purposes of this action, a new well will be any new non-de minimis well that is issued a construction permit after the date that the GSP is submitted to DWR. Given that the Basin currently has a storage deficit, the SABGSA may elect to place a limitation on the volume of water that can be pumped annually from any new well or new production from existing wells. The SABGSA may also consider modifying the pumping limitations that are placed on new wells and production in conjunction with the development of the Groundwater BPA Program (see Management Action 6 in Section 6.8).

6.5.1 Relevant Measurable Objective(s) for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The management action described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of the volume of water being extracted from the Basin, from both municipal agencies and the agricultural groundwater pumpers in the Basin, both from a spatial and temporal perspective. The information that will be gained through this management action will provide the basis for future refinements in the basin HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). The installation of metering on non-de minimis wells may result in a reduction in the volume of groundwater extracted on an annual basis. These reductions may result in benefits to the Basin, including:

- **Groundwater Elevation Measurable Objectives:** Water Use Efficiency Programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of Water Use Efficiency Programs will focus on identifying best water use practices that will reduce pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Land Subsidence Measurable Objectives:** Water Use Efficiency Programs will focus on reducing pumping through water conservation, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** Water Use Efficiency Programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations, which will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and TDS infiltrating to the aquifer.

6.5.2 Implementation Triggers for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management action described in this section is deemed critical for the successful implementation of this GSP and is included in the Tier 1 implementation category. The SABGSA will initiate work on the Tier 1 management actions within 1 year of GSP adoption. This management action is not directly linked to any of the SMCs (see Section 4). This management action is linked to the pumping fee program and is a prerequisite to the implementation of the Groundwater BPA Program (see Management Action 6 in Section 6.8).

6.5.3 Public Notice Process for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

Public outreach meetings, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the groundwater pumpers, municipal and domestic pumpers, rural residents and other stakeholders regarding the development and implementation of the Well Registration and Well Metering Program. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to provide input and comments on how the management actions related to registering wells and the requirements for groundwater extraction measurement are being implemented in the Basin. The public outreach meetings will be supplemented with informational mailers to be sent to all well owners in the Basin and informational press releases will be distributed to local media. It is probable that SABGSA representatives will need to contact some individual well owners to explain the program requirements and help some well owners in achieving compliance.

As additional information is gained through the implementation of these management actions, it will be conveyed to the participants in future public outreach meetings and will contribute to the database that is the basis for future refinements in the basin HCM and the basin water budget (see Sections 3.1 and 3.3, respectively). These future refinements will also be provided through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.5.4 Overdraft Mitigation for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

The management action described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of the volume of water being extracted from the Basin, from both pumpers meeting municipal and public drinking water demands and by the agricultural groundwater pumpers in the Basin, both from a spatial and temporal perspective. The information that will be gained through this management action will help the SABGSA better understand the causes of the storage deficit and how it can be mitigated. Although extremely valuable and important, the implementation of this management action will not have any direct impact on the mitigation of the estimated storage deficit as described in Section 3.3. Studies have shown that metering results in some reduction in pumping.

6.5.5 Permitting and Regulatory Process for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

To provide for implementation of this management action, the SABGSA will develop a program that requires all non-de minimis extractors to report extractions and use a water-measuring method satisfactory to the SABGSA in accordance with Water Code § 10725.8. It is anticipated that the SABGSA will adopt a regulation governing the Well Registration and Well Meter Installation Program.

6.5.6 Implementation Timeline for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management action described in this section is deemed critical for the successful implementation of this GSP and is included in the Tier 1 implementation category. The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. This management action is a prerequisite to the implementation of the Groundwater BPA Program (see Management Action 6 in Section 6.8).

6.5.7 Anticipated Benefits for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

The management action described in this section will be designed and implemented for the specific purpose of obtaining valuable data that will allow an enhanced understanding of the volume of water being extracted from the Basin, from pumpers meeting municipal and public drinking water demands and by the agricultural groundwater pumpers in the Basin, both from a spatial and temporal perspective. The information that will be gained through this management action will provide improved understanding of groundwater extractions so that other actions, including the BPA can be effectively managed. In addition, the information acquired though the implementation of this management action will help guide the SABGSA in determining the optimal strategy for sequencing the implementation of the higher tiered management actions and projects should they be necessary, which are described in Sections 6.5 through 6.10. This management action is a prerequisite to the implementation of the Groundwater BPA Program (see Management Action 6 in Section 6.8).

Additionally, studies have shown that the installation of meters on wells can directly result in reduced groundwater pumping by 10 percent or more. For perspective, assuming the meter installation program achieves 5 percent reduction in pumping, the resulting benefit would be approximately 725 AFY.

6.5.8 Legal Authority for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

The legal authority to empower the SABGSA to require well registration and groundwater extraction by pumpers in the Basin is included in SGMA. For example, Water Code § 10725.8 authorizes a SABGSA to require through their GSP that the use of every groundwater extraction facility (except those operated by de minimis extractors) be measured.

6.5.9 Cost and Funding for the Well Registration and Well Meter Installation Programs [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Planning-level costs for developing and establishing the Well Registration and Well Meter Installation Programs are estimated to be approximately $75,000 to $150,000 (not including the cost of meters) and are separate from development of this GSP. According to Water Code § 10725.8(b), costs associated with individual measurement devices are to be borne by the well owner/operator, so the cost exposure to SABGSA member agencies for implementing Well Registration and Well Metering Programs can be distributed among all well owners, including de minimis. Depending on the method of extraction measurement that the SABGSA ultimately approves, the costs associated with the selected method to measure and record groundwater extractions within the Basin may vary widely, based on the requirements for equipment, infrastructure, installation, and for operations and maintenance. Since the SABGSA members that provide public water supplies already fund and operate extraction metering facilities, most of the costs associated with the acquisition and installation of metering equipment will be borne by the owner's wells used for agricultural irrigation water supply and other non-de minimis uses.

Potential sources of funding for the Well Registration and Well Meter Installation Programs' components include state and Santa Barbara County grants, contributions from SABGSA member agencies, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.5.10 Drought Offset for the Measures Well Registration and Well Meter Installation Programs [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The information that will be gained through the metering of all non-de minimis groundwater pumpers will provide improved understanding of groundwater extractions so that other actions, including the BPA, can be effectively managed. In addition, the metered groundwater extraction data would be used in the development and administration of the GEC Marketing and Trading Programs should it be necessary. The information acquired through well metering will be critical to the SABGSA's ability to make informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought can be offset by increases in groundwater levels or storage during other periods.

6.6 Tier 1 Management Action 4 – Water Use Efficiency Programs [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

In the 2019 update of the Integrated Regional Water Management Plan, Santa Barbara County identified the development and implementation of Water Use Efficiency Programs as recommended resource management strategies (Santa Barbara County, 2019). The SABGSA has also identified the implementation of Water Use Efficiency Programs, for both public water agencies and agricultural groundwater pumpers, as a Tier 1 management action. The Water Use Efficiency Programs are generally described as follows:

- **Urban Water Use Efficiency Programs:** Initiatives that promote increasing water use efficiency by achieving reductions in the amount of water used for municipal, commercial, industrial, landscape irrigation, and aesthetic purposes. These programs can include incentives, public education, technical support, and other efficiency-enhancing programs.
- **Agricultural Water Use Efficiency Programs:** Initiatives that promote increasing water use and irrigation efficiency and achieving reductions in the amount of water used for agricultural irrigation. These programs can include incentives, public education, technical support, training, implementation of best water use practices, and other efficiency-enhancing programs.

Urban and agricultural water use efficiency has been practiced in the Basin for more than two decades and have been effective in significantly reducing water use within the region. Existing programs promote responsible design of landscapes and appropriate choices of appliances, irrigation equipment, and the other water-using devices to enhance the wise use of water. In recent years, many agencies in the state have passed regulations that require efficient plumbing devices, appliances, and landscape designs. Some of the agencies in the Basin offer programs that provide rebates to customers as an incentive to conserve. Over the years, agricultural water users have consistently improved irrigation methods (e.g., conversion to drip irrigation systems).

The water use efficiency management actions to be developed for implementation by municipal, agricultural, and domestic pumpers will promote expansion and supplementation of the water use efficiency programs that currently exist. These programs will also be developed to be aligned with the requirements of water conservation mandates that been put in place by the State of California. These include conservation mandates contained in Senate Bill (SB) 606 and Assembly Bill (AB) 1668. Both bills were signed into law in

May 2018. Based on that legislation, indoor residential use is to be capped at 55 gallons per capita per day (gpcd) in 2019 and ramped down to 50 gpcd by 2030, and outdoor residential use is to be capped in the future based on local climate and size of landscaped areas. Standards for outdoor usage are to be defined in a SWRCB rule-making process to be completed by June 2022. Effective urban water use efficiency measures could include:

- High water use outreach (e.g., high use reports)
- Meter audits to proactively detect leaks (e.g., leak reports)
- Rebates on water-saving fixtures (e.g., clothes/dish washers)
- Rebates on sustainable landscape conversion programs (e.g., Cash for Grass)
- Water awareness outreach events (e.g., library/outdoor market events)
- Enhanced efficient irrigation/best water use practices
- U.S. Environmental Protection Agency's WaterSense Program Alignment (e.g., Fix-a-Leak Week)

As described in Section 3.3, groundwater pumping from the Basin for agricultural irrigation represents a significant demand. For this reason, the SABGSA will strongly encourage and incentivize pumpers to implement the most effective water use efficiency methods applicable, often referred to as best practices. Additionally, provisions of the Water Conservation Act (amending Division 6, Part 2.55 of the Water Code) passed into law in November 2009 regarding agricultural water conservation and management. While these new laws do not require water use objectives or savings thresholds, they do encourage more efficient use of water by the agricultural sector and its suppliers. It is anticipated that industry leaders in the Basin will assist the SABGSA in facilitating workshops and technical training programs or support the implementation of other programs designed to communicate what the latest best water use practices are for their industry. Effective best water use practices could result in:

- Enhanced efficient irrigation/best water use practices.
- Irrigation audits and delivery of technical support for optimizing water use.
- Development of new weather stations and automated data for landowners using frost protection.
- Conversion to non-water intensive methods for frost protection.
- Increased use of soil amendments (organic compost) to improve health of soils, plant health, and reduce water use.
- More optimal irrigation practices by monitoring crop water use with soil and plant monitoring devices and tie monitoring data to evapotranspiration estimates.
- Conversion from high water demand crops to lower water demand crops.
- Use of satellite spectral/remote sensing data to refine irrigation practices.

Many growers already use best water use practices, but improvements can be made. A goal of promoting best water use practices is to broaden their use to more growers in the Basin. Rural de minimis groundwater users will be encouraged to use these best practices as well. Promoting best water use practices will include broad outreach to groundwater pumpers in the Basin to emphasize the importance of using best practices and understanding their positive benefits for mitigating declining groundwater levels and forestalling potential mandated limitations in groundwater extraction on their property.

The SABGSA will also collaborate with other entities that can offer resources and technical assistance to the water users in the Basin. The organizations will include the Cachuma Resource Conservation District; the U.S. Department of Agriculture, Natural Resources Conservation Service, Conservation Technical Assistance

Program; California Water Efficiency Partnership; Santa Barbara Water Wise Program; and the California Polytechnic State University Irrigation Training and Research Center.

6.6.1 Relevant Measurable Objective(s) for the Water Use Efficiency Programs [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The measurable objectives benefiting from the implementation of Water Use Efficiency Programs include:

- **Groundwater Elevation Measurable Objectives:** Water use efficiency programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of water use efficiency programs will focus on identifying best practices that will reduce pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Land Subsidence Measurable Objectives:** Water use efficiency programs will focus on reducing pumping through water conservation, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** Water use efficiency programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations which will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and TDS infiltrating to the aquifer.

6.6.2 Implementation Triggers for the Water Use Efficiency Programs [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management action described in this section is deemed critical for the successful implementation of the GSP and is included in the Tier 1 implementation category. The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption.

6.6.3 Public Notice Process for the Water Use Efficiency Programs [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

Targeted outreach meetings and technical and training workshops, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the groundwater pumpers, municipal and domestic pumpers, rural residents and other stakeholders regarding the development and implementation of the water use efficiency workshops. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to learn about water conservation methods, technologies, and best practices as well as the opportunity to provide input and comments on how the management actions related to development, implementation and performance of the water use efficiency programs that are being implemented in the Basin. The targeted public outreach meetings and technical and training workshops will be supplemented with informational mailers to be sent to all well owners and water agency customers in the Basin and informational press releases will be distributed to local media. If deemed valuable, the SABGSA representatives may work directly with individual well owners to explain program requirements and help with program implementation. The Water Use Efficiency Programs will also be promoted through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.6.4 Overdraft Mitigation for the Water Use Efficiency Programs [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

The development and implementation of Water Use Efficiency Programs within the Basin are intended to directly result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions that occur as a result of the implementation of both urban and agricultural water efficiency programs will directly result in groundwater pumping demand reductions and mitigation of the estimated storage deficit within the Basin.

6.6.5 Permitting and Regulatory Process for the Water Use Efficiency Programs [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

No permitting or regulatory process is needed for the development and implementation of urban and agricultural water use efficiency programs.

6.6.6 Implementation Timeline for the Water Use Efficiency Programs [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management action described in this section is deemed critical for the successful implementation of this GSP and included in the Tier 1 implementation category. The SABGSA member agencies will initiate work on Tier 1 management actions within 1 year of GSP adoption. These management actions are directly linked to the SMCs (see Section 4) and will help the Basin achieve the groundwater elevation, groundwater storage, land subsidence, and interconnected surface water measurable objectives.

6.6.7 Anticipated Benefits for the Water Use Efficiency Programs [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

The benefits to the Basin from the implementation of Water Use Efficiency Programs include:

- Water use efficiency programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations.
- The implementation of water use efficiency programs will focus on identifying best practices that will reduce pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- Water use efficiency programs will focus on reducing pumping through water conservation, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- Water use efficiency programs will focus on reducing pumping through water conservation. Less pumping will result in higher groundwater elevations which will eventually benefit GDEs.

For perspective, the implementation of water use efficiency and best management practices have been shown to reduce water usage by up to 20 percent or more. Assuming basin-wide implementation of these programs achieves a 10 percent reduction in pumping, the resulting benefit would be approximately 2,360 AFY.

6.6.8 Legal Authority for the Water Use Efficiency Programs [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

Regulatory compliance resides with those provisions of the Water Conservation Act of 2009, AB 1668, and SB 606 now codified into state law.

6.6.9 Cost and Funding for the Water Use Efficiency Programs [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Planning-level development costs for establishing the Water Use Efficiency Programs are estimated to be approximately $50,000 to $125,000 and separate from development of this GSP.

Potential sources of funding for the Water Use Efficiency Programs' components include state grants, contributions from SABGSA member agencies, Cachuma Water Conservation District, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.6.10 Drought Offset Measures for the Water Use Efficiency Programs [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The development and implementation of Water Use Efficiency Programs within the Basin will directly result in a reduction of the volume of groundwater that will be pumped from the Basin which will contribute to the mitigation of the estimated storage deficit within the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions.

As monitoring of the groundwater levels in the Basin occur in the future, the SABGSA will quantify the beneficial impact that the water use efficiency initiatives are having on the condition of the Basin, which will allow for future refinements in the basin water budget (see Section 3.3). The information acquired will be critical to the SABGSA in making informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought can be offset by increases in groundwater levels or storage during other periods.

6.7 Tier 2 Management Action 5 – Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

The volume of groundwater that is pumped from the Basin in recent years is more than the estimated basin yield of about 8,900 AFY. This condition has led to a persistent deficit of groundwater in storage. Although there will be benefits to the Basin because of the other management actions and potential future project implementation, the SABGSA has determined that the volume of groundwater being pumped must be reduced to the sustainable yield of the Basin. To achieve this goal, the SABGSA may develop and implement a regulatory program to equitably allocate a groundwater BPA volume of water to be pumped from the Basin annually. Once the program is implemented, individual non-de minimis pumper's will be provided an annual groundwater BPA which will start at historically used quantities of water and ramp down over time to bring pumping in the Basin within its sustainable yield by 2042. As described in SGMA, any limitation on extractions by the SABGSA "shall not be construed to be a final determination of rights to extract groundwater from the basin or any portion of the basin" (Water Code § 10726.4(a)(2)).

The amount of needed pumping reduction in the future is uncertain and will depend on several factors, including climate conditions, the effectiveness and timeliness of voluntary actions by pumpers, and the success of other management actions described in this GSP. The water budget presented in Section 3.3 indicates that the estimated annual storage deficit is approximately 10,600 AFY. It is reasonable to expect that the Tier 1 management actions may eliminate some of this deficit; however, it is likely that it will be necessary to implement the Groundwater BPA Program to have a demand management program that can be used by the SABGSA to achieve sustainability. The SABGSA may also consider implementing the BPA program if drought conditions persist. After GSP adoption, developing the Groundwater BPA Program would likely require the following steps:

- Establishing a methodology for determining baseline pumping considering:
  - Historical pumping
  - Sustainable yield of the Basin
  - Groundwater level trends
  - Land uses and corresponding irrigation requirements
- Establishing a methodology to determine individual annual allocations considering documented historical water use, opportunities for improved efficiency, and evaluation of anticipated benefits from other relevant actions individual pumpers may take. Alternatively, the SABGSA may define the allocations based on acreage and crop type.

- A timeline for implementing limitations on pumping ("ramp down") within the Basin as required to avoid undesirable results and reduce the impact on local growers.
- Approving a formal regulation to enact the program.

To develop the Groundwater BPA Program, the SABGSA may consider guidance developed by DWR in response to legislative directives for consistent implementation of the Water Conservation Act of 2009, as is used in Urban Water Management Plans. It is anticipated that the baseline pumping allocation schedule may be ramped down over time to meet basin groundwater extraction targets (consistent with the sustainable yield) until it is projected that groundwater levels will stabilize. Analyses will be updated periodically as new data are developed. The initial pumping ramp down schedule will be developed during program development. The rate of ramp down and ramp down schedules will depend on when the program starts and projections of how long and to what degree lower pumping rates are required to avoid undesirable results. The specific ramp down amounts and timing will be reassessed periodically and adjusted by the SABGSA as needed to achieve sustainability. These adjustments will occur when additional data and analyses are available. It is anticipated that groundwater monitoring data and the basin groundwater model will be used as a tool to evaluate alternative pumping reduction schemes and schedules.

It is anticipated that the Groundwater BPA Program will consist of the following general components: (1) estimation of the basin sustainable yield, (2) determination of pumping allocation amounts (i.e., groundwater extraction credits) for each non-de minimis pumper, and (3) pumping allocation reduction recommendations over the implementation period to reach the estimated sustainable yield by 2042. In summary, each non-de minimis groundwater user within the Basin will be assigned an allocation based on criteria to be established by the SABGSA. That allocation will be reduced incrementally, in accordance with the pumping ramp down schedule, as necessary until 2042 such that the total extraction from the Basin will be equal to the estimated sustainable yield at the end of that period. Non-de minimis groundwater users will be able to trade their groundwater extraction credits in accordance with SABGSA defined guidelines, but the total volume of pumping allowances within the Basin will decrease over time. The SABGSA understands that municipalities and public water agency groundwater pumpers have limitations regarding the volume of water that their agency is required to pump to meet customer demands. These limitations will be considered and addressed during the development of the Groundwater BPA Program. Actions taken to increase the amount of water available to the Basin through groundwater recharge or importation of water (see Section 6.11) will be considered when setting allocations.

The SABGSA realizes certain landowners will need or elect to periodically use an amount of groundwater in excess of their annual allocation. It is anticipated that the pumping fee policy will include provisions that will allow landowners, under special circumstances, to pump groundwater beyond the current groundwater allocation, but at considerably higher cost. To meet such demands while still avoiding undesirable results and sustaining the groundwater Basin, the SABGSA must employ other measures to manage demands within the sustainable yield of the Basin.

In addition, the SABGSA may incorporate supplemental conditions to be placed on new wells and new production from existing wells in the Basin in conjunction with the development of the Groundwater BPA Program. For the purposes of this action, a new well will be any new non-de minimis well that is issued a construction permit after the date that the GSP is adopted. Given that the Basin currently has an estimated storage deficit, the SABGSA may elect to place an adjustment factor in the groundwater BPA that would establish an additional limitation on the volume of water that can be pumped annually from any new well and new production from existing wells.

6.7.1 Relevant Measurable Objective(s) for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The measurable objectives benefiting from the implementation of the Groundwater BPA Program include:

- **Groundwater Elevation Measurable Objectives:** The Groundwater BPA Program will focus on reducing pumping which will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of the Groundwater BPA Program will focus on reducing pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Land Subsidence Measurable Objectives:** The Groundwater BPA Program will focus on reducing pumping, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** The Groundwater BPA Program will focus on reducing pumping which will result in higher groundwater elevations which will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and TDS infiltrating to the aquifer.

6.7.2 Implementation Triggers for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The management action described in this section is included in the Tier 2 implementation category and will be considered by the SABGSA if previous management actions do not achieve the sustainability goals. If necessary, the SABGSA will initiate work on Tier 2 management actions within 3 years of GSP adoption. This timeframe allows for development of funding to be obtained and put in place and to establish the metering program that supports this management action. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. This phase is anticipated to take from 12 to 18 months. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program will result in immediate benefit to the Basin. The program will be ongoing throughout the GSP implementation period as annual adjustments to the pumping allocations are made. It is anticipated that the pumping ramp down schedules will be revisited annually, if not more frequently.

6.7.3 Public Notice Process for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

The Groundwater BPA Program will be developed in an open and transparent process. Targeted outreach meetings and technical workshops, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the non-de minimis groundwater pumpers and other stakeholders about the details of the Groundwater BPA Program. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to learn about the programs, as well as the opportunity to provide input and comments on how the allocation program is being developed and implemented in the Basin. The targeted public outreach meetings and technical workshops will be supplemented with informational mailers to be sent to all non-de minimis well owners and growers in the Basin and informational press releases will be distributed to local media. If deemed valuable, SABGSA representatives may work directly with individual well owners to explain program requirements and help with program implementation. The Groundwater BPA Program will also be promoted through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.7.4 Overdraft Mitigation for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

Implementation of the Groundwater BPA Program within the Basin will directly result in a reduction of the volume of groundwater that will be pumped from the Basin because the SABGSA assigns specific extraction allocations on an annual basis that can be adjusted depending upon observed groundwater levels. These reductions in pumping would occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions associated with this program are intended to directly result in groundwater pumping demand reductions and mitigation of the estimated storage deficit within the Basin.

6.7.5 Permitting and Regulatory Process for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Any permitting or other regulatory compliance requirements will be identified and pursued during the initial phase of the implementation of this management action. Consistent with Water Code § 10730(a), this initial phase of an allocation program will exclude those well owners who extract less than 2 AFY (i.e., de minimis extractors).

The mandatory Groundwater BPA Program will be subject to CEQA. The program will be developed in accordance with all applicable groundwater laws and respect all groundwater rights.

6.7.6 Implementation Timeline for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The management action described in this section may be considered for implementation by the SABGSA within 3 years of GSP adoption. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. This phase is anticipated to take from 12 to 18 months. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program will result in immediate benefit to the Basin. The program will be ongoing throughout the GSP implementation period as annual adjustments to the pumping allocations are made. It is anticipated that the pumping ramp down schedules will be revisited annually, if not more frequently.

6.7.7 Anticipated Benefits for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

The Groundwater BPA Program will result in the avoidance of undesirable results, including chronic lowering of groundwater levels, reduction of groundwater in storage, depletion of surface water, and potentially degraded water quality. Peripheral benefits may include potential investment in alternate land uses or taking advantage of the groundwater extraction credits (discussed later) and/or land fallowing management programs. To achieve the required reductions, the non-de minimis pumpers will be incentivized to implement conservation measures resulting in more efficient use of water and greater resiliency to long-term climate variability.

6.7.8 Legal Authority for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

SGMA provides the SABGSA with authority to: "control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the aggregate…or otherwise establishing groundwater extraction allocations" (Water Code § 10726.4(a)).

6.7.9 Cost and Funding for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Planning-level development cost for establishing the Groundwater BPA Program is estimated to be approximately $75,000 to $150,000 and separate from development of this GSP.

Potential sources of funding for the Groundwater BPA Program components include state grants, contributions from SABGSA member agencies, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.7.10 Drought Offset Measures for the Groundwater Base Pumping Allocation (BPA) Program [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The development and implementation of the Groundwater BPA Program within the Basin will directly result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions that occur because of the implementation of this program will directly result in groundwater pumping demand reductions and mitigation of the estimated storage deficit within the Basin.

As monitoring of the groundwater levels in the Basin occurs in the future, the SABGSA will quantify the beneficial impact that the groundwater allocation initiatives are having on the condition of the Basin which will allow for future refinements in the basin water budget. The information acquired will be critical to the SABGSA in modifying the allocations and pumping ramp-down schedule over time and making informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought can be offset by increases in groundwater levels or storage during other periods.

6.8 Tier 2 Management Action 6 – Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

As previously described, the SABGSA will develop and implement a regulatory program to equitably allocate a pre-determined groundwater BPA to be extracted from the Basin annually. As necessary, individual non-de minimis pumper's allocations will be ramped down over time to bring pumping in the Basin to within its sustainable yield by within 20 years of the adoption of the GSP. In conjunction with the Groundwater BPA

Program, the SABGSA will pursue the development and implementation of a GEC Marketing and Trading Program to provide non-de minimis users with increased flexibility in using their annual allocations. The program will enable voluntary permanent transfer of allocations between parties, through an exchange of GECs. In addition, the program will provide options for potentially long-term or short-term temporary transfer of GECs, including credits derived from voluntary fallowing or conversion to lower water use crops (see Section 6.9). The program is intended to allow groundwater users or new development to acquire needed groundwater allocation, in the form of GEC, from other pumpers to maintain economic activities in the Basin, encourage and incentivize water conservation, encourage and incentivize temporary and permanent fallowing of agricultural lands, encourage conversion to lower water use crops, and facilitate a ramp-down of pumping allocations as water demands and basin conditions fluctuate during the 20-year GSP implementation period.

If needed and upon adoption and implementation of the Groundwater BPA Program, the SABGSA would allocate a specific volume of allowable groundwater use (pumping allowance) to non-de minimis pumpers consistent with the finalized groundwater BPA. During the initial years, the groundwater BPA is anticipated to be marginally decreased from historical levels. This will provide an opportunity for existing pumpers to prepare for and implement changes to their operations to accommodate potentially more aggressive reductions in annual pumping allocations in subsequent years and allow the SABGSA to evaluate the impacts from the previously implemented management actions. The subsequent annual allocations are anticipated to be ramped down more aggressively. Each year during GSP implementation, the SABGSA would publish a 5-year look-ahead schedule of the projected annual pumping allowances. Non-de minimis pumpers will be able to privately negotiate the sale of all or a portion of their groundwater pumping extraction credit allowance with willing purchasers, within the confines and rules of the GEC Marketing and Trading Program managed by the SABGSA. Upon agreement between pumpers, a proposed trade would be submitted to the SABGSA for review and approval, or separate mechanisms may be established regarding trades. If approved, the credit exchange parties would be notified, the trade certified, and the SABGSA would update the official, publicly accessible register to notate the trade and the updated annual pumping allowances. The provisions of the Groundwater BPA Program will provide that a percentage of all traded groundwater BPA credits be transferred to the SABGSA to be used to improve the conditions of the Basin and achieve sustainability goals.

The SABGSA will agree upon and approve details of the GEC Marketing and Trading Program, which may include either temporary or permanent water allocation transfers, or both. Each user's pumping allowance will represent and entitle the user to extract a specific volume of groundwater established by the SABGSA, adjusted commensurate with the ramp-down pumping reduction schedule developed by the SABGSA and where applicable, extraction credits between non-de minimis pumpers. The GEC Marketing and Trading Program will be structured by the SABGSA to prevent unintended consequences, such as hoarding, collusion, out-of-basin transfers, off-site well interference, price-fixing, or speculation. For example, to prevent hoarding, the SABGSA could cap the groundwater BPA held by an individual at a maximum percentage of the total groundwater BPA allocated to all users in the Basin. If warranted, the GEC Marketing and Trading Program will be reviewed annually during GSP review and updated as needed to address unintended consequences or other unanticipated program deficiencies. The program will likely include requirements for demonstrating actual water use within a specified period of time for irrigated lands that are being used as a credit and may include requirements and limitations regarding spatial limitations between which properties the GEC's can be traded. For example, the SABGSA may not agree to approve a GEC transfer between properties located at opposite ends of the Basin.

The SABGSA may adopt a policy to define groundwater extraction carryover provisions year-to-year and/or allow multi-year pumping averages. The inter-annual flexibility may be useful to growers who could change cropping patterns or fallow acreage. Though there is a risk that extreme drought may induce exceptionally high pumping in a single year, under this program, groundwater users may be able to strategize and better manage their assets. The goal of the groundwater extraction credit carryover structure is to provide groundwater pumpers with more flexibility in using their groundwater allocation year to year.

The anticipated development approach of the GEC Marketing and Trading Program by the SABGSA is as follows:

- Identify stakeholders/participants and conduct interviews and meetings to receive input and identify concerns to be addressed in program development.
- Evaluate existing programs in other basins and guidance from the DWR.
- Identify potential unintended consequences of the GEC Marketing and Trading Program to be addressed in development of governing documents (i.e., hoarding, out-of-basin transfers, off-site well interference, speculation, price fixing, collusion, etc.).
- Present findings of the interviews and fact-finding effort and provide recommendations to the SABGSA.
- Collaborate with non-de minimis pumpers and SABGSA member agencies to develop the GEC Marketing and Trading Program.
- Draft preliminary regulations for the GEC Marketing and Trading Program (i.e., allowable frequency and amount of water to be traded), allowable water uses (i.e., area of origin/spatial restrictions, fees and penalties requirements, accounting scope, enforcement requirements, etc.).
- Develop a governing structure for GEC trades and program administration.
- Develop a monitoring and enforcement structure.
- Develop and test an accounting/register system to track groundwater BPA, pumping allowance, GEC trades and compliance through metering of groundwater production.
- Determine applicability of CEQA review to GEC Marketing and Trading Program.
- Finalize the details of the initial GEC Marketing and Trading Program into a comprehensive GEC Marketing and Trading Program Policy document to be approved by the SABGSA.
- Adopt GEC Marketing and Trading Program implementing regulations.

6.8.1 Relevant Measurable Objective(s) for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The GEC Marketing and Trading Program is intended to avoid undesirable results in the Basin by providing incentives and flexibility to basin pumpers for water conservation, the transfer of GECs between users to allow voluntary fallowing and other beneficial uses, conversion of irrigated lands to dry land farming operations, and the reduction of water intensive land uses. The program will be implemented in a manner consistent with the annual groundwater BPAs and the schedule of pumping ramp downs necessary to achieve the sustainability objectives developed for the GSP.

The measurable objectives benefiting from the implementation of the GEC Marketing and Trading Program include:

- **Groundwater Elevation Measurable Objectives:** The GEC Marketing and Trading Program will provide pumpers with greater flexibility to conserve water, fallow irrigated cropland, and otherwise reduce pumping, which will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of the GEC Marketing and Trading Program will provide pumpers with greater flexibility to conserve water, fallow irrigated cropland, and otherwise reduce pumping, which will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Land Subsidence Measurable Objectives:** The GEC Marketing and Trading Program will provide pumpers with greater flexibility to conserve water, fallow irrigated cropland, and otherwise reduce pumping, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** The GEC Marketing and Trading Program will provide pumpers with greater flexibility to conserve water, fallow irrigated cropland, and otherwise reduce pumping, which will result in higher groundwater elevations that will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and TDS infiltrating to the aquifer.

6.8.2 Implementation Triggers for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The SABGSA member agencies will initiate work on Tier 2 management actions within 3 years of GSP adoption. The initial phase of the program will be focused on program design, policy and regulatory development, CEQA compliance, and stakeholder outreach. This phase is anticipated to take from 12 to 18 months. The Groundwater BPA Program (see Section 6.7) and the metering program (see Section 6.5), which will be developed in parallel with this program, will need to be developed and deployed before this management action can be initiated. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program will result in immediate benefit to the Basin and stakeholders by providing flexibility to landowners and allowing for credits to be held by the SABGSA for the benefit of the Basin. The program will be ongoing throughout the GSP implementation period as annual adjustments to the pumping allocations are made.

6.8.3 Public Notice Process for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

The GEC Marketing and Trading Program will be developed in an open and transparent process. Targeted outreach meetings and technical workshops, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the non-de minimis groundwater pumpers and other stakeholders about the details of the GEC Marketing and Trading Program. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to learn about the program, as well as the opportunity to provide input and comments on how the GEC Marketing and Trading Program is being implemented in the Basin. The targeted public outreach meetings and technical workshops will be supplemented with informational mailers to be sent to all non-de minimis well owners and growers in the Basin and informational press releases will be distributed to local media. If deemed valuable, SABGSA representatives may work directly with individual well owners to explain program requirements and help with program implementation. The GEC Marketing and Trading Program will also be promoted through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.8.4 Overdraft Mitigation for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

The development and implementation of GEC Marketing and Trading Program, in conjunction with the implementation of the mandatory Groundwater BPA Program within the Basin, will directly result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions will mitigate the estimated storage deficit within the Basin.

6.8.5 Permitting and Regulatory Process for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

The SABGSA anticipates that CEQA review and compliance is required for the SABGSA to develop the GEC Marketing and Trading Program or for SABGSA adoption of the GEC Marketing and Trading Program policy. Individual trades may require compliance with CEQA requirements. The program will be developed and implemented in accordance with all applicable groundwater laws and respect all groundwater rights.

6.8.6 Implementation Timeline for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The SABGSA intends to initiate development of the GEC Marketing and Trading Program within 3 years of GSP adoption. The initial phase of work will be to conduct the appropriate stakeholder outreach, draft the policy development, obtain public comment and legal review, develop an accounting system, and finalize an initial GEC policy. This phase is anticipated to take from 12 to 18 months. The Groundwater BPA and Voluntary Agricultural Crop Fallowing Programs (see Sections 6.7 and 6.9, respectively) will be developed in parallel with this program. The Groundwater BPA Program and metering program will need to be developed and deployed before this management action can be initiated. The timetable for implementation of the GEC Marketing and Trading Program is dependent on the schedule to complete CEQA review should it be determined that implementation of the program requires CEQA review.

6.8.7 Anticipated Benefits for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

Once implemented, the program will result in immediate benefits to the Basin. The program will be ongoing throughout the GSP implementation period as annual adjustments to the pumping allocations are made.

As one of the central components to achieving sustainability within the Basin, the GEC Marketing and Trading Program will provide an economic incentive for conserving water, voluntary fallowing of irrigated agricultural croplands, and promote beneficial uses of water and land uses by providing for the potential to monetize voluntary water conservation or the elimination of water intensive uses. For example, the GEC could provide the pumpers in the Basin with the flexibility for replacement of water-intensive crop types with other land uses, such as residential development, lower water use hydroponics, or solar projects. It may also encourage restoration of irrigated lands for use as open or recreational space to shift pumping from areas of depressed groundwater levels to those more favorable for additional pumping. The implementation of the GEC Marketing and Trading Program will result in the avoidance of undesirable results, including chronic lowering of groundwater levels, reduction of groundwater in storage, and potentially degraded water quality, resulting in more efficient use of water and greater resiliency to long-term climate variability.

6.8.8 Legal Authority for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

It is the established policy of the State of California "to facilitate the voluntary transfer of water and water rights where consistent with the public welfare" (Water Code § 109(a)). Additionally, "The Legislature hereby finds and declares that voluntary water transfers between water users can result in a more efficient use of water, benefitting both the buyer and the seller" (Water Code § 475).

Under SGMA, the SABGSA can "authorize temporary and permanent transfers of groundwater extraction allocations within the agency's boundaries, if the total quantity of groundwater extracted in any water year is consistent with the provisions of the groundwater sustainability plan" (Water Code § 10726.4(a)(3)).

6.8.9 Cost and Funding for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

The planning-level development cost for establishing the GEC Marketing and Trading Program is estimated to be approximately $150,000 to $200,000; the cost of this program will be separate from the development of this GSP.

Potential sources of funding for the GEC Marketing and Trading Program components include state grants, contributions from SABGSA member agencies, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.8.10 Drought Offset Measures for the Groundwater Extraction Credit (GEC) Marketing and Trading Program [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The development and implementation of the GEC Marketing and Trading Program, in conjunction with the implementation of the mandatory Groundwater BPA Program within the Basin, will directly result in a reduction of the volume of groundwater that will be pumped from the Basin because water production using these credits will have a cost, resulting in more efficient water use. Likewise, the SABGSA will retain a percentage of the credits that will not be associated with basin pumping. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions will mitigate the estimated storage deficit within the Basin.

As monitoring of the groundwater levels in the Basin occurs in the future, the SABGSA will quantify the beneficial impact that the combined groundwater BPA and GEC initiatives are having on the condition of the Basin, which will allow for future refinements in the basin water budget. The information acquired will be critical to the SABGSA in modifying the allocations and pumping ramp-down schedule and making informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought which can be offset by increases in groundwater levels or storage during other periods.

6.9 Tier 2 Management Action 7 – Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

In 2020, there were approximately 13,459 acres of active irrigated agriculture within the Basin that were being irrigated with approximately 17,300 acre-feet (AF) of water on an average annual basis. Land fallowing has been used historically in other locations as both a temporary and permanent solution to water shortages, but the most effective programs are voluntary. In conjunction with GSP implementation, the SABGSA will develop and implement a voluntary fallowing program that will facilitate the conversion of high water use irrigated agriculture to low water use agriculture use or open space, public land, or other land uses on a voluntary basis. The SABGSA has identified voluntary agricultural crop fallowing is a necessary additional management action to achieve sustainability. The SABGSA will develop programs that will permit both voluntary temporary and long-term or permanent fallowing and conversion to other land uses. An important consideration in developing the voluntary fallowing program will be to include protections of water rights for the overlying landowners that choose to temporarily fallow ground.

Factors that will be considered during the development of the fallowing program include the current extent of agriculture land and documented water use, the intended land and water use after fallowing, and the potential environmental impacts associated with fallowing. These include airborne emissions through wind-blown dust, the introduction or spreading of invasive plant species, and changes to the landscape that could adversely affect visual quality. The land uses proximal to proposed fallowing projects will be considered as part of this management action. For example, there could be differing levels of site stabilization or restoration needed or required based on the land use intended post-fallowing. Temporary stabilization will be less expensive and may be appropriate for properties to be developed for other use in the near term. A passive restoration approach may be applied for permanent fallowing if the goal is for the property to eventually return to native habitat, and active restoration may be applied for relatively near-term restoration to native habitat with the goal of providing open space, parks, or public trails.

The initial program phase will be to evaluate key issues associated with program development as follows:

- Producing guidelines for maintaining water rights on land that is temporarily fallowed.
- Develop a framework for incentivizing landowners to voluntarily fallow.
- Develop and implement an incentive framework for conversion from irrigated agriculture to dry land farming.

- Develop parameters for receiving a credit based on past water use and criteria for documenting historical water use
- Evaluate future land use alternatives.
- Ensure avoidance of unintended consequences from unmanaged fallowed land.
- Identify land restoration goals.
- Identify land management, inspection, and enforcement procedures.
- Develop a regulatory document that includes rules for characterizing tracking fallowed ground as a GEC.
- Consider programmatic and/or project-based CEQA review.
- Develop a tracking system.

As part of this management action, the SABGSA will develop a basin-wide accounting system that tracks landowners who decide to voluntarily fallow their land and cease groundwater pumping or otherwise refrain from using groundwater. If given the opportunity to create a "placeholder" for their ability to pump under regulations adopted by the SABGSA, some property owners currently irrigating crops, or that might want to irrigate in the future, may choose to forego the expense of farming and extracting water if those rights can be accounted for and protected. The Voluntary Agricultural Crop Fallowing Programs will be developed in parallel to the Groundwater BPA and the GEC Marketing and Trading Programs (see Management Actions 5 and 6 in Sections 6.7 and 6.8, respectively). It is also noted that the Voluntary Fallowing Program may potentially be enhanced, or a separate program could be implemented, which may provide for SABGSA to lease or purchase agricultural land for fallowing. The SABGSA could use fees generated through the Groundwater Pumping Fee Program to lease/purchase the lands to be fallowed, if necessary or deemed desirable by the SABGSA. Additionally, the SABGSA may also consider purchasing groundwater extraction credits.

The implementation of voluntary fallowing programs within the Basin may benefit from the provisions of AB 252, which was introduced to the Assembly in January 2021. If passed, AB 252 would create the Multi-Benefit Land Repurposing Incentive Program, which is intended to help alleviate the impacts of SGMA on farmers and ensure that farmland taken out of production due to SGMA is reused to provide conservation, recreation, or other benefits to local communities. Specifically, this bill will create a pilot program to support repurposing formerly irrigated agricultural land for groundwater recharge, biodiversity conservation, pollinator habitat, cattle grazing, and other beneficial and less water-intensive uses. A primary goal of the Multi-Benefit Land Repurposing Program is to help make the critical transition to sustainable groundwater management. The program proposed in this bill also can reduce potential negative impacts of taking land out of production, such as spreading invasive weeds and greater dust emissions, and instead bring substantial benefits to rural communities and wildlife habitat.

6.9.1 Relevant Measurable Objective(s) for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The measurable objectives benefiting from the implementation of Voluntary Agricultural Crop Fallowing Programs include:

- **Groundwater Elevation Measurable Objectives:** Voluntary fallowing programs will focus on reducing pumping, which will result in higher groundwater elevations.
- **Groundwater Storage Measurable Objectives:** This measurable objective is based on total pumping in the Basin. Therefore, the implementation of voluntary fallowing programs will focus on reducing pumping and will help achieve the goal of reducing total extractions to the long-term sustainable yield.
- **Land Subsidence Measurable Objectives:** Voluntary fallowing programs will focus on reducing pumping, thereby reducing the pumping stress on the local aquifer(s) and reducing the potential for subsidence.
- **Depletion of Interconnected Surface Water Measurable Objective:** Voluntary fallowing programs will focus on reducing pumping, which will result in higher groundwater elevations that will eventually benefit GDEs.
- **Degradation of Water Quality:** Improvements to water quality are expected as a result of reduction of fertilizer use and irrigation return flows to the aquifer, thereby limiting the amount of primarily nitrate and TDS infiltrating to the aquifer.

6.9.2 Implementation Triggers for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The SABGSA will initiate work on Tier 2 management actions within 3 years of GSP adoption. The initial phase of the program will be focused on program design, policy development, and stakeholder outreach. This phase is anticipated to take from 6 to 9 months. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program will result in immediate reductions in groundwater pumping, which will increase with the addition of fallowed lands and fluctuate depending on the nature and timing of converted land use.

6.9.3 Public Notice Process for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

Targeted outreach meetings and technical and training workshops, in addition to regularly scheduled SABGSA meetings, will be held periodically to inform the agricultural groundwater pumpers and other stakeholders about the details of the voluntary fallowing programs. Groundwater pumpers and interested stakeholders will have the opportunity at these meetings to learn about the programs as well as the opportunity to provide input and comments on how the fallowing initiatives are being implemented in the Basin. The targeted public outreach meetings and technical and training workshops will be supplemented with informational mailers to be sent to all agricultural well owners and growers in the Basin and informational press releases will be distributed to local media. If deemed valuable, SABGSA representatives may work directly with individual well owners to explain program requirements and help with program implementation. The Voluntary Agricultural Crop Fallowing Programs will also be promoted through annual GSP reports and links to relevant information on the SABGSA and member agencies' websites.

6.9.4 Overdraft Mitigation for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

The development and implementation of voluntary fallowing programs within the Basin will directly result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions that occur as a result of the implementation of the fallowing programs will directly result in groundwater pumping demand reductions and mitigation of the estimated storage deficit within the Basin.

6.9.5 Permitting and Regulatory Process for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

If necessary, the SABGSA will perform a CEQA evaluation for the Voluntary Agricultural Crop Fallowing Programs to identify potential environmental impacts and identify feasible alternatives or mitigation measures. Establishment of a voluntary land fallowing program is expressly authorized under SGMA (Water Code § 10726.2(c)). The fallowing program, including program standards, will be developed and undergo CEQA review, as necessary.

6.9.6 Implementation Timeline for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The SABGSA will initiate work on Tier 2 management actions within 3 years of GSP adoption. The initial phase of the program will be focused on program design, policy development, and stakeholder outreach. This phase is anticipated to take from 6 to 12 months. Full implementation of the program is anticipated following CEQA review, if needed. Once implemented, the program should result in immediate groundwater savings, which will continue to increase with addition of fallowed lands and fluctuate depending on the nature and timing of converted land use.

6.9.7 Anticipated Benefits for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

In addition to the benefits derived directly from reduced pumping, the program will allow for a level of land use and community planning for converted properties not otherwise available. Depending on the nature of land uses implemented, the program could result in increased recreational space or potential economic benefits from conversion of land use types. For example, the conversion of previously fallowed land to MAR projects may be investigated.

For perspective, in 2020, there was an estimated 14,459 acres of irrigated cropland in the Basin with a corresponding average water demand of approximately 17,300 AFY. A voluntary conversion or fallowing program involving 10 percent of the irrigated cropland would result in a benefit of approximately 2,360 AFY.

6.9.8 Legal Authority for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

Establishment of a voluntary land fallowing program is expressly authorized under SGMA (Water Code § 10726.2(c)).

6.9.9 Cost and Funding for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

The planning-level development cost for establishing the Voluntary Agricultural Crop Fallowing Programs is estimated to be approximately $75,000 to $150,000 and separate from development of this GSP.

Potential sources of funding for the Voluntary Fallowing Program components include state grants, contributions from SABGSA member agencies, groundwater extraction fees, transaction fees from extraction credit trades, and other mechanisms as may be identified by the SABGSA.

6.9.10 Drought Offset Measures for the Voluntary Agricultural Crop Fallowing Programs [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

The development and implementation of Voluntary Agricultural Crop Fallowing Programs within the Basin will directly result in a reduction of the volume of groundwater that will be pumped from the Basin. These reductions in pumping will occur during periods of normal, above normal, and below normal rainfall year conditions. Pumping reductions that occur as a result of the implementation of fallowing programs will directly result in mitigation of the estimated storage deficit within the Basin.

As monitoring of the groundwater levels in the Basin occur in the future, the SABGSA will quantify the beneficial impact that the fallowing initiatives are having on the condition of the Basin, which will allow for future refinements in the basin water budget. The information acquired will be critical to the SABGSA in making informed adaptive management decisions regarding ensuring that chronic lowering of groundwater levels or depletion of supply during periods of drought can be offset by increases in groundwater levels or storage during other periods.

6.10 Tier 3 Priority Projects – [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

Based on the results of the analysis that was performed during development of this GSP, the SABGSA concluded that the basin sustainability goals may be achieved through the implementation of the Tier 1 and 2 management actions described in Sections 6.3 through 6.9. The SABGSA will annually assess the effectiveness that the implemented management actions have achieved in stabilizing groundwater levels and meeting the basin sustainability goals described in this GSP and will reassess the need for continuing and/or expanding these actions on an annual basis. If the SABGSA determines that evidence exists that the effects of the implemented management actions are proving insufficient to meet sustainability goals, then the SABGSA may decide to implement selected projects from the portfolio of identified priority projects in the future. The GSA may choose to implement one or more of the Tier 3 priority projects at any time. The priority projects listed below and described in the following paragraphs were identified by the SABGSA for future consideration:

- Non-Native/Invasive Species Eradication
- Barka Slough Augmentation Project with Groundwater Supplies
- Watershed Management Projects, Including Controlled Burns
- DSW-MAR Basins (In-Channel and Off-Stream Basins)

Non-Native/Invasive Species Eradication

The SABGSA will support and enhance existing programs eradicating non-native and other invasive species along San Antonio Creek, and its major tributaries, in partnership with the Cachuma Resource Conservation District of Santa Barbara County. This project will reduce evapotranspiration from these non-native invasive plants, leaving more water in the San Antonio Creek watershed and increasing aquifer recharge in the Basin.

Species present along San Antonio Creek and its tributaries, including Arundo and tamarisk, consume a significant volume of water annually. These species also create a major fire threat, increase flood risks, and deprive habitat for wildlife. Research published by the California Invasive Plant Council states that on average, removal of 1 acre of Arundo results in a net savings of 20 AF of water per year (CIPC, 2011).

Once the extent of invasive species has been identified, the initial eradication phase will include mechanical and/or chemical treatment of identified invasive species removal in all areas of San Antonio Creek and its major tributaries that have yet to be treated. The final phase will include the on-going monitoring and maintenance treatment phase. This phase requires annual monitoring for re-growth of the invasive species or new invasive species and chemical treatment every 3 to 5 years.

Barka Slough Augmentation Project with Groundwater Supplies

The SABGSA will consider proceeding with the study, planning, preliminary design/engineering, and permitting phases for an augmentation project that will provide supplemental water to support the Barka Slough GDE during critical periods. The source of the augmentation water will be groundwater extracted from the Basin, through a system of existing agricultural wells located along San Antonio Creek, upstream from the Barka Slough. Additionally, existing VSFB wells will also be evaluated as a potential supply, subject to agreement from the U.S. government. The project infrastructure will be designed to accommodate the potential for using alternative supplemental water supplies, including SWP or other imported supplies, in the future. It is understood that groundwater extraction from basin wells to supply supplemental water to the Slough may exacerbate water level declines in the Basin and so this project is intended to provide water to the Slough only during severe conditions where impacts to the Slough are eminent.

Watershed Management Projects, Including Controlled Burns

The SABGSA will support and enhance watershed management actions and projects within the Basin on both watershed and local levels. Watershed management has proven effective in protecting and enhancing the physical, chemical, and biological processes that make up the riverine based sub-regions of the of San Antonio Creek drainage system.

This Resource Management Strategy is identified in the update of the Santa Barbara County Integrated Regional Water Management Plan (Santa Barbara County 2019) to underscore the importance of mitigating the impact of wildfire using a watershed management approach (including controlled burns) to mitigate the impact of wildfire and associated erosion and to preserve water storage capacity. While controlled burns have not been shown to provide large benefits with respect to enhancement of recharge to aquifers, there has been data to show that they do promote increased runoff. Increased surface water runoff may provide a benefit to Barka Slough.

DSW-MAR Basins (In-Channel and Off-Stream Basins)

DSW-MAR is a landscape management strategy that can help to reduce the storage deficit and maintain long-term water supply reliability. In addition to the potential groundwater recharge benefits that can be achieved with DSW-MAR, ancillary benefits from recharge ponds, reservoirs, and facilities that are developed for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. DSW-MAR targets relatively small drainage areas (generally 100 to 1,000 acres) from which stormwater runoff can be collected to infiltrate 100 to 300 AF of water per year, per individual basin. Infiltration can be accomplished in surface basins, typically having an area of 1 to 5 acres, or potentially through flooding of agricultural fields or flood plains, use of drywells, or other strategies. Smaller projects might provide additional benefit, but unit costs are likely to be somewhat greater. Larger projects may require more infrastructure and/or maintenance costs.

The initial phase of this project may include the completion of a study to identify the optimal number and location of a series of DSW-MAR facilities, based on hydrogeologic and watershed conditions. Based on discussions with SABGSA stakeholders, it is understood that several existing DSW-MAR basins were constructed in the past and some of these basins currently exist, although in disrepair. The subject study will include an assessment of these existing basins for potential renovation and upgrade. In addition, the study may include an evaluation of the potential benefits to the Basin, from an expansion of the precipitation enhancement program described below.

6.10.1 Relevant Measurable Objective(s) [§ 354.44(b)(1)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

Because the SABGSA does not plan to implement the identified Tier 3 projects, they will not have any impact on the measurable objectives for the Basin. If the SABGSA determines that one or more of the projects may be required, then there will be a benefit to all the measurable objectives that are identified in this GSP.

6.10.2 Implementation Triggers [§ 354.44(b)(1)(A)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.

The projects identified in this section are not deemed critical for the successful implementation of the GSP and are included in the Tier 3 implementation category as future options should they become necessary. The SABGSA does not plan to initiate any of these projects until evidence exists that the effects of the implemented (Tiers 1 and 2) management actions are proving insufficient. Although, the SABGSA has no near-term plans to initiate construction of any specific priority projects, for the purposes of achieving basin sustainability, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for several projects that are identified by the SABGSA for potential future consideration.

6.10.3 Public Notice Process [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

No specific notice to the public or other agencies is planned regarding the identified Tier 3 projects. If the SABGSA determines that one or more of the priority projects may require implementation, then a comprehensive program for informing the public and other agencies will be developed and implemented.

6.10.4 Overdraft Mitigation [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

Because the SABGSA does not plan to implement the identified Tier 3 projects, they will not have any impact on the mitigation of the estimated storage deficit within the Basin. The potential effects that any specific priority project will have on the Basin will be addressed during the study, planning and preliminary design/engineering phases of any projects that are identified by the SABGSA for potential future consideration.

6.10.5 Permitting and Regulatory Process [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Each of the identified Tier 3 projects will require various permits prior to implementation and all will require compliance with applicable regulations, including CEQA. These permitting and regulatory compliance issues for any specific project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of any project that is identified by the SABGSA for potential future consideration.

6.10.6 Implementation Timeline [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The projects identified in this section are not deemed critical for the successful implementation of the GSP and are included in the Tier 3 implementation category. The SABGSA has no near-term plans to initiate construction of any specific priority projects for the purposes of achieving basin sustainability. However, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for several projects that are identified by the SABGSA for potential future consideration.

6.10.7 Anticipated Benefits [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

Because the SABGSA does not presently plan to implement the identified Tier 3 projects, they will not have any direct benefit to the Basin. If the SABGSA determines that one or more of the priority projects may require implementation, then assessment of anticipated benefits will be characterized at that time. Anticipated benefits that any specific project will have on the Basin will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the SABGSA for potential future consideration.

6.10.8 Legal Authority [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

Legal authority for any specific project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all priority projects that are identified by the SABGSA for potential future consideration.

6.10.9 Cost and Funding [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Project costs and proposed mechanisms for funding for any specific priority project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the SABGSA for potential future consideration. Preliminary costs for developing and implementing Tier 3 projects are presented in Table 6-1.

6.10.10 Drought Offset Measures [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

Because the SABGSA does not plan to implement the identified Tier 3 priority projects, they will not have any impact on mitigating chronic lowering of groundwater levels or depletion of supply during periods of drought within the Basin. The potential effects that any specific project will have on the Basin regarding offsetting the effects of drought, will be addressed during the study, planning, preliminary design/engineering, and permitting phases of any projects that are identified by the SABGSA for potential future consideration.

6.11 Tier 4 Non-Priority Projects – [§ 354.44(b)(1)(d)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

(d) An Agency shall take into account the level of uncertainty associated with the basin setting when developing projects or management actions.

Based on the results of the analysis that was performed during development of this GSP, the SABGSA concluded that the basin sustainability goals can be achieved through the implementation of the Tier 1 through 2 management actions described in Sections 6.3 through 6.9. The SABGSA will annually assess the effectiveness that the implemented management actions have achieved in stabilizing groundwater levels and meeting the basin sustainability goals described in this GSP and will reassess the need for continuing and/or expanding these actions on an annual basis. If the SABGSA determines that evidence exists that the effects of the implemented management actions are proving insufficient to meet sustainability goals, then the SABGSA may decide to implement one or more of the Tier 4 non-priority projects in the future. Therefore, the SABGSA does not plan to initiate the construction of any non–priority project infrastructure for the specific goal of achieving basin sustainability until such time that evidence exists that the effects of the implemented management actions and, if required, priority projects are proving insufficient to meet sustainability goals. Although the SABGSA has no near-term plans to initiate construction of any specific non-priority projects, for the purposes of achieving basin sustainability, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for any number of projects that were identified by the SABGSA for potential future consideration. The following projects listed below and briefly described in the following paragraphs were identified by the SABGSA for future consideration:

- LACSD WWTF Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse
- SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program
- VSFB Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)
- Barka Slough Augmentation Project with SWP or Banked Supplemental Water Supplies
- In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers
- SABGSA to provide Technical Assistance and Financial Incentives for High Tunnel (“Hoop Houses”) Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge Projects
- Additional Projects for Potential Future Consideration by SABGSA
    - Development of Water Supply Wells in Bedrock Formations
    - Use of Treated Oilfield Produced Water for Irrigation
    - Water Exchanges to Secure Other Agency State Water Project Allocations

LACSD WWTF Recycled Water and Reuse In Lieu of GW Pumping or Indirect Potable Reuse

The LACSD currently owns and operates a municipal WWTF, which is regulated under the provisions of Central Coast RWQCB Order No. R3-2005-0133, to discharge a maximum of 225,000 gpd, averaged over each month. The existing WWTF is classified as an aerated facultative treatment pond system and includes a headworks, 3.1-acre facultative pond system, 47.6 acres of irrigation fields, and five retention basins. The treatment capacity is rated at 400,000 gpd. Treated effluent is disposed of through a system of spray irrigation fields, which are located adjacent to the facultative treatment ponds. Facultative pond systems are designed and operated to reduce concentrations of biochemical oxygen demand (BOD), total suspended solids, and coliform numbers (fecal or total) to meet water quality requirements. Facultative pond systems are designed to be operated in a manner in which an aerobic layer (oxygen rich) is present in the shallower depths and an anaerobic zone (oxygen poor) is present in the lower depths. Aerobic treatment processes in the upper layer provide odor control, nutrient and BOD removal. Anaerobic fermentation processes, such as sludge digestion, denitrification, and some BOD removal, occur in the lower layer. The key to successful operation of this type of pond is oxygen production by photosynthetic algae and/or re-aeration at the surface. The total effluent disposal system is approximately 66.18 acres of land which includes approximately 47.6 acres of spray irrigation fields.

Although the LACSD has no current plans to upgrade the WWTF, it may in the future consider adding treatment processes that could allow the LACSD to produce recycled water that meets Title 22 requirements and the construction of a recycled water distribution (“purple pipe”) system. The future supply of recycled may be used by agricultural pumpers, which are in the general vicinity of the LACSD service area, in lieu of pumping groundwater. Alternatively, the recycled water could be introduced into the basin aquifers for indirect potable water reuse. The SABGSA, in conjunction with the LACSD, consider proceeding with the study, planning, preliminary design/engineering, and permitting phases for the expansion of the WWTF to add advanced treatment processes that will allow the LACSD to produce recycled water that meets Title 22 requirements.

SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program

The SABGSA may consider providing financial assistance in the future to the Santa Barbara County Water Agency for the continued operation and potential expansion of the existing precipitation enhancement program (e.g., cloud seeding program), which has been operated by Santa Barbara County Water Agency since 1981. This program has been historically operated by Santa Barbara County in the vicinity of upper elevation tributaries entering Cachuma Reservoir. The precipitation enhancement project involves implementation of a cloud seeding program to augment natural precipitation to increase surface water runoff and aquifer recharge in the Basin. This process includes introduction of silver iodide into clouds to increase nucleation (i.e., the process by which water in clouds freezes to then precipitate out). The precipitation enhancement program would potentially expand the use of both ground-based seeding and aerial seeding to improve the probability of increased rainfall. Ground-based seeding would be conducted using remote-controlled flare systems, set up along key mountain ridges and would be automated. Aerial seeding would use small aircraft carrying flare racks along its wings to release silver iodide into clouds while flying through and above them. This program has lost participation from some of its historical funding partners and this project would allow the SABGSA to support the continued operation of this program.

VSFB Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)

The SABGSA may consider providing financial assistance and/or other forms of support in the future to support the development and implementation supplemental water supply projects on VSFB, which would allow VSFB to not increase and further reduce its reliance on groundwater pumping from the Basin. Until October of 1997, all water used at VAFB originated from groundwater pumped from wells in the Basin, supplemented by water from the Santa Ynez Water Treatment Plant (USAF, 2019). In October 1997, VAFB began taking delivery of SWP supplies from the Central Coast Water Authority and since that time, the volume of groundwater being pumped from the Basin by VAFB has significantly decreased during normal operating conditions. During normal operating years, the basin wells are used primarily to augment SWP supplies. During extended drought periods when SWP water is curtailed, the basin wells become the primary water source for VAFB. Such was the case in 2014 and 2015, when VAFB consumed approximately 2,243 AFY in 2014 and 1,552 AFY in 2015 (USAF, 2019).

Of particular concern is the current plan by the U.S. Air Force (USAF) to develop the Vandenberg Dunes Golf Courses Project. The proposed project would redevelop and expand the existing Marshallia Ranch Golf Course by constructing up to five new links golf courses. The proposed project includes approximately 1,273 acres, which is mostly undeveloped, except for the existing 250-acre Marshallia Ranch Golf Course, various roads, and a decommissioned Titan I launch facility. Proposed land development would include constructing up to five links golf courses, practice grounds, a lodge and inn facilities, and up to 75 one- and two-bedroom cottages, among other facilities.

The USAF anticipates that the proposed project will require approximately 184 AFY of water per golf course. The current plan is to construct up to five golf courses with an estimated annual water demand of up to 921 AFY of water. Under the proposed development plan, the USAF anticipates meeting this golf course irrigation demand by pumping groundwater from its basin wells when SWP water is unavailable. The SABGSA has concerns that the withdrawing the projected volume of groundwater water from these wells will increase the annual storage deficit in the Basin, as well as adversely impact other SMCs, including creating adverse impacts to the San Antonio Creek/Barka Slough habitats and associated potential GDEs.

The SABGSA plans to encourage the VSFB to identify and implement supplemental water supply projects would allow the base to reduce its reliance on groundwater pumping from the Basin. Of particular interest is the potential for the development of a desalination facility that VSFB is considering. The development of a desalination facility could not only provide an alternative supply for VSFB water demands, including the proposed golf course development, the potential exists for excess supplies from a desalination facility to be used by other users in the Basin, in lieu of pumping groundwater.

Barka Slough Augmentation Project w/ SWP or Alternative Supplemental Water Supplies

In the future, the SABGSA may consider proceeding with the study, planning, preliminary design/engineering, and permitting phases for an augmentation project that will provide supplemental water to support the Barka Slough GDE. The source of the augmentation water will be SWP or other supplemental supplies if they become available in the future. The proximity of the Central Coast SWP pipeline to the Barka Slough is such that minimal infrastructure would be required to facilitate this project.

The reliability of the availability of the SWP and other supplemental water supplies is problematic and inconsistent. For example, the latest estimates of anticipated SWP water availability under future conditions are included in the DWR 2019 SWP Delivery Capability Report (DWR, 2020). The Delivery Capability Report anticipates approximately 59 percent of the Santa Barbara County Flood Control and Watershed Conservation District's Table A, and other contract amounts, will be available on average under anticipated future conditions. These estimates are based on outputs from the CalSim-2 Operations model (DWR, 2019). However, the availability of these SWP water supplies will be variable year by year based on hydrologic conditions. The historical delivery of annual allocations from the SWP ranges from 5 to 100 percent of the contracted amount. As of 2021, the Base has been informed that the SWP allocation will be zero percent. Given the variable availability of SWP water supplies, a MAR project would likely need to be designed to operate sporadically, with recharge occurring during wet years to balance out lower, or non-existent delivery amounts, during dry years.

In Lieu Recharge Projects to Deliver Unused and Surplus Supplemental Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers

In the future, the SABGSA may consider proceeding with the study, planning, preliminary design/engineering, and permitting phases for direct delivery projects that would be designed to use available supplemental water supplies, such as SWP system supplies, in lieu of groundwater. This option offsets the use of groundwater, allowing the groundwater basin to recharge naturally. Direct delivery projects rely on the construction of pipelines and associated infrastructure to deliver the water to agricultural or the LACSD, as well as pump stations and storage facilities to handle supply and demand variations. Direct delivery is a highly efficient method to reduce groundwater pumping because it directly offsets the amount of water pumped from the aquifer, allowing the principal aquifer groundwater elevations to rebound through natural recharge. One of the significant drawbacks of this concept is that the delivered water must be available during the times when the users need it, which often occurs at times when competition for those water supplies are highest and are less likely to be available, especially during a dry year. As an example, the forecasted allocation of SWP water in 2021 is zero percent. The construction of storage facilities can mitigate these challenges to some extent, but this additional infrastructure results in substantially increased capital and operational costs.

SABGSA to Provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses") Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge Projects

In the future, the SABGSA may consider the development and implementation of a program to provide technical assistance and potentially financial incentives to agricultural pumpers that use high tunnels, also referred to as "hoop houses" for crop cultivation. High tunnels are simple, plastic-covered, passive solar-heated structures in which crops are grown in the ground. High tunnels resemble greenhouses, but are less expensive to construct and maintain. Fruit, vegetable, flower, and cannabis growers use them to extend the growing season and intensify production. The impervious plastic sheeting that covers the high tunnels can yield a large volume of water with every measurable rainfall. Based on research performed by Iowa State University Cooperative Extension Service (ISU, 2012), approximately 900 gallons of water will flow from the roof of a 30 ft by 96 ft high tunnel with a half-inch rain event. This equates to approximately 0.084 AF of runoff per 1-inch of rainfall for each acre of high tunnels installed. Given that the average annual rainfall in the Basin is approximately 17 inches, the potential annual volume of rainfall that could be captured is approximately 1.43 AF per acre of high tunnels installed. By capturing the runoff from high tunnel roofs, the harvested rainwater could be used as a supply of either onsite or off-site irrigation water, in lieu of pumping groundwater, or could be diverted to DSW-MAR Basins, in which the harvested rainwater could be recharged into the groundwater basin.

Additional Projects for Potential Future Consideration by SABGSA

In the future, the SABGSA may consider investigating the feasibility of implementing the following projects and others as may be identified.

- Bedrock wells – consideration may be given to pumping and treating groundwater from bedrock formations to create an alternative water supply.
- Oilfield-produced water – consideration may be given to working with the owners of the active oil production wells surrounding the basin to evaluate the feasibility of treating and using oilfield-produced water for irrigation.

- Water exchanges – consideration may be given to funding local water projects in other regions in exchange for State Water Project allocation.

6.11.1 Relevant Measurable Objective(s) [§ 354.44(b)(1)]

> **§ 354.44 Projects and Management Actions.**
>
> **(b) Each Plan shall include a description of the projects and management actions that include the following:**
>
> **(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.**

Because the SABGSA does not plan to implement the identified Tier 4 non-priority projects, they will not have any impact on the measurable objectives for the Basin. If the SABGSA determines that one or more of the projects may be required, then there will be a benefit to all the measurable objectives that are identified in this GSP.

6.11.2 Implementation Triggers [§ 354.44(b)(1)(A)]

> **§ 354.44 Projects and Management Actions.**
>
> **(b) Each Plan shall include a description of the projects and management actions that include the following:**
>
> **(1) The Plan shall include the following:**
>
> **(A) A description of the circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation and termination of projects or management, and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred.**

The projects identified in this section are not deemed critical for the successful implementation of the GSP and are included in the Tier 4 implementation category as future options should they become necessary. The SABGSA does not plan to initiate any of these projects until evidence exists that the effects of the implemented (Tiers 1 through 3) management actions and priority projects are proving insufficient. Although, the SABGSA has no near-term plans to initiate construction of any specific projects, for the purposes of achieving basin sustainability, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for any number of projects that are identified by the SABGSA for potential future consideration.

6.11.3 Public Notice Process [§ 354.44(b)(1)(B)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(1) The Plan shall include the following:

(B) The process by which the Agency shall provide notice to the public and other agencies that the implementation of projects or management actions is being considered or has been implemented, including a description of the actions to be taken.

No specific notice to the public or other agencies is planned regarding the identified Tier 4 non-priority projects. If the SABGSA determines that one or more of the projects may require implementation, then a comprehensive program for informing the public and other agencies will be developed and implemented.

6.11.4 Overdraft Mitigation [§ 354.44(b)(2)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(2) If overdraft conditions are identified through the analysis required by Section 354.18, the Plan shall describe projects or management actions, including a quantification of demand reduction or other methods, for the mitigation of overdraft.

Because the SABGSA does not plan to implement the identified Tier 4 non-priority projects, they will not have any impact on the mitigation of the estimated storage deficit within the Basin. The potential effects that any specific project will have on the Basin will be addressed during the study, planning and preliminary design/engineering phases of any projects that are identified by the SABGSA for potential future consideration.

6.11.5 Permitting and Regulatory Process [§ 354.44(b)(3)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(3) A summary of the permitting and regulatory process required for each project and management action.

Each of the identified Tier 4 non-priority projects will require various permits prior to implementation and all will require compliance with applicable regulations, including CEQA. These permitting and regulatory compliance issues for any specific project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of any project that is identified by the SABGSA for potential future consideration.

6.11.6 Implementation Timeline [§ 354.44(b)(4)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(4) The status of each project and management action, including a time-table for expected initiation and completion, and the accrual of expected benefits.

The projects identified in this section are not deemed critical for the successful implementation of the GSP and are included in the Tier 4 implementation category. The SABGSA has no near-term plans to initiate construction of any specific projects for the purposes of achieving basin sustainability. However, there may be interest in proceeding with the study, planning, preliminary design/engineering, and permitting phases for several projects that are identified by the SABGSA for potential future consideration.

6.11.7 Anticipated Benefits [§ 354.44(b)(5)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(5) An explanation of the benefits that are expected to be realized from the project or management action, and how those benefits will be evaluated.

Because the SABGSA does not plan to implement the identified Tier 4 non-priority projects, they will not have any direct benefit to the Basin. If the SABGSA determines that one or more of the projects may require implementation, then assessment of anticipated benefits will be characterized at that time. Anticipated benefits that any specific project will have on the Basin will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the SABGSA for potential future consideration.

6.11.8 Legal Authority [§ 354.44(b)(7)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(7) A description of the legal authority required for each project and management action, and the basis for that authority within the Agency.

Legal authority for any specific project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the SABGSA for potential future consideration.

6.11.9 Cost and Funding [§ 354.44(b)(8)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(8) A description of the estimated cost for each project and management action and a description of how the Agency plans to meet those costs.

Project costs and proposed mechanisms for funding for any specific project will be addressed during the study, planning, preliminary design/engineering, and permitting phases of all projects that are identified by the SABGSA for potential future consideration. Table 6-1 provides preliminary cost ranges for the Tier 4 non-priority projects.

6.11.10 Drought Offset Measures [§ 354.44(b)(9)]

§ 354.44 Projects and Management Actions.

(b) Each Plan shall include a description of the projects and management actions that include the following:

(9) A description of the management of groundwater extractions and recharge to ensure that chronic lowering of groundwater levels or depletion of supply during periods of drought is offset by increases in groundwater levels or storage during other periods.

Because the SABGSA does not plan to implement the identified Tier 4 non-priority projects, they will not have any impact on mitigating chronic lowering of groundwater levels or depletion of supply during periods of drought within the Basin. The potential effects that any specific project will have on the Basin regarding offsetting the effects of drought, will be addressed during the study, planning, preliminary design/engineering, and permitting phases of any projects that are identified by the SABGSA for potential future consideration.

6.12 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

CIPC. 2011. Arundo Donax Distribution and Impact Report, California Invasive Plant Council.

DWR. 2016. Monitoring Networks and Identification of Data Gaps Best Management Practices, California Department of Water Resources.

DWR. 2020. The Final State Water Project Delivery Capability Report 2019, California Department of Water Resources.

ISU. 2012. Rainwater Catchment from a High Tunnel for Irrigation Use. Iowa State University Cooperative Extension. January 2012.

Santa Barbara County. 2019. 2019 Update of the Integrated Regional Water Management Plan.

Santa Barbara County. 2020. *Agricultural Commissioner, Weights and Measures Department.* Retrieved January 22, 2021, from Santa Barbara County: https://cosantabarbara.app.box.com/s/jdt95fy7gst3g8649l9t3ukrorr5xeh9/folder/109007441066. April 1, 2020.

SYRWCD. 2010. Groundwater Production Information and Instructions Pamphlet. Santa Ynez River Water Conservation District.

TNC. 2019. Identifying GDEs Under SGMA, Best Practices for Using the NC Dataset. The Nature Conservancy.

TWRI. 2001. Potential Water Savings in Irrigated Agriculture in the Lower Rio Grande Basin of Texas. Texas Water Resources Institute.

USAF. 2019. Consistency Determination for the Vandenberg Dunes Golf Courses Project, U.S. Department of the Air Force.

USGS. 2020. San Antonio Creek Valley Groundwater Basin Land Use Spatial Data. April 27, 2020.

SECTION 7: **Groundwater Sustainability Plan Implementation**

7.1 Introduction

This section provides a conceptual road map for the San Antonio Basin Groundwater Sustainability Agency's (SABGSA's) efforts to implement this San Antonio Creek Valley Groundwater Basin (Basin) Groundwater Sustainability Plan (GSP) during the first 5 years after adoption and discusses implementation efforts in accordance with Sustainable Groundwater Management Act (SGMA) regulations § 354.8(f)(2).

This implementation plan is based on the SABGSA's current understanding of conditions and anticipated administrative considerations in the Basin that affect the management actions described in Section 6. Understanding of the conditions and administrative considerations in the Basin will evolve over time, based on future refinement of the hydrogeologic setting, groundwater flow conditions, and input from basin stakeholders.

Implementation of this GSP requires robust administrative and financing structures, with adequate staff and funding to ensure compliance with SGMA. The GSP calls for SABGSA to routinely provide information to the public about GSP implementation and progress towards sustainability and the need to use groundwater efficiently. The GSP calls for a website to be maintained as a communication tool for posting data, reports, and meeting information.

Section 6 presents several management actions to be implemented by SABGSA that will address data gaps and reduce uncertainty, improve understanding of Basin conditions and how they may change over time, and actions intended to promote conservation and optimize water use in the Basin. The management actions also include development of a Water Allocation Program (Base Pumping Allocation [BPA]) and Groundwater Extraction Credit (GEC) Marketing and Trading Program. SABGSA has developed a portfolio of management actions and projects that can be implemented in phases as the conditions in the Basin dictate. The management actions and potential future projects are classified with a tiered system, with the implementation of Tier 1 elements to be initiated within 1 year of GSP adoption by SABGSA and implementation of Tier 2 elements within 3 years of GSP adoption. Tier 3 and 4 projects will be considered for implementation in the future as conditions in the Basin dictate and as the effectiveness of the lower tier initiatives (Tier 1 and Tier 2) are assessed.

Based on the results of the comprehensive multi-phased analysis that was performed in conjunction with the development of this GSP, SABGSA concluded that the Basin sustainability goals that are described in this GSP and that are required under the provisions of SGMA, can be achieved through the implementation of the management actions (Tier 1 and 2) and priority projects (Tier 3) described in Sections 6.3 through 6.10. Although a number of non-priority projects (Tier 4) were identified for potential future consideration, SABGSA does not plan to initiate the construction of any non-priority project infrastructure for the specific goal of achieving Basin sustainability until evidence exists that the effects of the implemented management actions and priority projects are proving insufficient.

This section of the GSP describes how these management actions will be implemented and includes descriptions of the following:

- Administrative Approach and Implementation Timing
- Annual Reporting
- 5-Year GSP Evaluation and Update
- Management Action Implementation
- SABGSA Annual Budget Estimates
- Funding Sources

7.2 Administrative Approach and Implementation Timing

SABGSA may hire staff, hire consultant(s), or assign staff from a cooperating agency (e.g., Cachuma Resource Conservation District) to conduct or manage the effort, and/or hire staff to implement the GSP. If consultants are hired, it is anticipated that qualified professionals will be identified and hired through a competitive selection process, although the GSA may determine that it is in its best interest to offer sole-source contracts. It is also anticipated that the lead for a particular task will keep the SABGSA informed through periodic updates to the SABGSA Board and the public. As needed, SABGSA would likely conduct specific studies and analyses necessary to improve understanding of basin conditions. SABGSA would likely then use new information on basin conditions to identify, evaluate, and/or improve management actions to achieve sustainability. This GSP calls for the actions considered by SABGSA to be vetted through a public outreach process whereby groundwater pumpers and other stakeholders will have opportunities to provide input to the decision-making process.

Using authorities outlined in California Water Code §§ 10725 to 10726.9, SABGSA will ensure the maximum degree of local control and flexibility consistent with this GSP to commence management actions. Because the amount of groundwater pumping in the Basin in recent years is more than the estimated yield of about 8,900 acre-feet per year (as discussed in Section 3.3) and groundwater levels are declining in certain areas, SABGSA will begin to implement Tier 1 management actions within 1 year after GSP adoption and Tier 2 management actions within 3 years of GSP adoption. The effectiveness of the management actions will be reviewed annually, and additional higher-tiered management actions will be implemented as necessary to avoid undesirable results. A graphical depiction of the implementation sequence is presented as Figure 7-1.

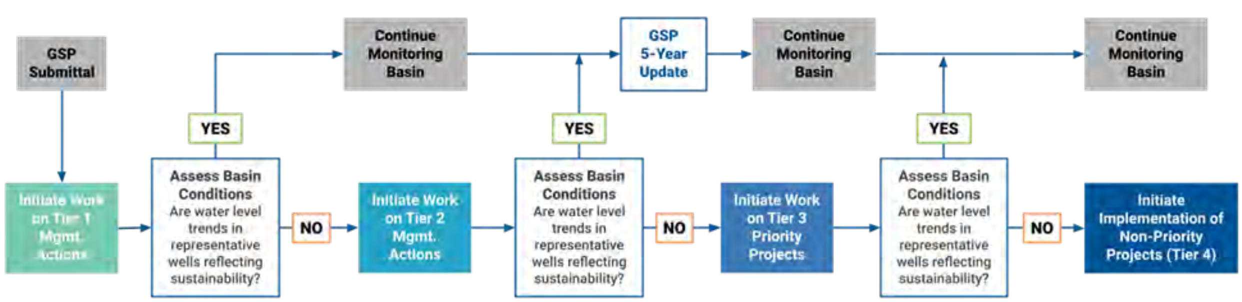

Figure 7-1. Implementation Sequence for Management Actions and Projects

7.3 Annual Reporting

The SABGSA will submit an annual report to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of the GSP. The annual report will include the following components for the preceding water year as required by DWR (California Code of Regulations [CCR] § 356.2):

1. General information, including an executive summary and a location map depicting the basin covered by the report.
2. A detailed description and graphical representation of the following conditions of the basin managed in the GSP:
   a. Groundwater elevation data from monitoring wells identified in the monitoring network will be analyzed and displayed as follows:
      i. Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions.
      ii. Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available.

   b. Groundwater extraction for the preceding water year. Data will be collected using the best available measurement methods and will be presented in a table that summarizes groundwater extractions by water use sector and identifies the method of measurement (direct or estimate) and accuracy of measurements, as well as a map that illustrates the general location and volume of groundwater extractions.

   c. Surface water supply used or available for use, for groundwater recharge or in lieu use will be reported based on quantitative data that describes the annual volume and sources for the preceding water year.

   d. Total water use will be collected using the best available measurement methods and will be reported in a table that summarizes total water use by water use sector and water source type and identifies the method of measurement (direct or estimate) and accuracy of measurements.

   e. Change in groundwater in storage will include the following:
      i. Change in groundwater in storage maps for each principal aquifer in the basin.
      ii. A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available.
3. A description of progress towards implementing the GSP, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.

7.4 5-Year GSP Evaluation and Update

SABGSA will evaluate the GSP at least every 5 years and whenever the GSP is amended and will provide a written assessment to DWR. The assessment will describe whether the GSP implementation—including implementation of projects and management actions—are meeting the sustainability goal in the Basin and will include the following:

1. A description of current groundwater conditions for each applicable sustainability indicator relative to measurable objectives, interim milestones, and minimum thresholds.
2. A description of the implementation of any projects or management actions and the effect on groundwater conditions from those projects or management actions.
3. Reconsideration and revision of elements of the GSP—including the basin setting, management areas, or the identification of undesirable results and the setting of minimum thresholds and measurable objectives—if necessary.
4. An evaluation of the basin setting in light of significant new information or changes in water use and an explanation of any significant changes. If SABGSA's evaluation shows that the Basin is experiencing chronic water level decline and reduction of groundwater in storage conditions, SABGSA will include an assessment of measures to mitigate that condition.
5. A description of the monitoring network in the Basin, including whether data gaps exist, or any areas in the Basin represented by data that do not satisfy the requirements of the GSP regulations (23 CCR §§ 352.4 and 354.34(c)). The description will include the following:
    a. An assessment of monitoring network function with an analysis of data collected to date, identification of data gaps, and the actions necessary to improve the monitoring network, consistent with the requirements of § 354.38.
    b. If the SABGSA identifies data gaps, the GSP will describe a program for the acquisition of additional data sources, including an estimate of the timing of that acquisition as well as incorporation of the newly obtained information into the GSP.
    c. The GSP will prioritize the installation of new data collection facilities and analysis of new data based on the needs of the Basin.
6. A description of significant new information that has been made available since GSP adoption or amendment or since the last 5-year assessment. The description will also include whether new information warrants changes to any aspect of the GSP, including the evaluation of the basin setting, measurable objectives, minimum thresholds, or the criteria defining undesirable results.
7. A description of relevant actions taken by the Agency, including a summary of regulations or ordinances related to the GSP.
8. Information describing any enforcement or legal actions taken by the Agency in furtherance of the sustainability goal for the Basin.
9. A description of completed or proposed GSP amendments.
10. Where appropriate, a summary of coordination that occurred between multiple GSAs in a single basin, GSAs in hydrologically connected basins, and land use agencies.
11. Other information the GSA deems appropriate, along with any information required by DWR to conduct a periodic review as required by California Water Code § 10733 (CCR § 356.4).

7.5 Management Action Implementation

Details of the proposed projects and management actions are presented in Section 6. The identified management actions and potential future projects are intended to bring the Basin into balance and achieve the sustainability goals without undesirable results within the next 20 years (by 2042). An estimate of the planning-level costs associated with the implementation of the Tier 1 and Tier 2 management actions are summarized in Table 7-1. An estimate of the planning-level costs associated with the implementation of the Tier 3 priority projects and Tier 4 non-priority projects are summarized in Table 7-2.

Table 7-1. Conceptual Planning-Level Cost Estimate for GSP Management Action Implementation

Activity	Tier	Planning-Level Estimate	
		Low	High
Address Data Gaps			
Expand Monitoring Well Network in the Basin to Increase Spatial Coverage and Well Density	1	$20,000	$200,000
Perform Reference Point Elevation and Video Surveys in Representative Wells That Currently Do Not Have Adequate Construction Records to Confirm Well Construction	1	$25,000	$75,000
Install Stream Gages at Barka Slough	1	$75,000	$125,000
LACSD Wellfield Pumping Coordination / Offsite Well Impact Mitigation	1	$15,000	$30,000
Review/Update Water Usage Factors and Crop Acreages and Update Water Budget	1	$20,000	$30,000
Survey and Investigate Potential GDEs in the Basin and Further Characterize Barka Slough	1	$50,000	$75,000
Review USGS Groundwater Model / Update Hydrologic Conceptual Model, Develop Water Budget for Barka Slough	1	$50,000	$100,000
Groundwater Pumping Fee Program	1	$100,000	$200,000
Well Registration and Well Meter Installation Programs	1	$75,000	$150,000
Water Use Efficiency Programs	1	$50,000	$125,000
Groundwater BPA Program	2	$75,000	$150,000
Groundwater Extraction Credit (GEC) Marketing and Trading Program	2	$150,000	$200,000
Voluntary Agricultural Crop Fallowing Programs	2	$75,000	$150,000
TOTAL (Tier 1 and Tier 2 Management Actions only)		**$780,000**	**$1,610,000**

Notes

Basin = San Antonio Creek Valley Groundwater Basin
BPA = Base Pumping Allocation
GDE = groundwater-dependent ecosystem
GEC = Groundwater Extraction Credit
GSP = Groundwater Sustainability Plan
LACSD = Los Alamos Community Services District
USGS = U.S. Geological Survey

Table 7-2. Conceptual Planning-Level Cost Estimate for GSP Project Implementation

Activity	Tier	Planning-Level Estimate
Priority Projects		
Non-Native / Invasive Species Eradication	3	>$200,000
Barka Slough Augmentation Project with Groundwater Supplies Using Existing Wells	3	>$200,000
Watershed Management Projects, Including Controlled Burns	3	>$200,000
Non-Priority Projects		
Distributed Storm Water Managed Aquifer Recharge (DSW-MAR) Basins (In-Channel and Off-Stream Basins)	4	>$1,000,000
LACSD Wastewater Treatment Facility Recycled Water and Reuse In Lieu of Groundwater Pumping or Indirect Potable Reuse	4	>$5,000,000
SABGSA to Become Funding Partner to Santa Barbara County Precipitation Enhancement Program	4	>$200,000
VSFB Groundwater Pumping Reduction Capital Project Participation (Desalination and/or Recharge and Recovery)	4	>$5,000,000
Barka Slough Augmentation Project with SWP or Banked Supplemental Water Supplies	4	>$1,000,000
In Lieu Recharge Projects to Deliver Unused and Surplus Imported Water to Offset Groundwater Extractions from LACSD and Agricultural Pumpers	4	>$5,000,000
SABGSA to Provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses") Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and/or Groundwater Recharge Projects	4	>$200,000

Notes

GSP = Groundwater Sustainability Plan

LACSD = Los Alamos Community Services District

SABGSA = San Antonio Creek Valley Groundwater Basin Groundwater Sustainability Agency

SWP = California State Water Project

VSFB = Vandenberg Space Force Base

7.6 SABGSA Annual Budget Estimates

SABGSA will incur costs for internal management and operation of the GSA, including monitoring of the condition in the Basin and GSP implementation. The associated cost estimates are still in the development stages and will depend on the management and organizational structure that the SABGSA selects. Additional variable costs may include engineering and other consulting services, permits and fees, California Environmental Quality Act compliance, legal expenses, and other administrative costs associated with the implementation of the Tier 1 and Tier 2 management actions and Tier 3 priority projects. Additionally, SABGSA will incur costs associated with the preparation of GSP annual reports to DWR and the required 5-year evaluation and, if necessary, updates to the GSP. An estimate of the conceptual planning-level costs for SABGSA annual management and operation are summarized in Table 7-3.

Table 7-3. Conceptual Planning-Level Cost Estimate for SABGSA Annual Management and Operation

Activity	Planning-Level Estimate	
	Low	High
SABGSA Staffing	$120,000	$200,000
Consulting Services	$75,000	$100,000
Public Outreach	$15,000	$30,000
Basin Monitoring[1]	$50,000	$75,000
Legal Services	$20,000	$30,000
Insurance	$4,500	$7,500
Audit / Accounting	$7,500	$15,000
Miscellaneous Expenses	$10,000	$15,000
GSP Annual Reporting	$65,000	$95,000
TOTAL	**$367,000**	**$567,500**

Notes

[1] Responsibility for executing the Basin monitoring program has not been established.

Basin = San Antonio Creek Valley Groundwater Basin

SABGSA = San Antonio Creek Valley Groundwater Basin Groundwater Sustainability Agency

GSP = Groundwater Sustainability Plan

7.7 Funding Sources

A Groundwater Pumping Fee Program is included as a Tier 1 management action in this GSP. SABGSA may consider measures to fund GSP implementation using a combination of groundwater extraction charges, including monthly fixed charges and variable pumping fees, assessments/parcel taxes, and grants. Because of California Constitutional limitations imposed through California Propositions 13, 218, and 26, there are strict rules about what constitutes a fee as compared to a tax. Taxes and assessments require voter approval. Water rates passed under Proposition 218 are subject to mandatory noticing and a potential majority protest. Regulatory fees identified as an exemption from taxes under Proposition 26 can be passed by the vote of the governing body of the agency imposing the fee. Assessments for special benefit are also governed by Proposition 218 and can be assessed to pay for a public improvement or service if it provides a special benefit to the properties. A benefit nexus is required to determine the amount of special benefit to each property. Funds collected from individual landowners and grants from DWR have funded the majority of the GSP costs to date and it is expected that grants available from general obligation bonds such as Proposition 68 may be available to fund GSP implementation.

Regarding potential funding opportunities, DWR has issued a Proposal Solicitation Package[54] for the implementation of GSPs. Funding for the program will be from the Sustainable Groundwater Management Grant Program Implementation Grants using funds authorized by the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access For All Act of 2018 (Proposition 68). These funds can be used for eligible projects that address drought and groundwater challenges to achieve regional sustainability for investments in groundwater recharge projects with surface water, stormwater, recycled water, and other conjunctive use projects. Eligible projects include activities associated with the implementation of an adopted GSP or approved alternative. The eligible projects must be listed in an adopted GSP or approved alternative. The Round 2 grant solicitation will provide approximately $77 million for medium- and high-priority (including critically overdrafted) basins. The funds will be available for eligible projects which are identified in the GSP. The funds will be disbursed as follows:

- At least $62 million for medium- and high-priority basins that meet the eligibility requirements outlined in the 2019 Guidelines (DWR, 2019) and those in Section III of DWR's Proposal Solicitation Package (DWR, 2020).

Only one application for funding will be accepted per basin. Applicants that apply on behalf of a GSA(s) are required to obtain and submit a letter of support from each GSA they represent. The tentative schedule is for the Round 2 Grants Solicitation to open in spring 2022 with grant awards to be announced in the fall of 2022. The minimum grant amount is $2 million per basin and the maximum grant amount is $5 million per basin. A minimum match of 25 percent of the project cost as local cost share is required. Eligible project expenses must be incurred after January 31, 2022.

Additionally, on May 14, 2021, Governor Newsom rolled out his California Comeback Plan announcing unprecedented and historic one-time funding investments. The plan comes after a year of unprecedented moments from a global pandemic, record-breaking wildfires, and increased momentum to build equity across multiple segments of society. Of particular interest to the SABGSA is potential funding for Assembly Bill 350, a bill to create a 3-year grant program to assist farmers and ranchers in critically overdrafted basins with conservation management planning. As part of this measure, the Governor is proposing $300 million in funds for implementation and planning related to SGMA.

After GSP adoption, SABGSA may perform a preliminary financing plan options evaluation. The evaluation would determine a structure to fund the proposed SABGSA activities and expected financial commitments throughout GSP implementation. Development of the funding mechanism(s) is critical to facilitate successful implementation of the GSP consistent with the requirements of SGMA. A key success factor is preparing a cost allocation that is equitable to SABGSA members and stakeholders. After the evaluation of financing plan options, a preliminary financing model may be developed to determine the revenue required to fund the operating plan, maintain reserve balances, and evaluate required adjustments to the fee structure over time as pumping ramps down to the estimated basin yield.

[54] The website for the Sustainable Groundwater Management (SGM) Grant Program's Proposition 68 Implementation Round 2 is available at https://www.grants.ca.gov/grants/sustainable-groundwater-management-sgm-grant-programs-proposition-68-implementation-round-2/. (Accessed August 19, 2021.)

7.8 References and Technical Studies [§ 354.4(b)]

§ 354.4 General Information.

(b) Each Plan shall include the following general information: A list of references and technical studies relied upon by the Agency in developing the Plan. Each Agency shall provide to the Department electronic copies of reports and other documents and materials cited as references that are not generally available to the public.

DWR. 2019. SGM Grant Program 2019 Guidelines. Prepared by the California Natural Resources Agency Department of Water Resources Division of Regional Assistance (DWR). September 2019. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater/Files/prop68_final-gl_August19_clean_ay_19.pdf. (Accessed August 19, 2021.)

DWR. 2020. Implementation Grants Proposal Solicitation Package. Prepared by the California Natural Resources Agency Department of Water Resources Division of Regional Assistance (DWR). October 2020. Available at https://water.ca.gov/-/media/DWR-Website/Web-Pages/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater/Files/Prop-68_psp_final_2020_ay20.pdf. (Accessed August 19, 2021.)

APPENDIX A

Groundwater Sustainability Agency Member Resolutions, Joint Exercise of Powers Agreement, and GSA Bylaws

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BOARD OF DIRECTORS

SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

RESOLUTION NO. 2017-1

A RESOLUTION OF THE SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY TO ELECT TO BECOME THE GROUNDWATER SUSTAINABILITY AGENCY FOR THE SAN ANTONIO CREEK GROUNDWATER BASIN PURSUANT TO THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

WHEREAS, the California Legislature has adopted, and the Governor has signed into law, the Sustainable Groundwater Management Act of 2014 ("Act"), which authorizes local agencies to manage groundwater in a sustainable fashion; and

WHEREAS, the legislative intent of the Act is to provide for sustainable management of groundwater basins, to enhance local management of groundwater, to establish minimum standards for sustainable groundwater management, and to provide local agencies with the authority and the technical and financial assistance necessary to sustainably manage groundwater; and

WHEREAS, in order to exercise the authority granted in the Act, a local agency or combination of local agencies must elect to become a groundwater sustainability agency ("GSA"); and

WHEREAS, the San Antonio Basin Groundwater Sustainability Agency ("Agency") is a local agency, as the Act defines that term; and

WHEREAS, the Agency exercises jurisdiction upon land overlying the entire San Antonio Creek Groundwater Basin ("Basin), designated basin number 3-014 in the Department of Water Resources' ("DWR") most recent changes to Bulletin No. 118; and

WHEREAS, the Agency is committed to sustainable management of the Basin's groundwater resources; and

WHEREAS, the Act requires that a GSA be formed for all basins designated by DWR as medium- or high-priority basins by June 30, 2017; and

WHEREAS, the Basin is designated as a medium-priority basin pursuant to the DWR's initial prioritization; and

WHEREAS, it is the intent of the Agency to work cooperatively with other local GSAs and stakeholders, as may be appropriate, to sustainably manage the Basin and ensure that the Act's goals are satisfied; and

WE, THE UNDERSIGNED, do hereby certify that the above and foregoing Resolution No. 2017-1 was duly adopted and passed by the Board of Directors of the San Antonio Basin Groundwater Sustainability Agency at a meeting held on the 14th day of June, 2017, by the following vote:

AYES: Durant, Pata, Sharer, Merrill, Writhe, Branquinho, Barnard
NOES: None
ABSENT: Huguenard

Randy Sharer, Board Chair
San Antonio Basin Groundwater Sustainability Agency

ATTEST:

Kevin Barnard, Secretary
San Antonio Basin Groundwater Sustainability Agency

Resolution No: 2017-02
RESOLUTION OF THE
Cachuma Resource Conservation District

RESOLUTION NO. 2017-02

RESOLUTION OF THE BOARD OF DIRECTORS OF THE CACHUMA RESOURCE CONSERVATION DISTRICT APPROVING THE EXECUTION OF A JOINT EXERCISE OF POWERS AGREEMENT WITH LOS ALAMOS COMMUNITY SERVICES DISTRICT TO FORM THE SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

WHEREAS, the Los Alamos Community Services District ("LACSD") and the Cachuma Resource Conservation District ("CRCD") are both local agencies, as defined by the Sustainable Groundwater Management Act ("SGMA"), Water Code §§ 10720 *et seq*., located within the San Antonio Creek Valley Groundwater Basin ("Basin") as defined by the California Department of Water Resources ("DWR") Bulletin 118,

WHEREAS, SGMA requires the formation of a groundwater sustainability agency ("GSA") by June 30, 2017, for each groundwater basin designated by DWR as medium- or high-priority, and DWR has designated the Basin as medium-priority,

WHEREAS, SGMA requires the adoption of a groundwater sustainability plan ("GSP") by January 31, 2022, for each medium-priority basin,

WHEREAS, pursuant to SGMA, specifically Water Code § 10723.6, and the Joint Exercise of Powers Act, Government Code §§ 6500 *et seq.*, LACSD and CRCD are authorized to create a joint powers authority to jointly exercise any power common to the two agencies, together with such powers as are expressly set forth in the Joint Exercise of Powers Act and in SGMA,

WHEREAS, the Board of Directors of LACSD voted on May 10, 2017 to execute a Joint Exercise of Powers Agreement ("JPA") between LACSD and CRCD relating to the formation of a joint powers authority for the purpose of becoming the GSA and developing a GSP for the Basin,

WHEREAS, the Board of Directors of CRCD desires by this resolution to approve the JPA forming the San Antonio Basin Groundwater Sustainability Agency.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the Cachuma Resource Conservation District as follows:

The CRCD Board of Directors hereby approves the JPA in the form presented to it and authorizes the President of the CRCD Board of Directors to sign the JPA on behalf of CRCD.

PASSED AND ADOPTED this 16th day of May 2017, by the following vote of the Board of Directors of the CRCD:

AYES: Russell, Cavaletto, Scolari, Bradley, Douglas, Steele, Weiss
NOES: Merritt
ABSENT: NONE

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ABSTAIN: Stollberg

Richard Russell, President
of the Board of Directors

ATTEST:

Leroy Scolari, Secretary
of the Board of Directors

CERTIFICATE OF SECRETARY

I, LEROY SCOLARI, SECRETARY OF THE BOARD OF DIRECTORS OF THE CACHUMA RESOURCE CONSERVATION DISTRICT, DO HEREBY CERTIFY THAT THE ABOVE IS A TRUE AND CORRECT COPY OF RESOLUTION PASSED AND ADOPTED BY THE BOARD OF DIRECTORS OF THE CRCD effective ~~March 15,~~ May 16 2017.

SECRETARY OF THE BOARD

Resolution No: 2017-03
RESOLUTION OF THE
Cachuma Resource Conservation District

RESOLUTION NO. 2017-03

RESOLUTION OF THE BOARD OF DIRECTORS OF THE CACHUMA RESOURCE CONSERVATION DISTRICT APPOINTING SEVEN DIRECTORS TO SERVE ON THE BOARD OF THE SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

WHEREAS, the Los Alamos Community Services District ("LACSD") and the Cachuma Resource Conservation District ("CRCD") are both local agencies, as defined by the Sustainable Groundwater Management Act ("SGMA"), Water Code §§ 10720 *et seq.*, located within the San Antonio Creek Valley Groundwater Basin ("Basin") as defined by the California Department of Water Resources ("DWR") Bulletin 118,

WHEREAS, pursuant to SGMA, specifically Water Code § 10723.6, and the Joint Exercise of Powers Act, Government Code §§ 6500 *et seq.*, LACSD and CRCD are authorized to create a joint powers authority to jointly exercise any power common to the two agencies, together with such powers as are expressly set forth in the Joint Exercise of Powers Act and in SGMA,

WHEREAS, the CRCD Board of Directors and the LACSD Board of Directors have approved a Joint Exercise of Powers Agreement ("JPA") between CRCD and LACSD relating to the formation of a new joint powers authority to be called the "San Antonio Basin Groundwater Sustainability Agency,"

WHEREAS, the JPA provides that the CRCD Board of Directors may appoint seven individuals to the Board of Directors of the San Antonio Basin Groundwater Sustainability Agency, according to the following representation categories defined in the JPA:

- Vineyards: Two directors
- Row crops: Two directors
- Orchards or other permanent crops: One director
- Cattle: One director
- Transitional land uses: One director

WHEREAS, the CRCD Board of Directors desires by this resolution to appoint seven individuals to the Board of Directors of the San Antonio Basin Groundwater Sustainability Agency.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the Cachuma Resource Conservation District as follows:

The CRCD Board of Directors hereby appoints the following individuals to serve on the Board of Directors of the San Antonio Basin Groundwater Sustainability Agency formed pursuant to the JPA, each for a term of four (4) years commencing on the date that the San Antonio Basin Groundwater Sustainability Agency votes to become the groundwater sustainability agency for the Basin:

1. Pat Huguenard (Vineyards)
2. Kevin Merrill (Vineyards)
3. Randy Sharer (Row crops)
4. Kenneth Pata (Row crops)
5. Tom Durant (Orchards/other permanent crops)
6. Brandy Branquinho (Cattle)
7. Christopher Wrather (Transitional land uses)

PASSED AND ADOPTED this 16th day of May 2017, by the following vote of the Board of Directors of the Cachuma Resource Conservation District:

AYES: Russell, Cavaletto, Scolari, Bradley, Douglas, Merritt, Steele, Wegis
NOES: NONE
ABSENT: NONE
ABSTAIN: Jim Stollberg

Richard Russell, President
of the Board of Directors

ATTEST:

LeRoy Scolari
Leroy Scolari, Secretary
of the Board of Directors

Resolution No: 2017-03
RESOLUTION OF THE
Cachuma Resource Conservation District

CERTIFICATE OF SECRETARY

I, LEROY SCOLARI, SECRETARY OF THE BOARD OF DIRECTORS OF THE CACHUMA RESOURCE CONSERVATION DISTRICT, DO HEREBY CERTIFY THAT THE ABOVE IS A TRUE AND CORRECT COPY OF RESOLUTION PASSED AND ADOPTED BY THE BOARD OF DIRECTORS OF THE CRCD effective May 16, 2017.

LeRoy Scolari

SECRETARY OF THE BOARD

RESOLUTION NO. 17-361

RESOLUTION OF THE BOARD OF DIRECTORS OF THE LOS ALAMOS COMMUNITY SERVICES DISTRICT APPROVING PARTICIPATION BY DISTRICT AS MEMBER OF GROUNDWATER SUSTAINABILITY AGENCY, APPROVING JOINT EXERCISE OF POWERS AGREEMENT WITH CACHUMA RESOURCE CONSERVATION DISTRICT, AND APPOINTING DIRECTOR AND ALTERNATE DIRECTOR TO SERVE ON BOARD OF JOINT POWERS AUTHORITY

WHEREAS, the Los Alamos Community Services District ("LACSD") and the Cachuma Resource Conservation District ("CRCD") are both local agencies, as defined by the Sustainable Groundwater Management Act ("SGMA"), Water Code §§ 10720 *et seq*., located within the San Antonio Creek Valley Groundwater Basin ("Basin"), and each have water supply, water management, or land use responsibilities within the Basin.

WHEREAS, SGMA requires the formation of a groundwater sustainability agency ("GSA") by June 30, 2017, for each groundwater basin designated by the California Department of Water Resources ("DWR") as a medium or high priority basin. SGMA requires the adoption of a groundwater sustainability plan ("GSP") by January 31, 2022, for each medium priority basin. DWR has designated the Basin as a medium priority basin.

WHEREAS, pursuant to SGMA, specifically Water Code § 10723.6, and the Joint Exercise of Powers Act, Government Code §§ 6500 *et seq.*, LACSD and CRCD are authorized to create a joint powers agency to jointly exercise any power common to the two agencies, together with such powers as are expressly set forth in the Joint Exercise of Powers Act and in SGMA.

WHEREAS, the Board of Directors of LACSD ("LACSD Board") has been presented with a proposed Joint Exercise of Powers Agreement ("JPA") between LACSD and CRCD relating to the formation of a joint powers authority for the purpose of becoming the GSA for the Basin to develop a GSP and manage the Basin.

WHEREAS, the Board of Directors of LACSD desires by this resolution to (i) approve the participation by LACSD as a member of the GSA for the Basin, (ii) approve the JPA, and (iii) appoint a director and an alternate director to serve on the board of the joint powers authority formed pursuant to the JPA.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the Los Alamos Community Services District as follows:

1. **Approval of Participation as GSA Member**. The LACSD Board hereby approves the participation by LACSD as a member of the GSA for the Basin.

2. **Approval of Joint Exercise of Powers Agreement**. The LACSD Board hereby approves the JPA in the form presented to it and authorizes the President of the LACSD Board to sign the JPA on behalf of LACSD.

3. **Appointment of Board Member and Alternate**. The LACSD Board hereby appoints Kevin Barnard to serve as a director and Leonard Bileti to serve as an alternate director on the board of the joint powers authority formed pursuant to the JPA, each for a term of term of four (4) years commencing on the date that said joint powers authority decides to become the GSA for the Basin.

PASSED AND ADOPTED this 10th day of May 2017, by the following vote of the Board of Directors of the Los Alamos Community Services District:

AYES: Torres, Snell, Gregg, Bileti and Solis

NOES: -0-

ABSENT: -0-

ABSTAIN: -0-

Larry A. Torres, President
of the Board of Directors

ATTEST:

Candyce Clark, Secretary
of the Board of Directors

CERTIFICATION

The undersigned Secretary of the Board of Directors of the Los Alamos Community Services District hereby certifies that the foregoing resolutions were duly adopted by the Board of Directors at a special meeting held on the 10th day of May, 2017.

Candyce Clark

Candyce Clark, Secretary
of the Board of Directors

Dated: May 11, 2017

San Antonio Basin Groundwater Sustainability Agency
920 E. Stowell Rd. Santa Maria, CA 93454
(805) 868-4013

May 28, 2020

Department of Water Resources
Mark Nordberg, GSA Project Manager
PO Box 942836
Sacramento, CA 94236-0001

RE: San Antonio Basin Groundwater Sustainability Agency Notice of Non-Material Change to GSA Notification

This letter is to notify the Department of Water Resources of a non-material change with respect to the San Antonio Basin Groundwater Sustainability Agency (GSA) Notification. The GSA was created in May 2017 by a Joint Exercise of Powers Agreement (JPA Agreement) between the Los Alamos Community Services District (Los Alamos CSD) and the Cachuma Resource Conservation District (Cachuma RCD). When the GSA was formed, the Cachuma RCD's participation in the GSA was envisioned as potentially interim in nature. The JPA Agreement expressly provided for the automatic substitution of the Cachuma RCD as a "Member" of the GSA with a subsequently formed water district overlying the San Antonio Creek Groundwater Basin ("Basin") and representing at least 50% of Basin pumping.

Santa Barbara LAFCO recently approved the formation of the San Antonio Basin Water District (a California Water District formed pursuant to Water Code § 34000 et seq.), which meets the requirements set forth in the JPA Agreement and covers the entirety of the Basin with a carve-out for the service area of the Los Alamos CSD. Pursuant to the terms of the JPA Agreement, the newly formed San Antonio Basin Water District has replaced the Cachuma RCD as a Member of the GSA, effective as of May 19, 2020.

Sincerely,

Anna Olsen
Executive Director, San Antonio Basin GSA

JOINT EXERCISE OF POWERS AGREEMENT

by and between

CACHUMA RESOURCE CONSERVATION DISTRICT AND

LOS ALAMOS COMMUNITY SERVICES DISTRICT

creating the

SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

MAY 2017

JOINT EXERCISE OF POWERS AGREEMENT OF THE SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

This **Joint Exercise of Powers Agreement of the San Antonio Basin Groundwater Sustainability Agency ("Agreement")** is made and entered into as of May 16, 2017 ("**Effective Date**"), by and between the Cachuma Resource Conservation District ("**CRCD**") and the Los Alamos Community Services District ("**LACSD**"), referred to herein individually as a "**Member**" and collectively as the "**Members**" for purposes of forming the San Antonio Basin Groundwater Sustainability Agency ("**Agency**" or "**SABGSA**") and setting forth the terms pursuant to which the Agency shall operate.

RECITALS

A. Both of the Members to this Agreement are local agencies, as defined by the Sustainable Groundwater Management Act ("**SGMA**"), Water Code §§ 10720 *et seq.*, located within the San Antonio Creek Valley Groundwater Basin ("**Basin**") and duly organized and existing under and by virtue of the laws of the State of California; and,

B. SGMA requires formation of a groundwater sustainability agency ("**GSA**") by June 30, 2017, for each groundwater basin designated by the California Department of Water Resources ("**DWR**") as a medium or high priority basin; and,

C. SGMA requires adoption of a groundwater sustainability plan ("**GSP**") by January 31, 2022, for each medium priority basin; and,

D. Pursuant to SGMA, specifically Water Code § 10723.6, and the Joint Exercise of Powers Act, Government Code §§ 6500 *et seq.*, the Members are authorized to create a joint powers agency to jointly exercise any power common to the Members, together with such powers as are expressly set forth in the Joint Exercise of Powers Act and in SGMA, for the purpose of becoming a GSA for the Basin; and,

E. The Members each have water supply, water management, or land use responsibilities within the Basin, as identified and defined by DWR in Bulletin No. 118 (as Basin No. 3-14); and,

F. The Members intend for the SABGSA to develop a GSP and manage the Basin pursuant to SGMA; and,

G. In order to become the GSA for the Basin, the Agency will comply with the notice and public hearing requirements described in Water Code section 10723(b) and with the notification requirements described in Water Code section 10723.8; and,

H. Based on the foregoing legal authority, the Members desire to create a joint powers authority for the purpose of taking all actions deemed necessary by the Agency, acting as the GSA, to ensure sustainable management of the Basin as required by SGMA.

TERMS OF AGREEMENT

In consideration of the mutual promises and covenants herein contained, the Members agree as follows:

ARTICLE 1
INCORPORATION OF RECITALS

1.1 The foregoing recitals are true and correct and are incorporated herein by reference.

ARTICLE 2
DEFINITIONS

The following terms have the following meanings for purposes of this Agreement:

2.1 "Act" means the Joint Exercise of Powers Act, set forth in Chapter 5 of Division 7 of Title 1 of the Government Code, sections 6500, *et seq.*, including all laws supplemental thereto.

2.2 "Agreement" means this Joint Exercise of Powers Agreement forming the San Antonio Basin Groundwater Sustainability Agency with jurisdiction over the San Antonio Creek Valley Groundwater Basin.

2.3 "Auditor" means the auditor of the financial affairs of the Agency appointed by the Board of Directors pursuant to Section 14.4 of this Agreement.

2.4 "Agency" means the San Antonio Basin Groundwater Sustainability Agency, also referred to herein as "SABGSA," created by this Agreement.

2.5 "Basin" means the San Antonio Creek Valley Groundwater Basin, also referred to as the San Antonio Groundwater Basin, as identified and defined by DWR in Bulletin 118 (as Basin 3-14).

2.6 "Board of Directors" or "Board" means the governing body of the Agency as established by Article 7 of this Agreement.

2.7 "Bulletin 118" means DWR's report entitled "California Groundwater: Bulletin 118" updated in 2016, and as it may be subsequently updated or revised in accordance with Water Code § 12924.

2.8 "Bylaws" means the bylaws adopted by the Board of Directors pursuant to Article 12 of this Agreement to govern the day-to-day operations of the Agency.

2.9 "Director(s)" and "Alternate Director(s)" mean a director or alternate director appointed by a Member pursuant to Article 7 of this Agreement.

2.10 "DWR" means the California Department of Water Resources.

2.11 "Executive Director" means the chief administrative officer of the Agency to be appointed by the Board of Directors pursuant to Article 11 of this Agreement.

2.12 "GSA" means a Groundwater Sustainability Agency as defined by SGMA in Water Code §§ 10720 *et seq.*

2.13 "GSP" means a Groundwater Sustainability Plan, as defined by SGMA in Water Code §§ 10727 *et seq.*

2.14 "Member(s)" means a local agency eligible under SGMA to be a groundwater sustainability agency and included in Article 6 of this Agreement.

2.15 "Officer(s)" means the Chair, Vice Chair, Secretary, or Treasurer of the Agency to be appointed by the Board of Directors pursuant to Article 8 of this Agreement and any additional officers that may be appointed by the Board as it deems necessary.

2.16 "SABGSA" means the San Antonio Basin Groundwater Sustainability Agency, also referred to herein as "Agency," created by this Agreement.

2.17 "SGMA" means the Sustainable Groundwater Management Act, Water Code §§ 10720 *et seq.,* including all laws supplemental thereto.

2.18 "State" means the State of California.

ARTICLE 3
CREATION OF THE AGENCY

3.1 Creation of a Joint Powers Authority. There is hereby created pursuant to the Act and SGMA a joint powers authority, which shall be a public entity separate from the Members to this Agreement, and which shall be known as the San Antonio Basin Groundwater Sustainability Agency. The boundaries of the Agency shall correlate with the boundaries of the Basin as determined by DWR in Bulletin 118 or as modified by DWR pursuant to Water Code section 10722.2.

3.2 Notices. Within 30 days after the Effective Date of this Agreement, and after any amendment, the Agency shall cause a notice of this Agreement or amendment to be prepared and filed with the office of the California Secretary of State containing the information required by Government Code section 6503.5. Within 70 days after the Effective Date of this Agreement, the Agency shall cause a statement of the information concerning the Agency, required by Government Code section 53051, to be filed with the office of the California Secretary of State and with the County Clerk for the County of Santa Barbara, setting forth the facts required to be stated pursuant to Government Code section 53051(a). Within 30 days after deciding to become the GSA for the Basin, the Agency shall inform DWR of its decision and intent to undertake sustainable groundwater management within the Basin in accordance with Water Code § 10723.8.

3.3 Purpose of the Agency. The purpose of the Agency is to implement and comply with SGMA in the San Antonio Groundwater Basin by (i) serving as the Basin's groundwater sustainability agency, (ii) developing, adopting, and implementing a GSP for the Basin, and (iii) sustainably managing the Basin pursuant to SGMA.

3.4 Principal Office. The principal office of the Agency shall be established by the Board of Directors, and may thereafter be changed by a majority vote of the Board.

ARTICLE 4
TERM

4.1 This Agreement shall become effective on the date first set forth above, which shall correspond to the date on which the last Member listed in Article 6 (Members) signs this Agreement, after which notices shall be filed in accordance with Section 3.2 (Notices). This Agreement shall remain in effect until terminated pursuant to the provisions of Article 17 (Withdrawal of Members) of this Agreement.

ARTICLE 5
POWERS

5.1 The Agency shall possess and shall exercise in its own name any and all powers reasonably necessary for the Agency to implement SGMA, together with such other powers as are expressly set forth in the Act and in SGMA. For purposes of Government Code section 6509, the powers of the Agency shall be exercised subject to the restrictions imposed on the CRCD or on a successor water district, should one replace the CRCD as a Member of the Agency (pursuant to Article 6), and in the event of the withdrawal of the CRCD without a water district replacing it as a Member, then the manner of exercising the GSA's powers shall be exercised subject to those restrictions imposed on the LACSD, and shall include, but not be limited to, the following powers:

(1) To exercise all powers afforded to a GSA pursuant to and as permitted by SGMA;

(2) To develop, adopt and implement the GSP pursuant to SGMA;

(3) To adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency and adoption and implementation of the GSP in accordance with applicable law;

(4) To obtain rights, permits and other authorizations for or pertaining to implementation of the GSP;

(5) To perform other ancillary tasks relating to the operation of the Agency pursuant to SGMA and applicable law, including without limitation, environmental review, engineering, and design;

(6) To make and enter into all contracts necessary to the full exercise of the Agency's powers;

(7) To employ, designate or otherwise contract for the services of agents, officers, employees, attorneys, engineers, planners, financial consultants, technical specialists, advisors,

and contractors;

(8) To exercise jointly the common powers of the Members, as directed by the Board, in developing and implementing a GSP for the Basin;

(9) To investigate legislation and proposed legislation affecting the Basin and to make appearances regarding such matters;

(10) To cooperate and to act in conjunction and contract with the United States, the State of California or any agency thereof, counties, municipalities, public agencies and private corporations and entities of any kind (including without limitation, investor-owned utilities), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of the powers of the Agency;

(11) To incur debts, liabilities or obligations, to issue bonds, notes, certificates of participation, guarantees, equipment leases, reimbursement obligations and other indebtedness, and, to the extent provided for in a duly adopted GSP, to impose assessments, groundwater extraction fees, or other charges, and other means of financing the Agency as authorized by and as provided in Chapter 8 of SGMA commencing at Section 10730 of the Water Code;

(12) To collect and monitor data on the extraction of groundwater from, and the quality of groundwater in, the Basin;

(13) To establish and administer a conjunctive use program for the purposes of maintaining sustainable yields in the Basin consistent with the requirements of SGMA;

(14) To exchange and distribute water;

(15) To regulate groundwater extractions as permitted by SGMA;

(16) To impose groundwater extraction fees as permitted by SGMA;

(17) To spread, sink and inject water into the Basin;

(18) To store, transport, recapture, recycle, purify, treat or otherwise manage and control water for beneficial use;

(19) To apply for, accept and receive licenses, permits, water rights, approvals, agreements, grants, loans, contributions, donations or other aid from any agency of the United States, the State of California, or other public agencies or private persons or entities necessary for the Agency's purposes;

(20) To develop and facilitate market-based solutions for the use and management of water rights;

(21) To acquire property and other assets by grant, lease, purchase, bequest, devise, gift or eminent domain, and to hold, enjoy, lease or sell, or otherwise dispose of, property, including

real property, water rights, and personal property, necessary for the full exercise of the Agency's powers;

(22) To sue and be sued in its own name;

(23) To provide for the prosecution of, defense of, or other participation in actions or proceedings at law or in public hearings in which the Members, pursuant to this Agreement, may have an interest and may employ counsel and other expert assistance for these purposes;

(24) To exercise the common powers of its Members to develop, collect, provide, and disseminate information that furthers the purposes of the Agency, including but not limited to the operation of the Agency and adoption and implementation of the GSP, to the Members, legislative, administrative, and judicial bodies, as well as the public generally;

(25) To accumulate operating and reserve funds for the purposes herein stated;

(26) To invest money that is not required for the immediate necessities of the Agency, as the Agency determines is advisable, in the same manner and upon the same conditions as Members, pursuant to Government Code section 53601, as it now exists or may hereafter be amended;

(27) To undertake any investigations, studies, and matters of general administration; and

(28) To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

ARTICLE 6
MEMBERSHIP

6.1 Members. The initial Members of the Agency shall be CRCD and the LACSD as long as they have not, pursuant to the provisions hereof, withdrawn from this Agreement.

6.2 Automatic Substitution of CRCD. If at any time the landowners in the Basin form a water district whose boundaries include lands that (i) overlie the Basin, and (ii) represent more than fifty percent (50%) of all groundwater water extractions from the Basin, not including Federal water extractions ("**Water District**"), the Water District shall be entitled, upon written notice ("**Notice**") to the Agency, to be substituted for the CRCD as a Member of the Agency. The Notice shall include a list of proposed Directors who meet all of the qualifications to serve on the Agency Board as set forth in Section 7.1.1 ("**Substitute Directors**"). Upon the substitution of the Water District as a Member of the Agency, the Substitute Directors designated by the Water District shall be substituted for any Directors appointed by the CRCD who are then serving on the Board, and shall fill any vacant positions on the Board for which the CRCD had the right to appoint the Directors. The substitution of the Water District as a Member shall be automatic without any payment of costs or reimbursements by the Water District or any action of the Agency, and shall be effective ten (10) days following delivery to the Agency of the Notice. From and after the date that the substitution is effective, the Water District shall stand in the place and stead of the CRCD.

6.3. New Members. In addition to the substitution of a Member under Section 6.2., any local agency (as defined by SGMA and the Act) that is not a Member on the Effective Date of this Agreement may become a Member upon:

(1) Unanimous approval of the Board of Directors as specified in Article 10 (Voting);

(2) Payment of a pro rata share of all previously incurred costs that the Board of Directors determines have resulted in benefit to the local agency, and are appropriate for assessment on the new Member; and,

(3) Amendment of this Agreement in accordance with Section 18.3 (Amendments to Agreement) to reflect the new Member.

ARTICLE 7
BOARD OF DIRECTORS

7.1 Formation of the Board of Directors. The Agency shall be governed by a Board of Directors ("**Board**"). The Board shall consist of a total of eight (8) Directors consisting of the following representatives who shall be appointed in the manner described below:

7.1.1 Seven (7) Directors appointed by a majority vote of the governing board of the CRCD. At any time upon a unanimous vote of the CRCD governing board, the representation categories below for the seven (7) Directors appointed by the CRCD (the "**Representation Categories**") may be modified to more accurately reflect groundwater usage within the Basin, but as of the Effective Date of this Agreement, the Directors appointed by the CRCD shall include owners or designated representatives of owners of land overlying the Basin that is dedicated to and used for the following Representation Categories:

(a) Vineyards: Two (2) Directors;

(b) Row crops: Two (2) Directors;

(c) Orchards or other permanent crops: One (1) Director;

(d) Cattle: One (1) Director; and

(e) Transitional land uses: One (1) Director. As used herein, the term "transitional land uses" shall refer to lands suitable for productive cultivation that, on the Effective Date of this Agreement, are not in agricultural production, fallowed, or used solely for livestock grazing.

7.1.2 One Director appointed by a majority vote of the governing board of the LACSD.

7.1.3 All Directors shall live or work full-time within the Basin or be a landowner, or be the designated representative of a landowner, within the Basin. In addition, each Director appointed by the CRCD to fill a Representation Category set forth in Section 7.1.1 shall either: (a) live or work full-time on land dedicated to and used for one of the Representation Categories; or, (b) shall be a landowner, or a landowner's designated representative, of land dedicated to and used for the Representation Category for which the Board member is appointed.

7.2 Duties of the Board of Directors. The business and affairs of the Agency, and all of its powers, including without limitation all powers set forth in Article 5 (Powers), are reserved to and shall be exercised by and through the Board of Directors, except as may be expressly delegated to the Executive Director or others pursuant to this Agreement, Bylaws, or by specific action of the Board of Directors.

7.3 Alternate Directors. Each Member may appoint an alternate to act as a substitute Director for each of the Directors appointed by that Member ("**Alternate Director**"). Each Alternate Director shall meet the same qualifications as are required of the Director for whom the Alternate Director serves. All Alternate Directors shall be appointed in the same manner as set forth in Article 7 for Directors. Alternate Directors shall not vote or participate in any deliberations of the Board unless appearing as a substitute for a Director due to absence or conflict of interest. If a Director is not present, or if a Director has a conflict of interest which precludes participation by the Director in any decision-making process of the Board, the Alternate Director appointed to act in his/her place shall assume all rights of the Director, and shall have the authority to act in his/her absence or inability to participate, including casting votes on matters before the Board. Alternate Directors are strongly encouraged to attend all Board meetings and stay informed on current issues before the Board.

7.4 Requirements. Each Director and Alternate Director shall be appointed by a resolution adopted by a majority vote of the appointing Member's governing board. The LACSD-appointed Director and Alternate Director shall serve for a term of four (4) years, can be reappointed for multiple terms, and can be removed at any time during his or her term by a resolution adopted by a majority vote of the LACSD governing board. CRCD-appointed Directors and Alternate Directors shall serve at the pleasure of the CRCD Board of Directors without a specified term and can be removed at any time by a resolution adopted by a majority vote of the CRCD governing board. No individual Director or Alternate Director may be removed except by the governing board of the Member that appointed him/her. Directors and Alternate Directors may resign at any time upon thirty (30) days prior written notice to the governing board of the Member that appointed him or her.

7.5 Vacancies and Appointments. Upon the vacancy of a Director position, the Alternate Director shall serve as Director until a new Director is appointed as set forth in Article 7. Members shall give notice of any appointments, removals and resignations of Directors or Alternate Directors to the Executive Director or Board by providing a copy of the Member's executed resolution of appointment or removal or a copy of the Director's resignation notice.

7.6 Director Compensation. Agency Directors, and Alternate Directors shall not be entitled to compensation from SABGSA, but nothing in this Article is intended to prohibit a Member from compensating any Director or Alternate Director appointed by the Member.

ARTICLE 8
OFFICERS

8.1 Officers. Officers of the Agency shall be a Chair, Vice Chair, Secretary, and Treasurer.

Additional officers may be appointed by the Board as it deems necessary. The Treasurer shall be appointed consistent with the provisions of Article 14.4. The Vice Chair, or in the Vice Chair's absence, the Secretary, shall exercise all powers of the Chair in the Chair's absence or inability to act.

8.2 Election, Resignation and Removal of Officers. Officers shall be elected annually for one (1) year terms by a majority vote of the Board of Directors. Officers shall be elected at the first Board meeting following the Effective Date, and thereafter at the first Board meeting following January 1st of each year. An Officer may serve for multiple consecutive terms, with no term limit. Any Officer may resign at any time upon written notice to the Board, and may be removed and replaced at any time by a majority vote of the Board.

8.3 Officer Compensation. Officers shall not be entitled to compensation from SABGSA, but nothing in this Article is intended to prohibit a Member from compensating any Officer elected by the Board.

ARTICLE 9
SABGSA DIRECTOR MEETINGS

9.1 Initial Meeting. The initial meeting of the SABGSA Board of Directors shall be held in the County of Santa Barbara, California, within thirty (30) days of the Effective Date of this Agreement.

9.2 Conduct. All meetings of the Board of Directors, including special meetings, shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act (Government Code sections 54950, *et seq.*) and shall be held within the jurisdiction of the SABGSA. The Board may use teleconferencing in connection with any meeting in conformance with and to the extent authorized by the Ralph M. Brown Act and any other applicable law.

9.3 Local Conflict of Interest Code. The Board of Directors shall adopt a local conflict of interest code pursuant to the provisions of the Political Reform Act of 1974 (Government Code sections 81000, *et seq.*)

ARTICLE 10
VOTING

10.1 Quorum. A quorum for any meeting of the Board of Directors shall consist of a majority of the Directors then appointed to the Board. In the absence of a quorum, any meeting of the Directors may be adjourned by any Director or Officer present, and no business may be transacted. For purposes of this Article, a Director shall be deemed present if the Director appears at the meeting in person or participates by teleconferencing, provided that the teleconferencing appearance is consistent with the requirements of the Ralph M. Brown Act.

10.2 Director Votes. Voting by the Board of Directors shall be made on the basis of one vote for each Director. A Director, or an Alternate Director when acting in the absence or inability to act of his or her Director, may vote on all matters of Agency business unless disqualified because of a conflict of interest pursuant to California law or the local conflict of interest code adopted by the Board of Directors.

10.3 Decisions of the Board of Directors. Decisions of the Agency Board of Directors shall be made as follows:

(a) Majority Approval. Except as specified in subsections (b) and (c) below, all decisions of the Board of Directors shall require the affirmative vote of a majority of all Directors then elected to the Board.

(b) Supermajority Approval. Notwithstanding the foregoing, a two-thirds (2/3) affirmative vote of all Directors then elected to the Board shall be required to approve any of the following: (i) any expenditure or estimated expenditure of $100,000 or more; (ii) the annual budget for the Agency; (iii) any stipulation to resolve litigation; (iv) establishment and levying any fee, charge or assessment; (v) groundwater extraction restrictions; (vi) the GSP for the Basin or any substantive amendment to the GSP; or (vii) adoption or amendment of the Bylaws.

(c) Unanimous Approval. Notwithstanding the foregoing, a unanimous affirmative vote of all Directors elected to the Board, not including any Director who is unable to act due to a conflict of interest, shall be required to approve issuance of indebtedness or the addition of new Members pursuant to Article 6.3 (New Members).

ARTICLE 11
EXECUTIVE DIRECTOR AND STAFF

11.1 Appointment. The Board of Directors may appoint an Executive Director, who may be, though need not be, an officer, employee, or representative of one of the Members. The Executive Director's compensation, if any, shall be determined by the Board of Directors.

11.2 Duties. If appointed, the Executive Director shall serve as the chief administrative officer of the Agency, shall serve at the pleasure of the Board of Directors, and shall be responsible to the Board for the proper and efficient administration of the Agency. The Executive Director shall have the powers designated by the Board, or otherwise as set forth in the Bylaws.

11.3 Term and Termination. The Executive Director shall serve until he/she resigns or the Board of Directors terminates his/her appointment.

11.4 Staff and Services. The Executive Director may retain such additional full-time and/or part-time employees and independent contractors as may be necessary from time to time to accomplish the purposes of the Agency, subject to the prior approval of the Board of Directors. Subject to applicable conflict of interest restrictions, the Agency may contract with a Member, another public agency, or a private entity for various services, including without limitation those related to the Agency's finances, purchasing, risk management, information technology, land and water improvement projects, and human resources. Initially, the Agency shall contract with the CRCD for the services of the Executive Director and Treasurer of the Agency, to serve at the pleasure of the Agency Board. A written agreement shall be entered into between the Agency and the other party contracting to provide such service, and that agreement shall specify the terms on which such services shall be provided, including without limitation the compensation, if any, that shall be paid for the provision of such services.

ARTICLE 12
BYLAWS

12.1 The Board of Directors shall approve and may thereafter amend, as it deems necessary, Bylaws of the Agency to govern the day-to-day operations of the Agency. The Bylaws shall be adopted on or before the first annual anniversary of the Board's first meeting.

ARTICLE 13
ADVISORY COMMITTEES

13.1 The Board of Directors from time to time may (i) establish one or more advisory committees, standing committees, or ad hoc committees to assist in carrying out the purposes and objectives of the Agency, and (ii) appoint persons to serve on such committees. At the time it establishes a committee, the Board shall determine the purpose and duration for the committee, the composition of the committee's membership, and the necessary qualifications for individuals appointed to the committee. The Board may terminate any committee in its discretion. Notwithstanding the foregoing, the Board of Directors (a) shall initially establish an advisory committee for the purpose of advising the Board in connection with the development of a Groundwater Sustainability Plan (the "**GSP Committee**"), (b) shall invite the County of Santa Barbara to designate one representative who shall serve as a member of the GSP Committee, and (c) shall not terminate the GSP Committee or the membership thereon by the representative designated by the County of Santa Barbara until such time as the GSP has been finalized. All committee meetings, including special meetings, shall be noticed, held, and conducted in accordance with the Ralph M. Brown Act (Government Code § 54950 *et seq.*).

ARTICLE 14
ACCOUNTING PRACTICES

14.1 General. The Board of Directors shall establish and maintain such funds and accounts as may be required by generally accepted public agency accounting practices. The Agency shall maintain strict accountability of all funds and a report of all receipts and disbursements of the Agency.

14.2 Records. The books and records of the Agency shall be open to inspection by the Members and by the public.

14.3 Fiscal Year. Unless the Board of Directors decides otherwise, the fiscal year for the Agency shall run from July 1st to June 30th.

14.4 Appointment of Treasurer and Auditor; Duties. Pursuant to Section 6505.5 of the Act, and as set forth in Section 11.4 above, CRCD's treasurer is hereby designated to serve as the Treasurer of the Agency. As required by Section 6505.5 of the Act, the person performing the functions of Auditor for the Agency shall also be the auditor of CRCD. The Treasurer and Auditor of the Agency shall perform the duties and responsibilities, specified in Sections 6505.5 and 6505.6 of the Act.

ARTICLE 15
BUDGET AND EXPENSES

15.1 Budget. Within sixty (60) days after the first meeting of the Board of Directors, and thereafter prior to the commencement of each fiscal year, the Board shall adopt a budget for the Agency for the ensuing fiscal year.

15.2 Management of Funds. The GSA shall maintain strict accountability of all funds and a report of all receipts and disbursement of funds.

15.3 Agency Funding and Contributions. Members may, but shall not be required to, make financial contributions to fund the expenses or ongoing operations of the Agency. For the purpose of paying the expenses and ongoing operations of the Agency, the Board of Directors shall maintain a funding account in connection with the annual budget process. The Board of Directors may fund the Agency and the GSP as provided in Chapter 8 of SGMA, commencing with Section 10730 of the Water Code.

15.4 Return of Contributions. Repayment or return to the Members of all or any part of any contributions made by Members may be directed by the Board of Directors at such time and upon such terms as the Board of Directors may decide; provided that (1) any distributions shall be made in proportion to the contributions paid by each Member to the Agency, and (2) any contribution paid by a Member voluntarily, shall be returned to the contributing Member, together with accrued interests at the annual rate published as the yield of the Local Agency Investment Fund administered by the California State Treasurer, before any other return of contributions to the Members is made. The Agency shall hold title to all funds and property acquired by the Agency during the term of this Agreement.

15.5 Issuance of Indebtedness. The Agency may issue bonds, notes or other forms of indebtedness, provided such issuance is approved by a unanimous vote of the Board of Directors as specified in Article 10 (Voting).

ARTICLE 16
LIABILITIES

16.1 Liability. In accordance with Government Code section 6507, the debts, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone, and not of the Members or the Directors.

16.2 Indemnity. The Agency, and those persons, agencies and instrumentalities used by it to perform the functions authorized herein, whether by contract, employment or otherwise, shall be exclusively liable for any injuries, costs, claims, liabilities, damages of whatever kind arising from or related to activities of the Agency, and the Members and Directors shall have no liability for any such injuries, costs, claims, liabilities, or damages.

The Agency agrees to indemnify, defend and hold harmless (i) each Member and its governing board and the members thereof, officers, officials, representatives, agents, and employees, (ii) each Director, and (iii) each Alternate Director from and against any and all claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, damages, judgments, expenses or costs, including but not limited to attorney's fees, and/or liabilities arising out of or attributable to the Agency or this Agreement ("Claims").

Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, and each Member, each Director and each Alternate Director, and any officers, officials, agents or employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency against any such Claims

The Members do not intend hereby to be obligated either jointly or severally for the debts, liabilities, obligations or Claims of the Agency, except as may be specifically provided for in Government Code § 895.2. Provided, however, if any Member(s) of the Agency are, under such applicable law, held liable for the acts or omissions of the Agency, such parties shall be entitled to contribution from the other Members so that after said contributions each Member shall bear an equal share of such liability.

16.3 Insurance. The Agency shall procure and at all times maintain appropriate policies of insurance providing coverage to (i) the Agency and its officers, employees, and agents, (ii) each Director, and (iii) each Alternate Director for general liability, errors and omissions, property, workers compensation, and any other coverage the Board deems appropriate. Such policies shall name the Members and their respective governing boards and the members thereof, officers, officials, representatives, agents, and employees as additional insureds.

ARTICLE 17
WITHDRAWAL OF MEMBERS

17.1 Unilateral Withdrawal. A Member may, at any time and without any liability of any kind to the other Member(s), the Agency, or any other party (except as provided in Section 17.3), unilaterally withdraw from this Agreement without causing or requiring termination of this Agreement, effective upon 30 days written notice to the Board or Executive Director and all other Members.

17.2 Rescission or Termination of Agency. This Agreement may be rescinded and the Agency terminated at any time by unanimous written consent of the Members, except during the outstanding term of any Agency indebtedness.

17.3 Effect of Withdrawal or Termination. Upon termination of this Agreement or unilateral withdrawal by a Member, a Member shall remain obligated to pay its share of all liabilities and obligations of the Agency required of the Member pursuant to terms of this Agreement, and that were incurred or accrued prior to the effective date of such termination or withdrawal. A Member who withdraws from the Agency shall have no right to participate in the business and affairs of the Agency or to exercise any rights of a Member under this Agreement or the Act, but shall continue to share in distributions from the Agency on the same basis as if such Member had not withdrawn, provided that a Member that has withdrawn from the Agency shall not receive distributions in excess of the contributions made to the Agency while a Member. The right to share in distributions granted under this Section 17.3 shall be in lieu of any right the withdrawn Member may have to receive a distribution or payment of the fair value of the Member's interest in the Agency. The substitution of the Water District for the CRCD as a Member shall not constitute a withdrawal by the CRCD and the Water District shall stand in the CRCD's place and stead with regard to any distribution, reimbursement, or payment that may be payable to the CRCD under this Agreement.

17.4 Return of Contribution. Upon rescission of this Agreement and termination of the Agency, any surplus money on-hand shall be returned to the Members in proportion to their monetary contributions made. The Board of Directors shall first offer any property, works, rights and interests of the Agency for sale to the Members on terms and conditions determined by the Board of Directors. If no such sale to Members is consummated, the Board of Directors shall offer the property, works, rights, and interests of the Agency for sale to any non-Member for good and adequate consideration. The net proceeds from any sale shall be distributed among the Members in proportion to their contributions made.

ARTICLE 18
MISCELLANEOUS PROVISIONS

18.1 No Predetermination or Irretrievable Commitment of Resources. Nothing herein shall constitute a determination by the Agency or any of its Members that any action shall be undertaken, or that any unconditional or irretrievable commitment of resources shall be made, until such time as the required compliance with all applicable local, state, and federal laws.

18.2 Notices. Notices to a Member hereunder shall be in writing and shall be sufficient if delivered to the Member's executive director, or to the clerk or secretary of the Member's governing board and addressed to the Member at the address noted below or at such other address or to such other person that the Member may designate in accordance with this Article. Delivery may be accomplished by (i) personal delivery, (ii) with postage prepaid by first class mail, registered or certified mail or express courier, or (iii) email transmission.

To CRCD:	To LACSD:
Cachuma Resource Conservation District Attn: Executive Director 920 E Stowell Road Santa Maria, CA 93454 Email: ExecutiveDirector@rcdsantabarbara.org	Los Alamos Community Services District Attn: Board Secretary 82 North Saint Joseph Street P.O. Box 675 Los Alamos, CA 93440 Email: Candyce@dock.net

18.3 Amendments to Agreement. This Agreement may be amended or modified at any time only by subsequent written agreement approved and executed by all of the Members, except that in no event shall this Agreement be amended to delete or abridge the rights of a future Water District described in Section 6.2.

18.4 Capitalization. Capitalized defined terms used in this Agreement shall have the meanings given to them in Article 2 of this Agreement.

18.5 Agreement Complete. The foregoing constitutes the full and complete Agreement of the Members. This Agreement supersedes all prior agreements and understandings, whether in writing or oral, related to the subject matter of this Agreement that are not set forth in writing herein.

18.6 Severability. Should any part, term or provision of this Agreement be decided by a court of competent jurisdiction to be illegal or in conflict with any applicable federal law or any law of the State of California, or otherwise be rendered unenforceable or ineffectual, the validity of the remaining parts, terms, or provisions hereof shall not be affected thereby, provided however, that if the remaining parts, terms, or provisions do not comply with the Act, this Agreement shall terminate.

18.7 Withdrawal by Operation of Law. Should the participation of any Member to this Agreement be decided by the courts to be illegal or in excess of that Member's authority or in conflict with any law, the validity of the Agreement as to the remaining Members shall not be affected thereby.

18.8 Assignment. The rights and duties of the Members may not be assigned or delegated without the written consent of all other Members. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void. The substitution of the Water District as a new Member shall not constitute an assignment or delegation of rights in violation of this provision.

18.9 Binding on Successors. This Agreement shall inure to the benefit of, and be binding upon, the successors and assigns, in accordance with Section 18.8, of the Members.

18.10 Dispute Resolution. In the event that any dispute arises between the Members relating to this Agreement, the Members shall attempt in good faith to resolve the dispute through informal means. If the Members cannot agree upon a resolution of the dispute, the dispute may be submitted to mediation prior to commencement of any legal action, if agreed to by all Members. Time is of the essence in resolving any dispute between the Members because the business of the Agency in formulating and submitting to the State a GSP is urgent and subject to statutory deadlines. Therefore, any mediation of a dispute shall be conducted no later than thirty (30) days after a member provides notice of a request for mediation and shall consume no more than a full day unless otherwise agreed by both Members. The cost of mediation shall be paid in equal shares by the Members.

18.11 Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original and together shall constitute one and the same instrument.

18.12 Singular Includes Plural. Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

18.13 Member Authorization. The legislative bodies of the Members have each authorized execution of this Agreement, and all signatories to this Agreement warrant and represent that they have the power and authority to enter into this Agreement in the names, titles and capacities stated herein and on behalf of the Members.

18.14 Third Party Beneficiaries. Except as expressly set forth in Section 6.2 whereby landowners within the Basin are third party beneficiaries insofar as formation and substitution of a water district is concerned, this Agreement is not intended to benefit any person or entity not a party hereto.

18.15 Waivers. No waiver of any breach of any provision herein and no delay in enforcing performance of any obligation hereunder shall be deemed a waiver of any preceding or succeeding breach, or of any other provision herein, and no such waiver or delay shall impair any right, power or remedy relating to the breach. No extension of time for performance of any obligation or act shall be deemed an extension of the time for performance of any other obligation or act.

18.16 Professional Fees. In the event of any action or suit arising in connection with the enforcement or interpretation of any of the covenants or provisions of this Agreement, the prevailing party shall be entitled to recover all costs and expenses of the action or suit, including actual attorneys' fees.

18.17 Email Transmission. If executed copies of this Agreement, or if any notices or other written communications permitted or required hereunder, are provided by one party to the other(s) by email transmission, the email copies and the signatures thereon shall for all purposes be treated as originals.

18.18 Further Assurances. The parties agree to take such actions and execute such documents as may be reasonably required to carry out the intent of this Agreement.

IN WITNESS WHEREOF, the Members hereto have executed this Agreement by authorized officials thereof to be effective on the date executed by the last Member as noted on Page 1.

CACHUMA RESOURCE CONSERVATION DISTRICT

By: ______________________
Richard Russell, President

APPROVED AS TO FORM:

By: ______________________
Susan F. Petrovich, Counsel

LOS ALAMOS COMMUNITY SERVICES DISTRICT

By: ______________________
Larry A. Torres, President

APPROVED AS TO FORM:

By: ______________________
Richard G. Battles, Counsel

BYLAWS OF THE
SAN ANTONIO BASIN GROUNDWATER SUSTAINABILITY AGENCY

Adopted June 14, 2017

ARTICLE 1
NAME

The name of this joint powers authority shall be the San Antonio Basin Groundwater Sustainability Agency (hereinafter called the "Agency").

ARTICLE 2
DEFINITIONS AND CONSTRUCTION

Unless specifically defined in these Bylaws, all defined terms shall have the same meaning as that ascribed to them in the Joint Exercise of Powers Agreement by and between Cachuma Resource Conservation District and Los Alamos Community Services District creating the San Antonio Basin Groundwater Sustainability Agency, executed May 16, 2017 and as subsequently amended (hereinafter called the "JPA Agreement"). If any of the terms within these Bylaws conflict with any term of the JPA Agreement, the JPA Agreement's terms shall prevail, and these Bylaws shall be amended accordingly to conform.

ARTICLE 3
GOVERNING AUTHORITY

The JPA Agreement shall govern the Agency's day-to-day operations in accordance with applicable law.

ARTICLE 4
PRINCIPAL OFFICE

The Agency's principal office shall be established by the Board of Directors, and may thereafter be changed by a majority vote of the Board.

ARTICLE 5
DIRECTORS

The powers and composition of the Board of Directors and the filling of vacancies and removal of the members of the Board of Directors (herein called "Directors") shall be as stated in the JPA Agreement.

ARTICLE 6
OFFICERS

6.1 Duties of the Chair. The Chair shall preside at all meetings of the Board and execute contracts, correspondence, conveyances, and other written instruments as authorized by the Board.

6.2 Duties of the Vice-Chair. The Vice-Chair shall, in the absence of the Chair, assume the duties of the Chair and perform such reasonable duties as may be required by the Board or the Chair of the Board.

6.3 Duties of the Secretary. The Secretary shall be responsible for maintaining Board meeting minutes and other records that may from time to time be required by the Board's activities, and shall perform such reasonable duties as may be required by the Board or Chair of the Board. The Secretary may delegate the actual performance of the tasks necessary to fulfill these duties.

6.4 Duties of the Treasurer. The Treasurer shall keep or maintain, or cause to be kept or maintained, adequate and correct books and accounts of the properties and transactions of the Agency, and shall send or cause to be sent to the Directors such financial statements and reports as are required by law or these Bylaws to be given. The books of account shall be open to inspection by any Director at all reasonable times. The Treasurer shall deposit or shall have caused to be deposited all money and other valuables in the name and to the credit of the Agency with such depositories as may be designated by the Board, shall disburse the funds of the Agency as may be ordered by the Board, shall render to the Chair of the Board, when requested, an account of all transactions as Treasurer and of the financial condition of the Agency and shall have other powers and perform such other duties as may be prescribed by the Board or the Bylaws.

ARTICLE 7
MEETINGS

7.1 Conduct of Meetings. Except as otherwise provided in these Bylaws or in rules and regulations adopted by the Directors, all meetings of the Directors shall be conducted pursuant to Robert's Rules of Order.

7.2 Regular Meetings. The Board will establish a regular meeting date and time, which shall be not less than once each month, and shall establish a regular place for holding such meetings within the Agency's boundaries as defined in the JPA Agreement. Any committee established pursuant to the JPA Agreement shall meet as frequently as is necessary to fulfill the committee's duties.

7.3 Special Meetings. Special meetings may be called by the Board Chair at any time for a specific, announced purpose and in compliance with the Ralph M. Brown Act. At the request of any three Directors, the Board Chair shall call such a special meeting. Written notice of a special meeting shall be delivered to all Board members at least 48 hours in advance of any meeting. Attendance at a special meeting by any Director amounts to a waiver of any defect in the giving of notice to such Director, unless at the meeting the Director specifically objects to the holding of the meeting on the grounds of such defect.

7.4 Voting. Voting on all motions and resolutions of the Board of Directors shall be by voice vote, calling for ayes, noes, and abstentions, except that the vote shall be by roll call if (1) any member of the Board or the Secretary requests a roll call vote, either before or after the voice vote is taken, or (2) a roll call vote is required by law.

7.5 Public Comment

(a) The Chair shall provide an opportunity for members of the public to address the Directors on any agenda item of interest to the public, before or during the Directors' consideration of the item. The Chair may limit the time allowed for each person to speak. Public participation need not be allowed on discussions of procedural issues, such as continuances, the order in which agenda items will be considered, and the like, and public participation need not be allowed on items that are presented by Staff to the Directors for information only.

(b) The agenda for each regular meeting will include a regular time near the beginning of the agenda to receive public comment on items that are within the jurisdiction of the Directors and are not otherwise on the agenda for the meeting. The Directors are not required to respond to any issues raised during the public comment period, and may not take any action on such issues other than to refer the item to staff or schedule action for a future agenda.

7.6 Continuance and Adjournment. The Directors may continue any item to another meeting specified in the order of continuance, may adjourn any meeting without specifying a new meeting date, and may adjourn any meeting to a time and place specified in the order of adjournment. Less than a quorum may so continue an item or adjourn a meeting. If all Directors are absent from any meeting, the Executive Director may so adjourn the meeting, and shall provide notice of any new meeting date and time as required by law.

ARTICLE 8
LIABILITIES

8.1 Liability. In accordance with Government Code section 6507, the debts, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone, and not of the Cachuma Resource Conservation District and Los Alamos Community Services District (collectively, herein called "Members") or the Directors.

8.2 Indemnity. The Agency, and those persons, agencies and instrumentalities used by it to perform the functions authorized herein, whether by contract, employment or otherwise, shall be exclusively liable for any injuries, costs, claims, liabilities, damages of whatever kind arising from or related to activities of the Agency, and the Members and Directors shall have no liability for any such injuries, costs, claims, liabilities, or damages.

The Agency agrees to indemnify, defend and hold harmless (i) each Member and its governing board and the members thereof, officers, officials, representatives, agents, and employees, (ii) each Director, and (iii) each Alternate Director from and against any and all claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, damages, judgments, expenses or costs, including but not limited to attorney's fees, and/or liabilities arising out of or attributable to the Agency or this Agreement ("Claims").

Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, and each Member, each Director and each Alternate Director, and any officers, officials, agents or employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency against any such Claims.

8.3 The Members do not intend hereby to be obligated either jointly or severally for the debts, liabilities, obligations or Claims of the Agency, except as may be specifically provided for in Government Code § 895.2. Provided, however, if any Member(s) of the Agency are, under such applicable law, held liable for the acts or omissions of the Agency, such parties shall be entitled to contribution from the other Members so that after said contributions each Member shall bear an equal share of such liability.

8.4 Insurance. The Agency shall procure and at all times maintain appropriate policies of insurance providing coverage to (i) the Agency and its officers, employees, and agents, (ii) each Director, and (iii) each Alternate Director for general liability, errors and omissions, property, workers compensation, and any other coverage the Board deems appropriate. Such policies shall name the Members and their respective governing boards and the members thereof, officers, officials, representatives, agents, and employees as additional insureds.

ARTICLE 9
AMENDMENT

These Bylaws may be amended from time to time by a two-thirds affirmative vote of Directors then appointed, pursuant to the JPA Agreement.

APPENDIX B

Responses to Public Comments on the Draft GSP

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San Antonio Creek Basin GSP Comments and Responses

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
SABWD	ES-2.6				In section ES-2.6, reference is made to both "basin yield" and "sustainable yield", but in neither case is there an explanation as to how those concepts relate to the Water Budget discussion. The discussion of sustainable yield is appropriate insofar as the Sustainable Groundwater Management Act (SGMA) and its implementing regulations provide that sustainable yield is a component of the Water Budget analysis; however, ES-2.6 lacks that foundational background. We suggest that be corrected. As for basin yield, the definition in E-2.6 appears to resemble the legal definition of "safe yield", and whether that is or is not the intent, we think the reference is lacking context and is not necessary to a discussion of the water budget. If anything it risks causing confusion and we suggest that it be removed. Finally, nowhere in the GSP does there appear to be a summary paragraph or chart that summarizes the Water Budget totals. We think it would be helpful to the reader if the GSP included a summary discussion of what the GSP has determined the Basin's Water Budget to be.	See revised text and water budget summary table in Sections ES-2.6 through 2.7.
SAB BOD					Add statement to ES and elsewhere in the PMA section that diminimus users will not be affected, have to have a meter, or pay an extraction fee.	See footnote added to Section ES-5.
Steven Slack	GSP Section 3 - 3.2 Groundwater Conditions	86			DATA GAPS per 3.2: Figure 3-45 also shows the locations of active and inactive stream gages along San Antonio Creek and its tributaries. Stream gage 11135800 is active and is located along San Antonio Creek near Los Alamos. Stream gage 11136040 is inactive and is located along Harris Canyon Creek upgradient of the confluence with San Antonio Creek. Stream gage 11136100 is active and is located west of the Basin along San Antonio Creek. Due to the placement of the gages, the recorded flow data cannot be used to accurately quantify stream gains or losses. However, seasonal flow data shown in Figure 3-45 are consistent with the stream classifications in Figure 3-44. CDFW RESPONSE: CDFW hopes that additional stream gages and groundwater wells will be installed to address these data gaps and that more information can be found between groundwater and surface water interaction.	Your comments were considered during development of the Groundwater Monitoring Network and Projects and Management Actions sections of the GSP. Additional stream gage data have been identified from stream gages 11136000 (San Antonio Creek at Harris Canyon) and 11136050 (San Antonio Creek above Barka Slough). However, the period of record for these gages is 1941-1955 and 1984-1987, respectively. Thus, they have had limited value in development of the GSP. We agree that the additional proposed stream gages will substantially improve our understanding of the Barka Slough water budget. Projects including construction of additional stream gages and shallow piezometers are included in Section 6.
Steven Slack	GSP Section 3 - 3.2 Groundwater Conditions	89			It was noted on Page 89 that only federally listed species were included in the Biological Assessment. Please do not forget the California State Listed Species. Some of these include: tricolored blackbird, western spadefoot, California tiger salamander and southern vernal pool as a natural community. This is not an inclusive list by any means. More can be found on our website at: https://wildlife.ca.gov/data/BIOS California National Diversity Database (CNDDB). CNDDB inventories narrative and geospatial information on the status and locations of rare plants and animals in California. The CNDDB spatial data can be downloaded as a shapefile or accessed via the Biogeographic Information and Observation System (BIOS) Data Viewer, a system designed to enable the management, visualization, and analysis of biogeographic data. This tool may inform GDE and ISW identification and prioritization for monitoring and protection. Note, CNDDB may not cover all GDEs and ISW, and as a positive detection database, it is not a replacement for on-the-ground surveys. Geographic areas with limited information on CNDDB often signify an absence of survey work. It is therefore inappropriate to imply that rare and endangered plants and animals do not occur in an area due to lack of information in the CNDDB.	Thank you for identifying the omission of California State Listed Species from Section 3.2.6 of the GSP. As referenced in Section 3.2.6, the biological assessment completed by AECOM in 2019 identifies and discusses potential impacts that the proposed Vandenberg Golf Course Project could have on federally listed species. Included in the AECOM, 2019 report, but omitted from the subject document, is a discussion of natural communities, wetlands, and aquatic features identified during the assessment. The discussion includes federal and state listed species associated with the respective community. GSI will revise the text in Section 3.2.6 to include a discussion of state listed species. Thank you for providing the CNDDB reference information. The reference has been incorporated into Section 3.2.6.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Steven Slack	GSP Section 3 - 3.2 Groundwater Conditions	88			As trustee for the State's fish and wildlife resources, the California Department of Fish and Wildlife (CDFW) has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species. [FGC §1802 and 711.7(a).] CDFW has an interest in the sustainable management of groundwater, as many sensitive ecosystems and public trust resources depend on groundwater and interconnected surface waters. Accordingly, CDFW encourages thoughtful groundwater planning that carefully considers fish and wildlife and the habitats on which they depend. CDFW created a groundwater planning considerations document focused on impacts to groundwater dependent ecosystems (GDEs) and interconnected surface waters (ISW) which can be found here: CDFW Groundwater Planning Considerations Attachments Can Be Found at Both These Links and Provide numerous tools: https://wildlife.ca.gov/Conservation/Watersheds/Groundwater https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=170185&inlineMonitoring Systems Effective monitoring methods and systems can aid in understanding groundwater management impacts to GDEs and ISW and informing subsequent action. Groundwater planners are encouraged to design robust monitoring systems with meaningful methods for tracking GDE and ISW conditions over time that account for the following monitoring considerations: 1. An effective monitoring system to evaluate impacts to GDEs and ISW depletions will ideally provide data that is representative of groundwater dependent habitat throughout the alluvial basin and will be designed to capture geospatial and temporal variability at a scale meaningful to fish and wildlife beneficial uses and users of groundwater and ISW. GSAs should consider frequency of measurements and observation point density to ensure measurements capture seasonal and operational variability. Monitoring methods should follow accepted technical procedures established by the USGS (or equivalently robust methods) and reference DWR's best management practices. 2. An effective monitoring system to evaluate impacts to GDEs and ISW depletions will be designed to capture early signs of adverse impacts, so that adaptive management can initiate to avoid undesirable results. Early signs of adverse impacts may manifest as stressed phreatophyte vegetation, increased instream temperature, etc. 3. **Meaningful Baselines**: Where historical baseline information on GDEs and ISW is absent, prompt groundwater information collection is critical to understanding the relationship between climatic variations/water year type and groundwater demand/availability. Monitoring systems can help inform baselines that reflect hydrologic variability and that can be used to measure the impact of management actions on groundwater resources. **Interconnectivity Efficacy**: An effective monitoring system to evaluate impacts to GDEs and ISW depletions will be able to identify and help characterize groundwater-surface water interaction by using appropriate methods including but not limited to paired groundwater and streamflow monitoring; seepage measurements; nested piezometers; geo-chemical and physical property monitoring; and application of monitoring data to water budget calculations, analytical modeling, and numerical modeling. **Monitoring Characteristics**: A groundwater plan may consider tracking a range of GDE and ISW characteristics to determine groundwater management impacts over time. These characteristics include but are not limited to: geospatial and temporal habitat	We agree that effective monitoring systems and protocols like those proposed by CDFW will provide critical information concerning basin conditions and effects of climate, effects of groundwater pumping, and potential for impacts to GDEs. This comment was received prior to the development of the Monitoring Networks and Implementation Sections of this GSP. Additionally, these Sections and the remaining GSP have undergone significant revision since this submittal of this comment. Many of the concepts and online tools recommended by CDFW have been incorporated into the GSP, including Sections 5 and 7.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					coverage; changes in groundwater interconnectivity status; habitat connectivity, heterogeneity, or density; habitat health (e.g., application of biological indices, remote sensing/aerial imagery); and species/vegetation presence (e.g., biological surveys). **Scalability**: An effective monitoring system will be designed to improve information gaps over time as resources become available; groundwater plans may choose to identify prioritized monitoring locations and systems that can be implemented in phases based on resource availability.	
Steven Slack	GSP Section 3 - 3.2 Groundwater Conditions	89			3.2.5 Interconnected Surface Water Systems (ISW's) Thank you for looking into ISW's. My comment is related to your admission of data gaps where you indicate: "Definitive data delineating any connections between surface water and groundwater or a lack of interconnected surface waters is a data gap that will be addressed during implementation of this GSP" California Department of Fish and Wildlife (CDFW) Asks the Following Questions Pertaining to: INTERCONNECTED SURFACE WATERS (ISW) 1. How will groundwater plans document the timing, quantity, and location of ISW depletions attributable to groundwater extraction and determine whether these depletions will impact fish and wildlife? 2. How will GSAs determine if fish and wildlife are being adversely impacted by groundwater management impacts on ISW? 3. If adverse impacts to ISW-dependent fish and wildlife are observed, how will GSAs facilitate appropriate and timely monitoring and management response actions? CDFW 's Stance on Data Gaps: MANAGEMENT CONSIDERATIONS CDFW encourages groundwater planners to detail how management actions will consider fish and wildlife beneficial uses and users of groundwater and what management actions will be initiated on what timeline if adverse impacts to fish and wildlife beneficial uses and users of groundwater, GDEs, or ISW are observed. The following are considerations to inform responsive management. Multi-Benefit Approach Groundwater planners are encouraged to design project and management actions for multiple-benefit solutions, including habitat improvements. Evaluation of supply augmentation management actions (e.g., managed aquifer recharge) and demand reduction management actions (e.g., limitations on groundwater extraction) may include a quantification of impacts on GDEs and ISW to justify actions that serve multiple beneficial uses and users of groundwater. Planners may also consider marginal cost increases in project and management actions to optimize habitat outcomes, thereby broadening funding opportunities, such as recharge projects that contribute both to aquifers as well as instream flow. Management Considerations: "Data Gaps and Conservative Decision-Making Under Uncertain Conditions" Adaptive Management "Prioritized Resource Allocation" Multi-Benefit Approach	This comment was received prior to the development of the Monitoring Networks and Projects and Management Actions Sections of this GSP. Additionally, these sections and remaining GSP have undergone significant revision since this submittal of this comment. Many of the concepts and online tools recommended by CDFW have been incorporated into the GSP, including Section 5 and 6.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Matthew Scrudato	GSP Section 3 - 3.1 Hydrogeologic Conceptual Model	1			3.1.1.2 Reference USGS infiltration data collected for the study and how it correlates to dataset ? Not sure if that data are available for reference yet. 3.1.1.3 Why are these three tributaries explicitly referenced in this paragraph and no other intermittent tribs located throughout the basin? Figure 3-3 Harris not labeled Figure 3.5 illustrates the three members of the Paso Formation. Possibly elaborate on the distinction between these members. 3.1.3 Possibly reference (somewhere in section) CalPoly study within Canada De Las Flores (north central) finding potential of subsurface folds separating sub-basins. 3.1.3.1.2 Previous paragraph provided a general description of well yields and specific capacities for Paso. Any general info to provide for Careaga? 3.1.3.1.3 (B) Hydraulic conductivity and restorativity not addressed. 3.1.3.1.4 Artesian conditions also referenced in CalPoly report as potential result of subsurface folding. 3.1.3.1.5 There's pump test data for all wells located on 4-Deer. Wouldn't Katherman have a lot of information to share, or we limiting sources to gov't agencies? Nothing new at VAFB? Suppose I'm surprised our available data is so limited in regard to aquifer properties. Figure 3-10 Aren't there springs and seeps on 4-Deer and Schaff properties? Figure 3-24 would be nice to have well depth available on these graphs if possible 3.2.3.2 (last paragraph) Also appears to be the case for SACC nest for TDS 3.2.3.4.1 (last paragraph) Possible elaboration needed here and for each constituent? Where along creek were samples collected and at what discharge? 3.2.3.4.3 Should there be a more detailed summary for TDS and Chloride (similar to this paragraph for Nitrate) as to what natural and human activities affect the concentration? PAGE 86 (last paragraph) Want to also mention 11136500 and 11136000? Short POY.	3.1.1.2 The USGS infiltration data provided by USGS was delivered as raw data. GSI requested hydraulic properties from the USGS deduced from the infiltration data. The USGS was not prepared to release the analyzed data prior to finalization of the model. GSI did not complete an internal analysis of the raw USGS infiltration data, but will review the USGS model and revise the GSP during plan updates. 3.1.1.3 The listed streams were those named in the USGS NHD. GSI will attempt to modify the text to include an exhaustive list of tributaries to San Antonio Creek. Figure 3-3 GSI will update Figure 3-3 by labeling additional tributaries to San Antonio Creek; at a minimum Harris Canyon Creek. Figure 3.5 Figure 3.5 was modified from a figure provided by the USGS. The USGS divided the Paso Robles formation into three members during development of the preliminary geohydrologic framework model and stated these are not official geologic units. GSI requested further explanation regarding the differentiation of the three units and provided an explanation in Section 3.1.2.2 when referring to Figure 3.5. 3.1.3 The CalPoly study, Carlson, 2019, supports the syncline structure (Los Alamos Syncline) of the Basin and indicates confining layers within the Paso Robles formation are the potential cause of local artesian conditions within Canada De Las Flores. A description of local artesian conditions observed in wells completed in the Paso Robles formation with reference to Carlson, 2019 is included in Section 3.1.3. 3.1.3.1.2 GSI did not identify hydraulic properties for the Careaga Sand formation such as well yields and specific capacities as mentioned in Section 3.1.3.1 for the Paso Robles formation. However, a transmissivity from a pump test completed on a VAFB well located near Barka Slough (Hutchinson, 1980) was identified and is mentioned in Section 3.1.3.1.5. GSI requested pump test data from VAFB, however this information has not yet been made available. Prior to release of the Administrative Draft, pump test data was made available for select wells in the VAFB well field located near Barka Slough and screened in the Careaga Sand. The wells have been added to Table 3-1 and associated text. Pump test data from "4-Deer" wells have been added as well. 3.1.3.1.3 (B) Discussion of principal aquifer hydraulic conductivity and storage coefficients are discussed in Section 3.1.3.1. 3.1.3.1.4 The CalPoly study, Carlson, 2019, supports the syncline structure (Los Alamos Syncline) of the Basin and indicates confining layers within the Paso Robles formation are the potential cause of local artesian conditions within Canada De Las Flores. A description of local artesian conditions observed in wells completed in the Paso Robles formation with reference to Carlson, 2019 is included in Section 3.1.3.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
						3.1.3.1.5 Prior to release of the Administrative Draft, pump test data was made available for select wells in the VAFB well field located near Barka Slough and screened in the Careaga Sand. The wells have been added to Table 3-1 and associated text. Pump test data from "4-Deer" wells have been added as well. Figure 3-10 The locations of springs and seeps identified in the Basin are from the USGS NHD. Additional springs and seeps were added to Figure 3-9 based on landowner observations. Figure 3-24 The hydrographs were revised. 3.2.3.2 (last paragraph) The text in the last paragraph of Section 3.2.3.2 was revised to include the SACC nested wells. 3.2.3.4.1 (last paragraph) The text regarding constituent concentrations in surface water samples for each constituent was modified to include a description of the location of where the sample(s) were collected. 3.2.3.4.3 The text in Section 3.2.3.4 for TDS and Chloride was modified to include a description of what human activities potentially affect the concentration of each constituent. PAGE 86 (last paragraph) The text in Section 3.2.5 was modified to include a discussion of historical stream gages 1136000 and 11136050.
Chris Wrather	GSP Section 3.1 - 3.2 Hydrogeologic Conceptual Model				Comments were received as an electronic letter, dated October 31, 2020.	These comments were received regarding an earlier draft of Section 3. Section 3 and the remaining GSP have undergone significant revision since this submittal of these comments. Response to comments is included as an attachment to this document.
Bryan Bondy	GSP Section 3.1 - 3.2 Hydrogeologic Conceptual Model				Comments were received as an electronic memorandum, dated March 19, 2021.	These comments were received regarding an earlier draft of Section 3. Section 3 and the remaining GSP have undergone significant revision since this submittal of these comments. Response to comments is included as an attachment to this document.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
CDFW	3.2.6				Comment #1 – GDEs based on the 30-foot Depth Groundwater Criterion in Section 3.2.6 of the Draft GSP Issue: A 30-foot depth to groundwater criterion was applied to identify potential GDEs (Section 3.2.6.1). According to Figure 3-55 of the Draft GSP, the groundwater depth is greater than 30 feet throughout the Basin, except in certain areas within Barker Slough. San Antonio Creek within the entire Basin consists of a riparian corridor, despite seasonal surface flows, and despite the Creek being referenced as an area with a depth to groundwater greater than 30 feet. After applying the 30-foot criterion, CDFW is concerned that GDEs along San Antonio Creek and throughout the Basin were eliminated from being considered as potential GDEs. Recommendation #1(a): CDFW recommends SABGSA clarify whether GDEs located where groundwater depth is greater than 30 feet below the surface, were eliminated as GDEs. If so, CDFW recommends the SABGSA identify these areas, and retain these areas as potential GDEs in the final GSP until future monitoring data can eliminate them as GDEs. Recommendation #1(b): CDFW recommends SABGSA utilize The Nature Conservancy's (TNC) GDE Pulse web-map to view vegetation that have been identified as potential GDEs, with data that identifies long term temporal trends of vegetation metrics (TNC 2021). Recommendation #1(c): CDFW recommends SABGSA utilize U.S. Fish and Wildlife Service's (USFWS)'s National Wetlands Inventory (2021) to identify potential GDEs such as riverine habitat, freshwater forested/shrub wetland, and freshwater emergent wetland.	Thank you for the additional data sources. Published TNC guidance literature was used for identifying GDEs within the Basin and is described in Section 3.2.6. GSI also used publicly available online data sources such as the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset which references data from the national wetland inventory. Potential GDEs were first identified using the NCCAG data set. Water level contour maps were prepared using spring 2015 groundwater level data for the Paso Robles Formation (unit underlying San Antonio Creek). Groundwater elevations were compared with creek bed elevations to identify areas where high groundwater levels were at or above 30 feet below ground surface. Figure 3-55 shows these locations. The projects and management actions section of the GSP (Section 6) includes a plan to conduct additional evaluation of GDEs in the basin as recommended by CDFW. The hydrogeological conceptual model and groundwater conditions will be updated as new data become available at a minimum of once every 5-years during the GSP interim review periods.
CDFW					Comment #2 – Unarmored Threespine Stickleback (UTS) Habitat Issue: The maps and figures in the Draft GSP do not show open water habitat that support special-status species such as UTS, a federal Endangered Species Act (ESA) listed and California Endangered Species Act (CESA) listed species, that is also listed as a Fully Protected Species in California. Accordingly, it is unclear if open water habitat was mapped. According to the California Natural Diversity Database (CNDDB; CDFW 2021), San Antonio Creek has known occurrences of UTS within Barka Slough and upstream in Los Alamos. San Antonio Creek through Barka Slough is also considered a Southern California Threespine Stickleback Stream where there are small stands of cattails, overhanging willows in riparian areas that support native fish populations of UTS (Gasterosteus aculeatus williamsoni), prickly sculpin (Cottus asper), ESA-listed Tidewater goby (Eucyclogobius newberryi), and arroyo chub (Gila orcuttii), a California Species of Special Concern (SSC) (CNDDB; CDFW 2021). Recommendation #2: CDFW recommends SABGSA map and document open water habitat in addition to GDEs in the final GSP.	Documented plant and animal species were identified using published literature associated with known GDEs within the Basin (see Section 3.2.6). Publications will continue to be reviewed as they become available or identified and the GSP will be revised appropriately. Thank you for the citations. The CNDDR and USFWS 2021 references will be considered as GDEs are further evaluated during GSP implementation (refer to Sections 3.2.6 and 7). Per SGMA, the GSP must only account for areas of interconnected surface water and associated GDEs. No areas of interconnected surface water were identified along San Antonio Creek (with the exception of Barka Slough) that met both elements of the definition supplied in SGMA in that: "the surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer, and the overlying surface water is not completely depleted." UTS are identified as a species of concern in Section 3.2.6. Open water habitat was not mapped because the only perennial open water is located within Barka Slough, a mapped GDE area.
CDFW					Comment #3 – Minimum Thresholds for Surface Water Depletion Issue #3.1: CDFW has concerns with the Draft GSP's proposed interim minimum threshold, "0.15 cfs of surface water flow measured at the Casmalia stream gage west of the Slough. This threshold was selected based on the analysis of historical base flow at the Casmalia stream gage presented on Figure 4-2" (Pg. 4-54). The SABGSA has not provided enough information to confirm that low flow measurements below 0.50 cfs can be accurately measured at the Casmalia stream gage.	Review of historical measurements recorded at the Casmalia stream gage and rating curve, generated by the USGS for the Casmalia stream gage (available using the USGS' WaterWatch Toolkit Rating Curve Builder at https://waterwatch.usgs.gov/?m=mkrc), indicate a measurement precision of less than 0.15 cfs. A qualitative evaluation of accuracy of discharge measurements includes consideration of a number of factors, such as: measuring section, velocity conditions, equipment, spacing of observation verticals, rapidly changing stage, and wind. Discharge measurements are assigned ratings from excellent (2 percent) to poor (greater than 8 percent) based on the above

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					Additionally, 0.15 cfs is considerably low for native fish species, including for UTS. Based on the information provided in the Draft GSP, CDFW is not able to determine if the minimum threshold is sufficient to ensure avoidance of significant and unreasonable adverse impacts (undesirable results) to UTS. Hydrologic connectivity should be maintained to provide suitable habitat for UTS. Recommendation #3.1(a): CDFW recommends SABGSA establish the minimum thresholds at 0.50 cfs at the Casmalia gage instead of 0.15 cfs, to consider impacts to UTS, which are particularly sensitive to additional water reductions due to groundwater pumping, and other stressors which can increase with lower surface water levels, such as water quality, temperature, and turbidity. Recommendation #3.1(b): CDFW recommends SABGSA establish a measurable surface water flow trigger of 0.75 cfs to begin the implementation of management actions and priority projects to avoid significant and unreasonable impacts to UTS. A reasonable timetable is also needed to ensure projects are ready to be implemented to avoid surface water flows reaching CDFW's proposed minimum threshold of 0.5 cfs. Issue #3.2: CDFW expressed concerned in Comment #1 of GDEs along San Antonio Creek and throughout the Basin that were eliminated as potential GDEs. The USGS currently measures streamflow at three locations along San Antonio Creek; one upstream of the town of Los Alamos (Los Alamos gage # 11135800), one where San Antonio Creek leaves the basin (Casmalia gage #11136100), and one on a tributary to San Antonio Creek (Harris Canyon Creek gage #11136040) (USGS 2021). The Draft GSP only establishes minimum thresholds at the Casmalia gage. Recommendation #3.2(a): CDFW appreciates SABGSA's efforts to utilize the Casmalia gage, however, CDFW recommends SABGSA incorporate the Harris Canyon and Los Alamos gages into SABGSA's monitoring efforts to supplement SABGSA's ability to assess impacts to interconnected surface waters and GDES within the Basin. Recommendation #3.2(b): CDFW recommends minimum thresholds also be established for gage #1135900 and #11136040. This will ensure avoidance of impacts to any additional GDEs within the Basin, identified as a result of Recommendation #1(a).	items (USGS, 2010). The baseflow analysis reviewed data from 2015-2021. Per SGMA the GSA is not responsible for restoring conditions prior to enactment of SGMA (January 2015). No significant and unreasonable results have been observed in the Basin pertaining to all sustainable management criteria (SMCs) to date. Basin stakeholders have acknowledged the need to stabilize groundwater levels and change of groundwater in storage and have developed projects and management actions (discussed in Section 6) as such. Due to the lack of observed significant and unreasonable results and evaluation of multiple MT scenarios, MTs have been set below current conditions for most of the SMCs. A measured flow of 0.5 cfs at the Casmalia stream gage was calculated as the geometric mean since 2015 (enactment of SGMA). A measured flow of 0.15 cfs at the Casmalia stream gage is representative of potential baseflow conditions since 2015. Flow leaving the Slough indicates that there is still water in the slough to support GDEs. The MT of 0.15 cfs is not intended to be reached, but rather avoided. Nonetheless, per SGMA, it is not the responsibility of the GSA to restore conditions, including measured baseflow, prior to what was observed before January 2015. Projects and management actions (P&MAs) designed to move the Basin toward sustainable groundwater management are discussed in Section 6 and are planned to be initiated upon implementation of the GSP. GSI and the GSA acknowledge additional analysis of the Basin's interconnected surface water and groundwater dependent ecosystems (GDEs) (e.g., Barka Slough groundwater budget) is needed. This is evidenced by stating the current MT of 0.15 cfs as interim and outlining P&MAs to better understand the hydrology in areas of interconnected surface water/GDEs. The GSP will be revised, at a minimum of once every 5 years during the interim GSP periods, appropriately based on findings from these studies. Only two active USGS stream gages remain in the Basin: the Casmalia stream gage and the Los Alamos stream gage. The Harris Canyon stream gage was decommissioned. The GSA has included the installation of additional stream gages in the P&MAs section of the GSP. The SMC is related to interconnected surface water. No interconnected surface water (as defined by SGMA, "the surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer, and the overlying surface water is not completely depleted.") was identified in the area of the Los Alamos stream gage and the flow in this area is categorized as intermittent. If further evaluation of interconnected surface water and existing GDEs indicates SMC should be assigned to the Los Alamos stream gage, the GSP will be revised accordingly.in the area of the Los Alamos stream gage and the flow in this area is categorized as intermittent. If further evaluation of interconnected surface water and existing GDEs indicates SMC should be assigned to the Los Alamos stream gage, the GSP will be revised accordingly. Reference: USGS. 2010. Discharge Measurements at Gaging Stations. Chapter 8 of Book 3, Section A. Techniques and Methods 3—A8. By D. Phil Turnipseed and Vernon B. Sauer. U.S. Department of the Interior, U.S. Geological Survey. https://pubs.usgs.gov/tm/tm3-a8/tm3a8.pdf.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
CDFW	3.2.6.2				Comment #4 – Section 3.2.6.2 Terrestrial and Aquatic Special-Status Species Occurrence Issue #4.1: CDFW has concerns with the limited number of terrestrial and aquatic special-status species that the SABGSA lists in the Draft GSP. The San Antonio Creek Valley provides habitat that supports several sensitive species (some listed as endangered or threatened) throughout their life cycles, including the ESA and southwestern willow flycatcher (Empidonax traillii extimus), least Bell's vireo (Vireo bellii pusillus), tricolored blackbird (Agelaius tricolor), and arroyo chub, an SSC (CNDDB 2021; USFWS 2021). Habitats that support these species also consist of phreatophytes and other vegetation communities that are dependent on shallow aquifers that support surface water in each of these systems. Phreatophytic vegetation is a critical contributor to nesting and foraging habitat and forage for a wide range of species and can be affected by sensitive to depth to groundwater threshold impacts (Naumburg et.al. 2005) and (Froend et. al. 2010). This sensitivity to groundwater level thresholds means that localized pumping and recharge actions altering groundwater levels can impact the health and extent of phreatophyte vegetation health. Both decreasing (drying out) or increasing (drowning) groundwater elevation has the potential to stress phreatophytes depending on the plant species and the groundwater elevation and duration (e.g., short term wetness/dryness versus prolonged wetness/dryness). Recommendation #4.1: CDFW recommends SABGSA add the following species to the final GSP: the southwestern willow flycatcher, least Bell's vireo, tricolored blackbird, and arroyo chub. Issue #4.2: Based on the information provided in the Draft GSP, CDFW is not able to determine if southern California steelhead (Oncorhynchus mykiss; steelhead) is present within the Basin. Recommendation #4.2: CDFW recommends SABGSA identify steelhead as a species that has the potential to occur within the Basin, and has the potential to be impacted by groundwater pumping.	Documented plant and animal species were identified using published literature associated with known GDEs within the Basin (see Section 3.2.6). Publications will continue to be reviewed as they become available or identified and the GSP will be revised appropriately. Thank you for the citations. These references will be further considered when additional GDE characterization is conducted during GSP implementation. See revisions to Section 3.2.6.2.
CDFW	2.2.3				Comment #5: Section 2.2.3 Land Use and General Plans Summary; Cannabis Cultivation (Cannabis Priority Watershed) Issue: CDFW is concerned that cannabis groundwater use is not being fully accounted for when evaluating this SGMA area. Ignoring the growth potential of this industry could result in a lack of groundwater management accountability. There are approximately eight cannabis projects within the San Antonio Creek Watershed. Six of those are within 1000 feet of San Antonio Creek and all are likely using groundwater. Page 2-12 of the Draft GSP states that "Land uses in the Basin are primarily agricultural. Of note, in 2019 the Santa Barbara County Board of Supervisors placed a limit on outdoor cannabis cultivation in the unincorporated areas of the County outside the Carpinteria Agricultural Overlay District County to no more than 1,575 acres (Santa Barbara County Code § 50-7) and requires a special land use permit". The Basin has sensitive, natural communities consisting of Coast Live Oak, Valley Oak, Riparian Mixed Hardwood and Willow habitats along Santa Antonio Creek and its tributaries. According to CNDDB, these habitats support several sensitive species (some listed as endangered or threatened) throughout their life cycles, including California red-legged frog (Rana draytonii), tricolored blackbird, La Graciosa thistle (Cirsium scariosum var. loncholepis), Gambel's water cress (Nasturtium gambelii)),	GSI agrees and acknowledges the growth, and potential growth, of cannabis projects within the Basin. GSI has seen evidence of this during quarterly groundwater monitoring events, stakeholder feedback, and permit applications publicly accessible via the Santa Barbara County (County) website. Cannabis is one of several crop types considered within the water budget in the context of this GSP. The water sources for this crop are treated in a similar fashion as the water sources for the other crop types included in the GSP. However, cannabis is different than the other crops included in the group of agricultural crops in that it is subject to permitting by the Planning and Development department of the County of Santa Barbara and therefore the locations of these crops will be well understood into the future. GSI reviewed land use surveys provided by the USGS from 1959-2016 as well as land use data available through the County website (pesticide application permit data) for 2020. GSI compared the agricultural acreages with acreage within the Basin categorized as "Prime Farmland" per the USDA online Web Soil Survey tool. According to the 2020 land survey data the Basin had already surpassed the number of acres available in the Basin categorized as "Prime Farmland." In conjunction with feedback from Basin Stakeholders and a collective understanding the Basin has been experiencing a chronic decline in water levels and groundwater in storage (i.e., projects and management

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					and unarmored threespine stickleback, and California tiger salamander (CTS) (Ambystoma californiense). There are approximately 52 known/potential CTS ponds in the Basin (CNDDB; CDFW 2021). Groundwater and interconnected surface water depletion is a major concern for fish and wildlife beneficial users in the Basin. Designating this area as a High Priority Cannabis Watershed requires groundwater to be monitored and sustainably managed for the benefit of all beneficial users, including groundwater dependent vegetated communities and interconnected surface waters that are necessary to support riparian and aquatic habitat, and the sensitive species therein such as steelhead. Decreased stream flow may contribute to direct mortality if fish eggs are exposed, covered with silt, or left without sufficient oxygenated water. Water degraded in temperature or chemical composition can displace or limit fish populations. Recommendation #5: CDFW recommends the SABGSA monitor the Basin as a Cannabis High Priority Watershed. This High priority captures the documented impacts within the groundwater basin and the shifting groundwater consumption rates, as influenced by legalization of cannabis [Water Code §§ 10933. (b)(7,8)]. Based on the number of Departmental applications for legal cultivation, there is documented significant demand and potential adverse impacts to beneficial users of groundwater. The cannabis market growth is expected to increase almost ten times during an eight-year span (Fortune Business Insights 2021). North America is expected to lead the world cannabis market. Santa Barbara County recently approved a zoning permit for 87 acres of outdoor cannabis cultivation.	actions will plan to be implemented to begin to sustainably manage and accurately measure groundwater consumption), GSI determined it appropriate to use the 2020 agricultural acreage for purposes of the projected groundwater budget. The projected groundwater budget takes trends into account such as changes in crop types and improvement of irrigation efficiency. Although cannabis has only recently begun to grow in respect to planted acreage within the Basin, acreage of planted vineyards has generally increased throughout the period of record. Battany, 2019, estimated a water duty factor of 1.5 AF/acre/yr for CBD/Hemp. The water duty estimate for vineyards is 1.6 AF/acre/year; based on this reference the projected water budget appropriately accounts for the potential growth (or replacement of existing crops) of cannabis acreage within the Basin. It is important to note that the accuracy of the hydrogeological conceptual model, water budget, and efficacy of projects and management actions will be reviewed and revised as needed at a minimum of once every 5-years during the GSP interim review periods. Although some existing cannabis projects are located near San Antonio Creek, it is likely any new irrigation groundwater well constructed in support of the project will be completed deep within the Paso Robles Formation or Careaga Sand. This is supported by existing well completion records. According to the hydrogeological conceptual model developed by the USGS (included in Section 3 and further described in Appendix E) and measured groundwater levels, pumping from these deep wells have less, if any, impact on potential plant communities and wildlife species within San Antonio Creek and its tributaries compared to climatic conditions and adjacent shallow domestic wells. It is also possible that increased groundwater pumping to support agricultural irrigation has resulted in increased agricultural irrigation runoff into San Antonio Creek and its tributaries (as shown in the water budget). GSI has attempted to identify documented plant and animal species using published literature associated with known GDEs within the Basin (see Section 3.2.6). GSI will continue to review publications as they become available or identified and revise the GSP appropriately. Thank you for the citations. GSI was unaware or did not have access to the CNDDR and USFWS 2021 references. The GSA plans to monitor interconnected surface water and groundwater dependent ecosystems using the proposed interconnected surface water monitoring network along with investing to better understand areas such as San Antonio Creek and its tributaries and Barka Slough through projects and management actions. The GSA plans to continue monitoring Basin water quality through the groundwater quality monitoring network described in Section 5. The classification of the Basin or larger watershed as a Cannabis High Priority Watershed is currently understood as the responsibility of the CA Water Board and the CADFW and not the GSA per SGMA. If the Basin is classified as a Cannabis High Priority Watershed the GSP will be updated to reflect the designation and associated monitoring and reporting protocols.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
CDFW	2.2.3				Comment #6: Section 2.2.3 Land Use and General Plans Summary; Cannabis Cultivation Issue #6.1: Without the designation of the Basin as a Cannabis High Priority Watershed, evaluation of cannabis crop water usage may be overlooked throughout the Basin. Cannabis cultivation is a water intensive crop that can have a significant impact to environmental beneficial users of groundwater Cannabis groundwater wells provide water for the irrigation of water-intensive cannabis cultivation (assuming six gallons of water per day per plant) (Bauer S. 2015). CDFW is concerned that without management of the two principal aquifers under SGMA by the SABGSA, significant and unreasonable surface water depletions may occur, compromising groundwater dependent ecosystems within and along the streams. Recommendation #6.1(a): CDFW recommends a more careful review of the existing information on cannabis cultivation within the principal aquifers and recommends the information be considered when evaluating groundwater management. The majority of cannabis cultivation rely on groundwater for cannabis crops irrigation, and the likely interconnected nature between Basin groundwater levels and the Slough suggests that such uses (individually or cumulatively) should be considered when evaluating cannabis impacts in the underlying Careaga Sand water bearing formation. Recommendation #6.1(b): CDFW recommends the Basin be classified as a Cannabis High Priority Watershed. Issue #6.2: The majority reliance on groundwater for cannabis crops irrigation, and the possible areas of interconnected surface waters in San Antonio Creek and its tributaries and seeps suggest that such uses (individually or cumulatively) should be considered when evaluating cannabis impacts in the Paso Robles Formation and the Careaga Sand. Recommendation #6.2: CDFW recommends a more careful review of the existing information on cannabis cultivation within the Basin and recommends the information be considered when evaluating groundwater management.	The accuracy of the hydrogeological conceptual model, uncertainties associated with the water budget, and efficacy of projects and management actions will be reviewed and revised as needed at a minimum of once every 5-years during the GSP interim review periods. The Paso Robles Formation and the Careaga Sand have been identified as principal aquifers and will be managed by the GSA under SGMA as such. The classification of the Basin or larger watershed as a Cannabis High Priority Watershed is currently understood as the responsibility of the CA Water Board and the CADFW and not the GSA per SGMA. If the Basin is classified as a Cannabis High Priority Watershed the GSP will be updated to reflect the designation and associated monitoring and reporting protocols.
CDFW	General				Comment #7: SABGSA may need to revise the GSP before it is finalized and adopted by SABGSA. Recommendation #7: CDFW recommends SABGSA provide a red-lined version of the final GSP to understand the changes made between the Draft GSP and final GSP. Alternatively, CDFW recommends SABGSA provide a summary of changes made and comments addressed by SABGSA in preparation of a final GSP.	The plan for completion and submission of the GSP is to provide this complete list of all of the public comments received and to both respond to and address these comments. The form of these responses and addressed comments will be in this table and the finalized GSP in coordination with the stakeholders and GSA staff and board. These will provide the summary of changes that were made between the public draft and finalized GSPs.
Tannis Thorlakson				3-17	It would be helpful if either in a new column or in the Notes you could put the average crop water use factors used to make these calculations, so we can look back as we have more data on water use by crops to update these numbers.	Crop water use factors were added to the *Notes* section of Table 3-22 (formerly 3-17).
Tannis Thorlakson		31, last parag raph			Ag water use is described as increasing by 27% during the current water budget compared to the historical period. Can a sentence be added to explain what the main driver of that increase was? (e.g. increase in acres, change in crop type, reduced precipitation, etc.).	Language added to text explaining increase is due to an increase in irrigated acres.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Tannis Thorlakson		37-38			Projected hydrology. Very helpful section and description. According to this section, we should expect about the same total amount of precipitation with climate change in the Basin. Do the climate models project intensity of future precipitation events? If precipitation increases in intensity, we would expect more surface water runoff and less percolation. A brief description of how intensity of rainfall was (or was not) incorporated into the projections would be helpful.	Language was added to the text explaining the DWR-provided climate-change data does not include descriptions regarding precipitation intensity.
Tannis Thorlakson		40-41			Can you include the projected agriculture water use in AF/ac (not just totals) for 2042 and 2072? I believe this will be helpful for people to interpret the future ag water demands provided in the last sentence of paragraph 3 on page 41. It might be helpful to include the population growth you expect when describing projected M&I demands.	Projected agricultural water use of the future project water budgets 2042 and 2072 were added to the text. Assumed population growth for projected demand is included in Table 3-32 (formerly 3-27) *Notes*.
Jim Stollberg					The assumption that groundwater pumping for agriculture will increase may be in error. It is very possible that ag pumping will not increase over time and potentially will decrease with increased efficiencies in farming techniques. I recommend the increase pumping assumption or calculation should be fleshed out with stakeholders.	Projected agricultural pumping is based on historical trends in irrigated acreage by crop-type, historical land-use survey data from the USGS and Santa Barbara County, crop water-use factors from adjacent basins and reviewed/revised by Basin stakeholders, and DWR provided climate change factors for precipitation and ET. Future updates to the water budget will be made as actual pumping and irrigated crop area data are obtained.
Bryan Bondy	GSP Section 3.3 Water Budget				Comments were received as an electronic memorandum, dated March 19, 2021.	These comments were received regarding an earlier draft of Section 3. Section 3 and the remaining GSP have undergone significant revision since this submittal of these comments. Response to comments is included as an attachment to this document.
SAB BOD					Include discussion of monitoring several rainfall gauges in addition to the Fire station to get a handle on variability. SB County Flood Control has 5 or 6 gauges in the basin.	See footnote following Table 3-13.
SAB BOD					The District's attorney has some comments about the water budget – those will be sent to us.	No comments were received from the District's attorney.
Tannis Thorlakson		4-12			You still don't define what 'average' is when setting the undesirable result. This should be defined in a foot note for clarity. The average should also be based on a rolling-average. If it doesn't, it won't incorporate incorporate potential changes in 'average' precipitation due to climate change, and thus has the potential for MT to never be triggered as we never return to an 'above average' rainfall period in the next 20 years.	A 20-year rolling average was included in the revised text.
Tannis Thorlakson	Section 4: Sustainable Management Criteria	12			At the top of page 12 in defining the significant and unreasonable conditions, we refer to MT being triggered "after average or above-average precipitation periods." How is average or above-average precipitation periods defined? Will what is considered 'average' be adjusted moving forward (e.g. using some form of rolling average, or accounting for wetting or drying trends in the region)? I think it would be helpful to have more clarity on how these terms are defined if they are helping to evaluate when a MT is being triggered.	A 20-year rolling average was included in the revised text.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Matthew Scrudato (email)	4.5.2				I understand we're doing this in a lot of basins, but an arbitrary 10-foot drop seems so - well - arbitrary. What is this based on? Possibly more detail about the historical low. When it occurred, drought conditions, time frame. Included in this email is some general vegetation information from VAFB. A 2010 study of base wetlands and riparian habitat. It names a few of the plants located in the slough. Most with root depth much more shallow than 15 feet. Shouldn't we make this MT the maximum barka elevation and not the average? By saying we're using the average we're saying that all barka land ABOVE the average will experience water levels even greater than the 15 feet. Essentially, we're ok with that % of property shifting from the native riparian to something different as a result of water level declines. I understand we don't have much room for play and not much more time until we hit the 15 feet. Just putting my thoughts out there.	The proposed MTs for Groundwater Levels mentioned in this comment were changed based on stakeholder feedback. Additional plant species were added to Table 3-9 based on the source you provided. The MT for interconnected surface water mentioned in this comment was revised based on basin stakeholder feedback. The efficacy of the MT with respect to avoiding impacts to Barka Slough will be further evaluated as more information is obtained about the Barka Slough water budget after stream gages are installed.
Matthew Scrudato	4.5.2.3				Data not yet published, but there does appear to be contamination as indicated in the COGG study. There's mention of rooting depth throughout the report. Which plants specifically are we referring to when setting thresholds based on rooting depth? I'm no biologist, but it's hard to imagine all wetland plants have such a deep rooting depth. Maybe I'm visualizing this wrong but shouldn't the min threshold be set at 15 feet below the highest elevation of the slough? What's the range in elevation and what % of Barka is about this average elevation? Just appears we're trying to maintain vegetation at average elevations and below, everything above average elevation is prone to levels dropping below rooting depth.	A discussion of the COGG study is included in Section 3. Table 3-9 has been added to reference maximum rooting depths of common riparian plants. The MT for depletion of interconnected surface water was changed based on stakeholder feedback. The efficacy of the MT with respect to avoiding impacts to Barka Slough will be further evaluated as more information is obtained about the Barka Slough water budget after stream gages are installed.
Matthew Scrudato	4.6.2.1				GDEs………How are we handling springs? There's no mention of springs in the report. Known springs on Hunter and Synize (sp?) property in center of basin. Possibly more. RE….no significant or unreasonable effects have been observed……………I keep reading this statement and suppose I don't understand. How were effects monitored during the drought to determine if there was or wasn't an effect on vegetation? Was baseflow reduced in channel? Suppose I'm saying that there doesn't really appear to be any data that I'm aware of to substantiate this statement.	A discussion of springs is now included in Section 3. There is no known documentation regarding condition of GDE vegetation during the drought. Basin stakeholders defined significant and unreasonable and they reported no significant and unreasonable results had occurred. GSI spoke with CDFW personnel regarding any known changes in the condition of the Slough (and inland wetlands in CA), reviewed available reports (some provided by SB County) regarding occurrence of plant populations in the Slough or west of the Slough (AECOM, 2019), and GSI completed an EVI analysis of the Slough area and a discussion is included in Section 3.2.6. Baseflow at the Casmalia stream gage is discussed in Section 4.10.
Matthew Scrudato	4.8				Can we present these wq data in a table? or reference where these data are located?	A description of data sources used to compile the summarized water quality data is included in Section 3.2.3.
Matthew Scrudato	4.8.2.1				No mention of N, Calcium or magnesium as an indication of agricultural return flow and fertilizer use. an important parameter to add for this basin.notice in chart but no discussion.highest concentrations of TDS near Orcutt Oil Field in Careaga should here be mention of COGG study and initial water quality results?	Additional discussion regarding nitrogen, calcium, and magnesium in relation to agricultural runoff will be considered during of the text. A discussion of the COGG study is included in Section 3.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Matthew Scrudato	4.8.4				There's mention of no significant or unreasonable results......... What about the constituents that currently don't meet MCL (molybdenum, arsenic, chromium, etc.)? When does it become significant and unreasonable if not now?	No minimum thresholds have been established for contaminants because state regulatory agencies, including the RWQCB and the Department of Toxic Substances Control, have the responsibility and authority to regulate and direct actions that address contamination. The WQOs presented in Table 4-3 are the minimum thresholds for TDS, chloride, sulfate, boron, sodium, and nitrate as measured by SWRCB ILRP and DDW programs in 20 percent of wells monitored. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the minimum threshold concentration is 110 percent of the ambient water quality in 20 percent of the wells. This is the basis for establishing an undesirable result for water quality.
Matthew Scrudato	4.9.1				Subsidence...has it been a steady decrease during this 20 year period, or or are we seeing fluctuation? Any increase on average or above average precip years? Would be nice to see a 20 year graph of these data (possibly elsewhere in report?).InSAR data provided by DWR shows that meaningful land subsidence did not occur during the period between June 2015 and June 2019 in the Basin. May want to elaborate on this sentence help reader understand conditions (drought, excessive pumping, etc.).Should potential subsidence be observed, the GSA will first assess..........there already appears to be subsidence. Are you referring to increased subsidence? At what point is this considered an issue? Anything greater than 0.49 inches/year?	Analysis of land subsidence was limited by available period of record datasets. GEI completed a preliminary land subsidence evaluation and it is included in Appendix D. The MT for land subsidence is included in Section 4.9.2. Expanded discussion of the conditions during the InSAR dataset period of record were considered during revision of the text.
Matthew Scrudato	4.10.1				Thinking back to gage and visually monitoring flow. How about SERS or even a stationary camera to monitor flow. Won't know how much Q, but will know days of flow. However, no impact to GDEs have been observed...........I don't understand this statement. who is observing what to make this statement factual?	This comment was received regarding an earlier draft of Section 4. Section 4 and the remaining GSP have undergone significant revision since this submittal of this comment. The interconnected surface water monitoring network was revised based on stakeholder feedback. Two additional stream gages are proposed up and downstream of Barka Slough (see Section 6). Visual observation is no longer being considered for the interconnected surface water monitoring network. Surface water flow measurement at the Casmalia stream gage will be the sole interim measurement for sustainable management criteria regarding the interconnected surface water sustainability indicator.
Matthew Scrudato	4.10.2				The Barka Slough area is the only location in the Basin where groundwater is interconnected with surface water..........What about the springs?	An expanded discussion of GDEs and springs is included in Sections 3.2.5 and 3.2.6.
Matthew Scrudato			4-1		Can you plot the casmalia gage on this map as a reference?	The location of the Casmalia stream gage is included on Figures 3-54 and 4-4.
Matthew Scrudato			4-2		Legend should reference the average elevation line, the MO and the MT	This figure has been revised based on stakeholder feedback.
Matthew Scrudato	4.10.2.2				Separate report, by water level and qw data indicate minor connection with SYR basin at far east area.	A discussion of the potential connection between the Basin and the EMA is included in Section 3.1.3.2.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Matthew Scrudato	Section 4: Sustainable Management Criteria	10			Thinking about the Casmalia stream gage and wondering if we can use baseflow as a threshold. Baseflow analysis shows continued reduction.RE-Impacts to the slough and vegetation. The 1980 USGS OFR 80-750 mentions no impact to vegetation from 1958-77. There's an aerial photo specifically to view/categorize Barka vegetative conditions on 7/1/78. VAFB was supposed to continue with yearly aerial photos to monitor veg change (most likely never happened). Anyway, this photo could be a good baseline and future photos could/should be scheduled for comparisons (obviously I'm not considering cost here, but VAFB may be able to commit to this?).	The interconnected surface water monitoring network and SMCs were modified based on feedback from Basin stakeholders. In addition, EVI satellite data has been included in the monitoring program to detect changes in GDE vigor within Barka Slough.
Tiffany Abeloe	Section 4: Sustainable Management Criteria	18			Using only 20% of the monitored wells to determine thresholds for undesirable results seems like a pretty small percentage of the total wells monitored. Â This would only be approximately 7 wells determining mitigation measures for the entire Basin. Could that percentage be higher? How was that percentage decided upon? Thank you.	The percentage was changed to 50% based on basin stakeholder input.
SAB BOD					Make sure it is clear that when we discuss the 25' foot MT for water levels that we also state that PMAs will be implemented upon adoption of the GSP and not when the water levels cross the MT. They hope to never get to the MT.	See additional language in Section 4.5.2.
SAB BOD					Matt S raised the concern about how the 25' MT might affect the Slough.	More data on the water budget for the Slough will be obtained during GSP implementation to better understand how water levels in the basin affect the slough. VSFB is planning to build a model of the Slough and looking for ways to mitigate the impact of their pumping. The stream gages will be needed, as well as the other surface water inflow terms on the flanks. See existing language in 4.5.2.2.
Tiffany Abeloe	4				I would rather see the MT set at 15' rather than 25' below Fall 2018 groundwater levels. Pushing the threshold to the lowest point before negative impacts occur seems foolhardy to me. As it is, the 25' MT is already below current groundwater levels which could result in the undesirable result of degraded water supplies. The basin is already in arrears (10K' afy b/w in and out flows?) and a 15' decline is a lot of water lost. I believe 15' gives the SABWD time to implement project and management actions before reaching that level. As a domestic well water user, I believe 25' will result in undesirable results for my shallow well.	Multiple groundwater level minimum threshold (MT) scenarios have been presented to the advisory committee, board of directors, and GSA over the last year and more recently at the July public workshop and August Board of Directors meeting. A vote took place by the attendees of the August meeting determining the groundwater level MTs to be included in the Public Draft of the GSP. Potential impacts of the various MT scenarios discussed included impacts, if any, to domestic, agricultural, and municipal wells (see Section 3.2.1.3 for the well impact analysis and Section 4.5.2 for a description of the rationale for the selection of 25 feet below Fall 2018 groundwater levels) as well as potential impacts to interconnected surface water at Barka Slough. If the current MTs are deemed inadequate during the GSP implementation period, the GSA may revise the MTs at a minimum of once every 5 years during the GSP interim periods.
SAB BOD					Address concern from Tiffany Abeloe re domestic wells by pointing to the well impact analysis showing not much increase in domestic well issues when going with the 25'MT. Include graphic with response to comment.	See response to Ms. Abeloe's comment above.
Bryan Bondy	4	4-1			End of second paragraph: Consider noting that the SMC reevaluation and potential modification will happen no less frequently than the required 5-year GSP assessments.	See added language in Section 4.
Bryan Bondy	4.1	4-3			Definition of "Undesirable result" differs from the definition in the cited Water Code section. The text "…caused by groundwater pumping…" should read "…caused by groundwater conditions…" There may be other differences; this just happens to be the one I noticed.	The definition has been revised.
Bryan Bondy	4.2.1	4-4			It may be helpful to qualify the objectives for "Avoid Degraded Groundwater Quality" by noting that the GSA is only responsible for groundwater quality degradation caused by groundwater pumping or GSP implementation and explain the nexus between pumping or GSP implementation and potential water quality changes.	GSI agrees with the qualifications provided and adds that they are applicable to all the sustainable management criteria (SMCs). These qualifications are included in the respective SMC sections.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Bryan Bondy	4.3.2	4-6			Bullet List: a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively. b. Third bullet – There is a concern with the use of the term "Impacts" because not all impacts may be significant and unreasonable. Consider replacing "Impacts" with "Significant and unreasonable impacts" to better align with the SGMA definition of undesirable results.	See added language to Section 4.3.2.
Bryan Bondy	4.5.1	4-13			Bullet List: a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively. b. First bullet – It may be helpful to explain the basis for selecting 50% of representative wells exceeding the minimum thresholds. c. Second bullet – There is a concern with the use of the term "impact" because not all impacts may be significant and unreasonable. Consider replacing "impact" with "significant and unreasonable impacts" to better align with the SGMA definition of undesirable results. d. Third bullet – i. What are the historical average production rates that will be used as the baseline for evaluation of this criterion (I did not find the values in the GSP)? ii. The logic for the third bullet seems questionable. The average historical production likely includes some years with lower-than-average values. Why would it be significant and unreasonable in the future to not be able to produce at average historical rates when the historical rates themselves include years with less than average production, which was not considered an undesirable result historically? iii. Consider providing quantitative measures. Is one well unable to produce historical average quantities of water considered significant and unreasonable, or is it some larger number (or percentage) of wells?	See added language and footnotes to Section 4.5.1. The undesirable result described in the third bullet has been revised to be more consistent with that of the reduction of groundwater in storage sustainability indicator. The undesirable result has been revised to consider the Basin's calculated sustainable yield. See revised text in Section 4.5.1.
Bryan Bondy	4.5.2	4-14 - 4-16			It is noted that the well impact analysis used to support the minimum thresholds is not very sensitive to the groundwater elevation, as indicated by the small change in the percentages of wells with various groundwater levels below top of screen. The well impact analysis results for the range of groundwater levels considered appears to be controlled by a small number of wells that are located in apparently unconfined areas near the edges of the basin and some wells that appear to be outliers compared to nearby wells. For these reasons, the well impact analysis results may not be representative of most wells in the basin and the resulting minimum thresholds may not be as representative as thought. It is suggested this analysis be revisited during the first 5-year GSP assessment period and refined by including additional wells (assuming more well construction information become available) and/or other approaches to evaluating potential significant and unreasonable impacts.	It is not clear if the wells in question are located in unconfined portions of the basin. The distribution of the wells included in the well impact evaluation have broad spatial coverage and include all well types (e.g., municipal, agricultural, domestic). For these reasons, we conclude the well impact evaluation to be reasonably representative of water levels and wells in the Basin. GSI agrees with the recommendation to continue to revise the well impact analysis as more data become available.
Bryan Bondy	4.8	4-31			The text states: "The SABGSA has no responsibility to manage groundwater quality unless it can be shown that water quality degradation is caused by pumping in the Basin, or the SABGSA implements a project that degrades water quality." It is suggested that the GSP include a discussion about the potential for pumping or GSP implementation to degrade water quality and describe criteria for evaluating whether those conditions are occurring (or describe how and when those criteria will be developed).	See added language to Section 4.8.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Bryan Bondy	4.9.1	4-40			Bullet list in middle of page: a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively. b. Consider caveating all criteria as only applying if groundwater levels are below historical low levels during the period in question.	See added language to Section 4.9.1.
Bryan Bondy	4.9.1	4-43 & 4-46			The text on page 4-43 (minimum threshold) and page 4-46 (measurable objective) both say the criteria are based on the measured subsidence at the UNAVCO CGPS Station ORES from 2000-2020. However, the minimum threshold and measurable objective values are different (0.05 vs 0.04 feet per year). The text suggests that the values should be the same; therefore, it is unclear why the values are different.	The land subsidence minimum threshold of 0.05 feet per year is meant to signify an increased land subsidence rate compared to the average rate measured at the UNAVCO CGPS over its period of record (0.04 feet per year, or the measurable objective). See revised text in Section 4.9.2. To GSI's knowledge, there are no available infrastructure evaluations indicating the likely rate or amount of land subsidence that could cause damage to existing infrastructure in the Basin. Consequently, an increased rate of land subsidence compared to the average rate over the historical period is being used as the minimum threshold for the land subsidence sustainability indicator.
Bryan Bondy	4.10.2				There are concerns with using the Casmalia stream gage to establish the minimum threshold for depletion of interconnected surface water: First, the GSP Emergency Regulations require the minimum threshold to be the rate of depletion of surface water flow caused by groundwater pumping, not the surface water flow rate itself. Second, because the gage is downstream of the basin, it is measuring unused water leaving Barka Slough area. In theory, some of water measured by the gage is available for transpiration in Barka Slough if it is needed. In other words, the surface water flows at the gage could potentially decrease before undesirable results occur in Barka Slough. It is possible that flows at the gage could go to zero before significant and unreasonable effects at the Barka Slough manifest. Lastly, the flows measured by the gage may be impacted by processes unrelated to depletion by pumping, which are beyond the GSA's authority and control. These include: (1) flows from the four tributaries that confluence with San Antonio Creek downstream of the basin boundary; (2) variability in transpiration rates within the Barka Slough; and (3) transpiration along the portion of San Antonio Creek located between the basin boundary and the gage. The GSP discusses a historical depletion rate estimate developed using Darcy's Law. It is suggested that consideration be given to setting the initial minimum threshold based on the Darcy's Law calculation using the chronic lowering of groundwater levels minimum thresholds as a calculation input. This approach may align better with the GSP Emergency Regulations (using a depletion rate instead of surface water flow) and would eliminate concerns about other physical processes affecting the measurement of flow. The minimum threshold could be revisited, as planned, using the numerical model during the first 5-year GSP assessment period. If the current approach of using the Casmalia gage is retained, it is recommended that the minimum threshold be better explained and set lower. Page 4-54 says "This threshold was selected based on the analysis of historical base flow at the Casmalia stream gage presented on Figure 4-2." That is not enough information to understand the basis for the selected minimum threshold value. Based on visual inspection of Figure 4-2, it appears that the minimum threshold was exceeded in 2015, yet the GSP says "the EVI analysis indicates no discernible long-term trend in Barka Slough	Until the hydrology in the area of Barka Slough is better understood and uncertainties involved with the Darcian Flux calculations can be minimized, measured surface water flow at the Casmalia stream gage will serve as a proxy for measurement of the depletion of interconnected surface water sustainable management criteria (SMC). Currently, the water budget for Barka Slough is not well understood. The GSA is proposing to install stream gages immediately upgradient and potentially immediately downgradient of Barka Slough to quantitively measure annual surface water flow in and out of Barka Slough. Additionally, the GSA will evaluate the need for shallow piezometers in Barka Slough to more accurately measure depth to water in relation to likely GDE maximum rooting depths. It is understood the Vandenberg Space Force Base (VSFB) is working with the USGS to develop a water budget for Barka Slough as well as modeling scenarios of variable groundwater pumping from the VSFB well field near Barka Slough as a primary and or secondary water resource for the proposed VSFB Golf Courses Project. In conjunction with the numerical groundwater model, this information is anticipated to allow the SMCs, including the minimum threshold (MT), for depletion of interconnected surface water to more directly measure the rate of depletion of surface water flow caused by groundwater pumping. As more information is obtained, the minimum threshold for surface water depletion will be revisited. Based on the hydrogeological conceptual model developed by the USGS and presented in Section 3, surface water outflow from Barka Slough accounts for all surface and groundwater outflow from the Basin that is not captured by groundwater pumping or evapotranspiration. Consequently, it is possible to calculate, after accounting for surface water inflow and outflow components downgradient of Barka Slough and upgradient of the Casmalia stream gage, the volume of water exiting the Basin using the Casmalia stream gage. As mentioned previously, the installation of a stream gage immediately upgradient of Barka Slough would account for the surface water inflow component into Barka Slough. Subtracting this value from the volume measured at the Casmalia stream gage would allow calculation of the groundwater discharge to surface water component of the groundwater budget. This value can be used to compare to previous Darcian Flux calculations for the Barka Slough and enhance the ability to quantify the measurement of the depletion of interconnected surface water.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					vegetative health" (p. 3-117). This suggests that there have not been undesirable results historically, including 2015. If undesirable results did not occur at the 2015 flows, then the minimum threshold is probably too high.	Surface water flow in Barka Slough and downgradient of Barka Slough are classified as perennial according to the USGS NHD. Although it is possible significant and unreasonable results within the Basin may not be observed until a lower flow (than the current MT) and potentially no flow is observed at the Casmalia stream gage, special status aquatic species have been reported along San Antonio Creek west of the Basin. The surface water depletion MT is intended to be protective of, a groundwater pumping induced, decrease in streamflow that could impact habitat for special status species. The depth to groundwater in the shallow sediments within the Slough and the existing GDE plant rooting depths is also not well understood. Additionally, less flow or no measured flow at the Casmalia stream gage could indicate there is no longer outflow from the Basin; resulting in a closed Basin and potential degradation of groundwater quality. Therefore, an MT below that selected from the baseflow analysis of the Casmalia (note the current MT of 0.15 cfs is the average base flow measured for 3 consecutive months from June to September) cannot be adequately justified until the hydrology of Barka Slough and the existing GDE can be further assessed. The EVI analysis was conducted to aid in the evaluation of historical and current "health" of Barka Slough. The planned EVI analysis will provide an indication of vegetative health but does not represent a full characterization of GDE conditions, including aquatic habitat. EVI is calculated from the proportions of visible and near-infrared sunlight reflected by vegetation. EVI data provide an indicator of healthy, well-watered vegetation; however, does not account for plant species type or change in plant species type (potentially due to lowering of available groundwater). No complete original biological analysis was conducted for the Barka Slough GDE. Following the EVI analysis discussion in the Section 3.2.6, the GSP states, "The Nature Conservancy guidance recommends that the condition of each GDE unit be inventoried and documented by describing the species composition, habitat condition, and other relevant information reflected in Worksheet 2 of the guidance (Rohde et al., 2018). TNC further states that the ecological condition of the GDE unit should be characterized as having a high, moderate, or low ecological value based on criteria provided in the TNC guidance. These tasks would likely rely heavily on field surveys. This additional characterization was not conducted but may be undertaken during GSP implementation. Until the additional characterization has been conducted, Barka Slough will be characterized as having high ecological value."
Matthew Scrudato	Section 5_Monitoring Networks				Last thought RE DMS, What type of data will be associated with and linked to the water level data? Maybe this isn't the place for this detail in the report. Will this have info like:date, time, accuracy, equipment used, RP used, well status (nearby pumping, recently pumped, cycling, rising, etc.), measurement method (steel tape, etape, etc.)	These details are included in the DMS. The DMS is described generally in Section 5.9.
Matthew Scrudato	5.7				There's mention that the significant land subsidence didn't occur between 2015-2019. Are you using this period because this was a time of significant pumping, drought, and limited runoff? If so, possibly elaborate. Think it would be a good idea to establish a small network of benchmarks with high accuracy elevation as a baseline. PAGE 39 There's mention in paragraph 1 that there's no way to quantify the degree to which SW depletion has occurred. How about a baseflow analysis of both streamgages? There's a big dataset for both gages. Just an idea. PAGE40 recommend transducers in 16G3, 16C2 16C4 (c wells may have that already), recommend installation of SERS at entry and exit of slough to at least determine number of days the channel is flowing. Better data set (and cheap) than a visit every 3 months.	2015-2019 was used because this is the period of record for the InSAR dataset. No significant land subsidence has been observed over the available period of record. A network of benchmarks will be considered (including funding) and is discussed in Section 5.7.1. Baseflow of the Casmalia stream gage is discussed in Section 4.10. Transducers are already installed in 16G3, 16C2, and 16C4. The installation of SERS will be considered for improvement of the Depletion of Interconnected Surface Water Monitoring Network.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Matthew Scrudato	5.6.1				This probably goes back to my earlier comment and my confusion with the water quality network. SWRCB DDW protocols from appendix D7 would relate to the municipal wells. The ILRP would relate to the Ag Order 3.0. If you're also planning to sample additional wells, or use the USGS data (2 wells sampled annually), or sample from the vault wells, you'll need to reference the first reference in the appendix from DWR which mentions water quality sampling and recommends following USGS protocols outlined in the USGS field manual. Ignore comment if there are no wells outside of municipal and ag order wells. PAGE32 Should we also mention the COGG survey. Preliminary results indicate quality issues.	The text referred to the incorrect table (Table 5-1). The correct table is Table 5-3 and the text has been revised. A discussion of the COGG study is included in Section 3.
Matthew Scrudato	Section 5_Monitoring Networks	22			A couple of things come to mind RE water quality. There's reference to table 5.1 and the water quality well list. There's plans to sample all these 31 wells as the QW network and all the wells in Figure 5.4? I'm checking to be sure that what I'm reading is correct. Maybe it's the way this is written is what makes it a bit confusing to me. There are 50 wells in table 5.1. There's mention of 7 municipal wells and 21 ag wells. What about all the baseline data from general USGS monitoring over the years? Why are you only referencing the 2017 sampling only? There's quite of bit of data in NWIS.https://maps.waterdata.usgs.gov/mapper/nwisquery.html?URL=https://nwis.waterdata.usgs.gov/ca/nwis/qwdata?huc_cd=18060009&format=sitefile_output&sitefile_output_format=xml&column_name=agency_cd&column_name=site_no&column_name=station_nm&inventory_output=0&rdb_inventory_output=file&TZoutput=0&pm_cd_compare=Greater%20than&radio_parm_cds=all_parm_cds&qw_attributes=0&qw_sample_wide=wide&rdb_qw_attributes=0&date_format=YYYY-MM-DD&rdb_compression=file&list_of_search_criteria=huc_cd_by_name&column_name=site_tp_cd&column_name=dec_lat_va&column_name=dec_long_va&column_name=agency_use_cdWe also still sample 2 wells annually in the basin.7N/33W/27G1 and 9N/33W/2B1Any additional baseline data in the GAMA database?	The text referred to the incorrect table (Table 5-1). The correct table is Table 5-3 and the text has been revised.
Matthew Scrudato	Section 5_Monitoring Networks				PAGE12 I located a few wells in these data gap areas. The USGS were supposed to add them to the quarterly samples, but only took a water quality sample. Anyway, not sure which wells you tried to get access to. Some that come to mind are: EAST UPLAND Chamberlin Property. We have a water quality sample. They may provide continued access for monitoring. NW UPLAND We measured and sampled a well on the Careaga Oil lease. They were very helpful and welcoming. What about the Stevens property directly north of the SACR cluster?	The GSA will continue to request landowners participate in the Groundwater Level Monitoring Network by allowing access to their wells. Wells in "data gap" areas, including the wells you mention, will be prioritized.
Matthew Scrudato	Section 5_Monitoring Networks	12			paragraph 3 provides density information and mentions this was "from various cited sources". Please cite these sources in this paragraph so the reader knows where to look in the references.	The well density information is from the DWR BMP which cites various sources. Because GSI is referencing the DWR BMP and cites the DWR BMP, the "from various sources" was removed from the text.
Matthew Scrudato	Section 5_Monitoring Networks	10			Â RP description(s), and elevation. Sometimes there are 2 RPs.2)-Measurement Protocols very vague. Here are some references you may want to add and use as a reference: https://pubs.usgs.gov/tm/1a1/pdf/GWPD4.pdfÂ and here: https://pubs.usgs.gov/tm/1a1/pdf/GWPD1.pdf3)-There's mention of QA/QC in measurement protocols. What does this program entail exactly? Need more information here. Too vague.4)-Collection underfollowing conditions paragraph should include stable(static) water level (which gets back to QA/QC-how do you know it's static?). Also need to consider surrounding conditions. Has it been pumped recently? Nearby well pumping?5)-How is equipment decontaminated? Procedures are outlined in the USGS manual for steel and electric tapes. Chapter 3, 3.3.8.Option A with 0.1 to 2%Liqui-nox solution. Procedure 2using 0.005% bleach. Other recommendations for oilhttps://pubs.usgs.gov/twri/twri9a3/final508Chap3book.pdf6)-If there's pressure in well I would recommend drilling a vent hole.7)-How did you already determine that	Additional detail and language have been added to the Groundwater Level Monitoring Network Protocols section.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					the RP elevation is accurate to 0.5 feet? From USGS DGPS? What about new additions? What equipment will be used to determine elevation? If using a cell phone you'll get a much different accuracy.	
SABWD	6	6-1			The bulk of Section 6 appropriately refers to management actions of the GSA. However, the introduction on Page 6-1 refers to a portfolio of management actions developed by SABWD and LACSD that could be implemented as part of the GSP. The District wishes to clarify that no such portfolio exists, at least as to the SABWD, and we ask that this reference be stricken from the GSP.	The GSP has been revised to address this comment
SAB BOD	6				Include hoop house recharge concept in the list of projects.	The GSP has been revised to address this comment. An additional project has been added to the Tier 4 Non-Priority Projects, entitled "SABGSA to provide Technical Assistance and Financial Incentives for High Tunnel ("Hoop Houses" Rainwater Harvesting Projects for Supplemental Irrigation Water Supplies and / or Groundwater Recharge Projects"
SAB BOD					Mention use of vegetative swales for enhancing recharge. This concept is being studied by Dr. Andy Fisher at UCSC. Perhaps this is an add on to our discussion about distributed recharge.	After review of the work that Dr. Andy Fisher has been working on and that has been reported in the literature, GSI believes that the use of vegetative swales for enhancing recharge is sufficiently covered in the discussion of the Tier 3 Priority Project DSW-MAR Basins (In-Channel and Off-Stream Basins)
SAB BOD					Add statement to ES and elsewhere in the PMA section that diminimus users will not be affected, have to have a meter, or pay an extraction fee.	The GSP has been revised to address this comment. A sentence has been added in Section 6.4 which states "De minimus pumpers will not be metered and will not be required to pay an extraction-related pumping fee."
Bryan Bondy	6				The projects and management actions described in this section appear to be reasonable. Other projects that may be worth investigating or considering include: a. Bedrock wells – consideration could be given to pumping and treating groundwater from bedrock formations to create an alternative water supply. b. Oilfield-produced water – consideration could be given to working with the owners of the active oil production wells surrounding the basin to evaluate the feasibility of treating and using oilfield-produced water for irrigation. c. Water exchanges – consideration could be given to funding local water projects in other regions in exchange for State Water Project allocation.	The GSP has been revised to address this comment. An additional project has been added to the Rier 4 Non-Priority Projects, entitled "Additional Projects for Potential Future Consideration by SABGSA "
Bryan Bondy				6-1	Header row - Groundwater Dependent Ecosystems is not a sustainability indicator identified in SGMA.	The Header in Table 6-1 was revised to reflect the MO to read Depletion of Interconnected Surface Water
Bryan Bondy	6.9				Tier 2 Management Action 7 – Voluntary Agricultural Crop Fallowing Programs: It is noted that voluntary fallowing would likely only occur if a cap-and-trade system is in place (i.e., the proposed "Base Pumping Allocation" and "Groundwater Extraction Credit Marketing and Trading Program"). Therefore, it is suggested that this dependency be noted in the description of the management action. It is also noted that the program may potentially be enhanced (or a separate program could be implemented, depending on who it is framed) by the having the GSA lease or purchase agricultural land for fallowing. The GSA could use fees to lease/purchase the lands, if necessary or desired. The GSA could also consider purchasing groundwater extraction credits.	The GSP has been revised to address this comment. A sentence has been added in Section 6.9 which states, "The Voluntary Agricultural Crop Fallowing Programs will be developed in parallel to the Groundwater BPA and the GEC Marketing and Trading Programs (see Management Actions 5 and 6 in Sections 6.7 and 6.8, respectively). It is also noted that the Voluntary Fallowing Program may potentially be enhanced, or a separate program could be implemented, which may provide for GSA to lease or purchase agricultural land for fallowing. The GSA could use fees generated through the Groundwater Pumping Fee Program to lease/purchase the lands to be fallowed, if necessary or deemed desirable by the GSA. Additionally, the GSA may also consider purchasing groundwater extraction credits.
SAB BOD	7				We need to revise our discussion about funding options. Jessica Diaz will help us. Need to better explain that the Water District raises money but has no responsibility for implementation. The per acre charge the District collects covers administration but grants and an extraction fee will have to cover MAs.	There is no reference in Section 7 GSP Implementation with regard to funding obligations or responsibilities on the part of the Water District.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Tiffany Abeloe	General				I believe the last 2 SABGSA meetings were recorded, but I am unable to find the recordings. I understand there is a desire to increase efforts for stakeholder communication yet I can't find much of anything. The only minutes I found were for the SABWD meetings. Am I missing something somewhere or are there no minutes or recordings available for the GSA?	The agenda, minutes and presentations are available on the San Antonio Basin Groundwater Sustainability Agency, sanantoniobasingsa.org. They can be found by viewing past events or found on the calendar under the respective meeting date.
Samantha Arthur (Audubon Society)					Hello, I am writing on behalf of Audubon California, Clean Water Action, Clean Water Fund, Local Government Commission, The Nature Conservancy, and Union of Concerned Scientists with the attached comments on the draft Groundwater Sustainability Plan for this basin. Please refer to this updated comment letter as opposed to the previous comment submitted, which included an incorrect attachment. We know that SGMA plan development and implementation is a major undertaking, and we want every basin to be successful. We would be happy to meet with you to discuss our evaluation as you finalize your Plan for submittal to DWR. Feel free to contact us at ngos.sgma@gmail.com for more information or to schedule a conversation. Sincerely, Samantha Arthur Working Lands Program Director Audubon California	No response to this comment is warranted. A copy of the comment letter dated October 31, 2021 is included as an attachment.
Samantha Arthur (Audubon Society)					1. Consideration of Beneficial Uses and Users in GSP development Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes, 1 groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine. A. Identification of Key Beneficial Uses and Users Disadvantaged Communities and Drinking Water Users The identification of Disadvantaged Communities (DACs) and drinking water users is insufficient. We note the following deficiencies with the identification of these key beneficial users. - The GSP fails to identify and map the locations of DACs and describe the size of each DAC population within the basin. - While the plan provides a density map of domestic wells in the basin (Figure 2-4), the GSP fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the basin. - The GSP fails to identify the population dependent on groundwater as their source of drinking water in the basin. Specifics are not provided on how much each DAC community relies on a particular water supply (e.g., what percentage is supplied by groundwater). These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, and to support the consideration of beneficial users in the development of sustainable management criteria and selection of projects and management actions. RECOMMENDATIONS - Map the locations of DACs and provide the population of each identified DAC. The	No disadvantaged communities (DACs) were identified within the Basin, based on several datasets (refer to the IRWMP (Dudek, 2019); California Air Resources Board's (CARB) California Climate Investments (CCI) Priority Populations online mapping tool; California Office of Environmental Health Hazard Assessment's CalEnviroScreen online mapping tool of Senate Bill 535 DACs; and DWR's DACs online mapping tool using 2018 data at the places and tracts scale). Figure 3-26 Well Impact Analysis for Domestic Wells includes all domestic wells within the Basin with usable location and well construction data (specifically depth to top of screen) compared to Fall 2018 groundwater levels. Figure 3-23 shows how many wells, by type, are anticipated to be impacted (groundwater levels reaching top of screen) as groundwater levels drop incrementally from Fall 2018 levels. Average depths of wells, by well type, included in the well impact analysis has been included in Section 3.2.1.3.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					DWR DAC mapping tool can be used for this purpose.2 Identify the sources of drinking water for DACs, including an estimate of how many people rely on groundwater (e.g., domestic wells, state small water systems, and public water systems). - Include a map showing domestic well locations and average well depth across the basin.	
Samantha Arthur (Audubon Society)					A. Identification of Key Beneficial Uses and Users (Cont.) Interconnected Surface Waters The identification of Interconnected Surface Waters (ISWs) is insufficient, due to lack of supporting information provided for the ISW analysis. The GSP presents a conceptual representation of gaining and losing streams (Figure 3-52. Gaining and Losing Streams). The GSP also presents a map (Figure 3-53. Stream Classification) of the basin's stream reaches, as classified by the USGS National Hydrography Dataset (NHD), with labels `Intermittent' and 'Perennial'. The GSP states (p. 3-102): "Figure 3-53 is a stream classification map of the Basin as defined by the USGS NHD (USGS, 2020b). Based on the USGS NHD, all the streams in the Basin are classified as intermittent and likely to be losing streams. The stream channels located in Barka Slough are classified as perennial and likely to be gaining streams." The GSP continues (p. 3-103): "Interconnected surface water and groundwater within the Paso Robles Formation and Careaga Sand is indicated by the Barka Slough and perennial classification of streams in that area." With these two statements, the GSP implies that interconnected reaches are defined by perennial conditions. However, this is an incorrect conclusion. Note the regulations [23 CCR §351(o)] define ISW as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". "At any point" has both a spatial and temporal component. Even short durations of interconnections of groundwater and surface water can be crucial for surface water flow and supporting environmental users of groundwater and surface water. Using seasonal groundwater elevation data over multiple water year types is an essential component of identifying ISWs. The GSP does not present or analyze depth to groundwater data when identifying ISWs in the basin. RECOMMENDATIONS - Provide a map showing all the stream reaches in the basin, with reaches clearly labeled as interconnected or disconnected. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP. - Provide depth-to-groundwater contour maps using the best practices presented in Attachment D, to aid in the determination of ISWs. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth to groundwater contours across the landscape. This will provide accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found. - Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate, when mapping ISWs. We	Figure 3-53 provides all stream reaches in the Basin and classification. The analysis described in Section 3.2.6 that identifies groundwater dependent ecosystems refers to the period described by the SGMA Emergency Regulations [§354.16(g)]: "including data from January 1, 2015, to current conditions." The choice of the period selected is described to be a relatively dry year. As noted in that section 3.2.6: groundwater elevations are generally the highest in the spring, following recharge from winter rains. Spring-time groundwater elevations in 2015, a relatively dry year, are considered representative of average modern conditions as measured throughout the spring-summer months, during the period of maximum annual evapotranspiration. It also represents the period when SGMA was enacted; interconnected surface water observed after January 2015 are subject to evaluation under SGMA. No interconnected surface water (as defined by SGMA, "the surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer, and the overlying surface water is not completely depleted.") was identified elsewhere in the Basin using this analysis. As stated in the comment, the regulations state that surface water that is hydraulically connected to groundwater requires a continuous saturated zone between the surface water and groundwater systems be present at any point. The intermittent ephemeral portions of San Antonio Creek and tributaries do not have a continuous saturated zone between the surface water and groundwater system. In these areas, rainfall that percolates through the stream bed does not form a continuous saturated zone. Groundwater elevation contours included shallow and nested observation well sets across the Basin. Groundwater level contours for the underlying Paso Robles Formation show substantial separation between the stream bed and the saturated portion of the aquifer. Nested wells also show that the flow is downward until the Paso Robles Formation and Careaga Sand discharges to the surface at Barka Slough. The identification of interconnected surface water and groundwater dependent ecosystems is directly related. These two analyses and the review of the hydrogeological conceptual model, developed by the USGS and presented in Section 3.1, adequately identify interconnected surface water within the Basin since enactment of SGMA. The hydrogeological conceptual model and groundwater conditions will be updated as new data become available at a minimum of once every 5-years during the GSP interim review periods.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					recommend the 10-year pre-SGMA baseline period of 2005 to 2015. - Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.	
Samantha Arthur (Audubon Society)					A. Identification of Key Beneficial Uses and Users (Cont.) Groundwater Dependent Ecosystems The identification of Groundwater Dependent Ecosystems (GDEs) is insufficient. The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). However, insufficient groundwater data was used to characterize groundwater conditions in the basin's GDEs. The GSP states (3-90): "Contoured groundwater elevation data for spring 2015 were used to determine areas where the Natural Communities polygons were within 30 feet depth to groundwater. Spring 2015 groundwater elevations were chosen for this analysis because this marked a period of the greatest recent data availability. These data are considered representative of average spring-summer conditions within the last 5 years." We recommend using groundwater data from multiple seasons and water year types to determine the range of depth to groundwater around NC dataset polygons. Using seasonal groundwater elevation data over multiple water year types is an essential component of identifying GDEs and is necessary to capture the variability in environmental conditions inherent in California's climate. We commend the GSA for including an inventory of flora and fauna species in the basin's GDEs. Section 3.2.6.1 presents a discussion of potential GDE vegetation classifications and their acreage, and each of these GDE units is mapped individually on Figure 3-10 (Natural Communities Commonly Associated with Groundwater Dataset). Table 3-9 presents the plants and their rooting depths likely present in Barka Slough. Table 3-12 presents the special-status species that may be located within the basin, which are further discussed in the GSP text and mapped on Figure 3-57 (Special-Status Species Critical Habitat). Within Section 3.2.6.1 (Identification of Potential GDEs), the GSP states that the maximum rooting depth of Valley Oak (Quercus lobata) is 80 feet. However, this deeper rooting depth was not used when verifying whether Valley Oak polygons from the NC Dataset are supported by groundwater. Figure 3-10 shows acreage of Valley Oak polygons across the basin in areas covered by the > 30 ft depth to water area mapped on Figure 3-55. Of the 495 acres of Valley Oak mapped on Figure 3-10, no acreage is retained as a potential GDE in the GSP. RECOMMENDATIONS - Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network. - Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a pre-SGMA baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types.	The analysis described in Section 3.2.6 refers to the period described by the SGMA Emergency Regulations included in the blue box at the beginning of that section [§354.16(g)]: "including data from January 1, 2015, to current conditions." The choice of the period selected is described to be a relatively dry year. As noted in that section: groundwater elevations are generally the highest in the spring, following recharge from winter rains. Spring-time groundwater elevations in 2015, a relatively dry year, are considered representative of average modern conditions as measured throughout the spring-summer months, during the period of maximum annual evapotranspiration. It also represents the period when SGMA was enacted; GDEs observed after January 2015 are subject to evaluation under SGMA. The comment requests preparation of depth to groundwater maps. This is unnecessary because groundwater elevation contour maps were prepared and compared to ground surface elevations to derive the locations where the water table is within 30 feet of land surface. Using this analysis, depth to groundwater in areas where populations of Valley Oak were identified were greater than 100 feet based on the Spring 2015 groundwater elevations. Thank you for the additional data sources. Published TNC guidance literature was used for identifying GDEs within the Basin and is described in Section 3.2.6. The hydrogeological conceptual model and groundwater conditions will be updated as new data become available at a minimum of once every 5-years during the GSP interim review periods.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					- Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth-to-groundwater contours across the landscape. The GSP maps the 30-foot groundwater depth contour on Figure 3-55, showing two areas (<= 30 ft Depth To Water and > 30 ft Depth To Water). However, full depth to groundwater contours are needed to evaluate the valley oak NC dataset polygons. - Re-evaluate the 495 acres of valley oak present in the basin. Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as valley oak (Quercus lobata). We recommend that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.	
Samantha Arthur (Audubon Society)					A. Identification of Key Beneficial Uses and Users (Cont.) Native Vegetation and Managed Wetlands Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget. , The integration of native vegetation into the water budget 3 4 is sufficient. We commend the GSA for including the groundwater demands of this ecosystem in the historical, current and projected water budgets. Managed wetlands are not mentioned in the GSP, so it is not known whether or not they are present in the basin. RECOMMENDATION - State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.	No managed wetlands have been identified in the Basin. See additional text added to Section 2.2.1 and 2.3.1.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Samantha Arthur (Audubon Society)					B. Engaging Stakeholders Stakeholder Engagement During GSP Development Stakeholder engagement during GSP development is insufficient. SGMA's requirement for public notice and engagement of stakeholders is not fully met by the description in the Communication and Engagement Plan (Appendix C).5 The Communication and Engagement Plan describes engagement with environmental stakeholders during the GSP development process through the inclusion of an environmental representative on the GSA Advisory Committee. However, we note the following deficiencies with the overall stakeholder engagement process: - The opportunities for public involvement are described in very general terms. They include public notices, meetings, and workshops. No specific outreach was described for DACs and drinking water users. DACs were mentioned once in the initial list of stakeholders and interested parties within the basin, but were not otherwise mentioned in the GSP. - The plan does not include a plan for continual opportunities for engagement through the implementation phase of the GSP for any stakeholders, including DACs, domestic well owners, and environmental stakeholders. RECOMMENDATIONS - In the Communication and Engagement Plan, describe active and targeted outreach to engage DAC members, drinking water users, and environmental stakeholders through the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process. - Describe efforts to consult and engage with DACs and domestic well owners within the basin. - Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the basin within the GSP.	No disadvantaged communities (DACs) were identified within the Basin, based on several datasets (refer to the IRWMP (Dudek, 2019); California Air Resources Board's (CARB) California Climate Investments (CCI) Priority Populations online mapping tool; California Office of Environmental Health Hazard Assessment's CalEnviroScreen online mapping tool of Senate Bill 535 DACs; and DWR's DACs online mapping tool using 2018 data at the places and tracts scale). The outreach has been conducted in accordance with the Communication and Engagement Plan, which included outreach to the entire Basin. No federally recognized tribes were identified within the Basin, therefore no special outreach efforts were warranted.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Samantha Arthur (Audubon Society)					C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is insufficient. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.7,8,9 Disadvantaged Communities and Drinking Water Users For chronic lowering of groundwater levels, the GSP presents a well impact analysis in Section 3.2.1.3. The GSP states (p. 3-50): "Fall 2018 groundwater elevations measured in basin monitoring wells were used to assess how many wells have static water levels that are below the top of screen elevation as of that date and how many would be below top of screen if groundwater levels were lower. The results of the analysis presented on Figure 3-23 indicate that groundwater water elevations in fall 2018 were below top of screen in 20 percent of domestic wells and 12 percent of agricultural wells in the Basin." Minimum thresholds for groundwater levels are set at 25 feet below fall 2018 water levels. The GSP states (p. 4-15): "The analysis indicates that water levels declining 25 feet below fall 2018 water levels do not result in a substantial increase in the number of wells affected by this condition. If water levels continue to decline, the analysis indicates well owners could observe some depletion of supply. Based on this analysis, stakeholders in the Basin believe that setting the minimum threshold for water levels at 25 feet below fall 2018 water levels will not result in depletion of supply or undesirable results. Setting the minimum threshold at this level allows time for project and management actions to be implemented before minimum thresholds are reached. The well impact analysis presented in Section 3.2 indicates that the majority of the agricultural and domestic wells can tolerate additional groundwater level decline without experiencing undesirable results." Despite this well impact analysis, the GSP does not sufficiently describe whether minimum thresholds are consistent with California's Human Right to Water policy and will avoid significant and unreasonable loss of drinking water, especially given the absence of a domestic well mitigation plan in the GSP.10 Furthermore, undesirable results are characterized by groundwater levels dropping below the minimum threshold after periods of average and above-average precipitation in 50 percent of representative wells for two consecutive years. Using 50% as the threshold suggests that minimum thresholds reached during dry years or periods of drought will not result in an undesirable result. This is problematic since the GSP is failing to manage the basin in such a way that strives to minimize significant adverse impacts to beneficial users, which are often felt greatest in below-average, dry, and drought years. In addition, the GSP does not sufficiently describe or analyze direct or indirect impacts on DACs when defining undesirable results, nor does it describe how the existing groundwater level minimum thresholds will avoid significant and unreasonable impacts to DACs and domestic well users beyond 2015 and be consistent with Human Right to Water policy.10 For degraded water quality, the GSP presents water quality standards for constituents of concern (COCs) in Table 4-3. The GSP establishes minimum thresholds pertaining to salts and nutrients as follows (p. 4-34): "The WQOs presented in Table 4-3 are the	The well impact analysis presents a part of the rationale for the setting of minimum thresholds and measurable objectives to Avoid Chronic Lowering of Groundwater Levels for all well users in the Basin, including agricultural, municipal wells, and domestic wells in Section 4.5.2 in the Plan. This analysis, described in detail in Section 3.2.1.3, was conducted over several months in development of the Plan with multiple public meetings to set the MTs and MOs with the input of the GSA and public in protection of all well users. No disadvantaged communities (DACs) were identified within the Basin, based on several datasets (refer to the IRWMP (Dudek, 2019); California Air Resources Board's (CARB) California Climate Investments (CCI) Priority Populations online mapping tool; California Office of Environmental Health Hazard Assessment's CalEnviroScreen online mapping tool of Senate Bill 535 DACs; and DWR's DACs online mapping tool using 2018 data at the places and tracts scale). As discussed in Section 4.5.2: There was considerable debate among stakeholders about how much depletion of supply could result from water levels falling below the top of screen. Municipal, agricultural, and domestic wells have different sensitivities to this condition and will experience depletion of supply differently. The methodology and results of this analysis were discussed with stakeholders and ultimately accepted by the GSA Committee as the basis for establishing undesirable results and minimum thresholds. Furthermore: Domestic well owners and local municipalities cannot easily respond to a reduction in supply, particularly during extended dry periods, and would have to absorb substantial cost if wells had to be deepened. The GSA decided to not allow water levels in municipal wells to drop below the top of screen if possible. Local agricultural interests were less concerned about water levels falling below top of screen because they have not observed undesirable results or depletion of supply and so wanted to set the minimum thresholds deeper. The selected MT does not result in a significant increase in the number of domestic wells that would experience water levels falling below top of screen; thus, we believe the MT for water levels is adequately protective of domestic wells. Minimum threshold and undesirable results for the Degraded Groundwater Quality Sustainability Indicator have been set in accordance with Federal and State Drinking Water MCLs and SMCLs as well as the Water Quality Control Plan for the Central Coastal Basin developed by the Central Coast Regional Water Quality Control Plan and the California Environmental Protection Agency. The GSA however, has no authority regarding regulation of regulated contaminants and therefore those constituents will continue to be regulated by state agencies such as the Regional Water Quality Control Board and the Department of Toxic Substances Control. The GSA will coordinate with these agencies should contamination be identified in the future. Effects of sustainable management criteria for the Degraded Groundwater Quality Sustainability Indicator is included in Section 4.8.2.5. Table 4-3 presents water quality standards for selected constituents of concern. Table 3-5 presents historical water quality data and associated MCLs, SMCLs, and Water Quality Objectives. Per SGMA, groundwater conditions, including groundwater quality, occurring prior to 2015 are not required to be restored. Therefore, based on available groundwater quality data, the water quality data presented in Figures 3-33 through 3-46 is considered ambient and indicate the distribution of constituent concentrations.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					minimum thresholds for TDS, chloride, sulfate, boron, sodium, and nitrate as measured by SWRCB ILRP and DDW programs in 20 percent of wells monitored. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the minimum threshold concentration is 110 percent of the ambient water quality in 20 percent of the wells." The GSP does not, however, state which COCs have ambient concentrations that exceed the WQO, or provide a summary table of the resulting minimum thresholds. The GSP states (p. 4-32): "No minimum thresholds have been established for contaminants because state regulatory agencies, including the RWQCB and the Department of Toxic Substances Control, have the responsibility and authority to regulate and direct actions that address contamination." However, SMC should be established for all COCs in the basin that may be impacted by groundwater use and/or management, in addition to coordinating with water quality regulatory programs. The GSP only includes a very general discussion of impacts on drinking water users when defining undesirable results and evaluating the impacts of proposed minimum thresholds. The GSP does not, however, mention or discuss direct and indirect impacts on DACs or drinking water users when defining undesirable results for degraded water quality, nor does it evaluate the cumulative or indirect impacts of proposed minimum thresholds on DACs or drinking water users. RECOMMENDATIONS Chronic Lowering of Groundwater Levels - Describe direct and indirect impacts on drinking water users and DACs when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels. Degraded Water Quality - Describe direct and indirect impacts on drinking water users and DACs when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."11 - Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on drinking water users and DACs. - In Table 4-3 (Water Quality Standards for Selected Constituents of Concern), compare WQOs, MCLs, and ambient (prior to January 2015) water quality concentrations. Present the final minimum threshold for each COC. - Set minimum thresholds and measurable objectives for all water quality constituents within the basin that can be impacted and/or exacerbated as a result of groundwater use or groundwater management. Ensure they align with drinking water standards.12	Projects and Management Actions (see Section 6) implemented by the GSA that have the potential to impact groundwater quality will go through an evaluation and planning process prior to implementation. The actions will be monitored regarding surface and groundwater conditions as well as be subject to the Basin's sustainable management criteria for all sustainability indicators.

Samantha Arthur (Audubon Society)					C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users (cont.) Groundwater Dependent Ecosystems and Interconnected Surface Waters When defining undesirable results for chronic lowering of groundwater levels, the GSP briefly mentions impacts to GDEs in the Barka Slough area. However, these impacts are not described or analyzed. This is problematic because without identifying potential impacts on GDEs, groundwater level minimum thresholds may compromise these environmental beneficial users. Furthermore, our comments above in the GDE section note that insufficient shallow groundwater data was used to verify the NC dataset polygons and deeper rooting depths of valley oak were not considered. After re-analyzing GDEs based on our comments above, consider potential impacts to GDEs for the chronic lowering of groundwater levels sustainability indicator. The GSP recognizes data gaps with respect to the interconnected surface water SMC. For the Barka Slough area, the GSP states (p. 4-54): “Without an improved understanding of the slough water budget, it is not possible at this time to confidently establish a minimum threshold for depletion of interconnected surface water. Until more is known about the relationship between groundwater and surface water in the vicinity of the Slough and depletion can be quantified and monitored, an interim minimum threshold, based on the best available information, focuses on avoiding depletion and maintaining surface water and groundwater flow entering and leaving the Slough.” The minimum threshold is 0.15 cfs of surface water flow measured at the Casmalia stream gage west of the Slough, selected based on the analysis of historical base flow at the Casmalia stream gage (Figure 4-2). However, no analysis or discussion is presented to describe how the SMC will affect GDEs, or the impact of this minimum threshold on GDEs in the basin. Furthermore, the GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the basin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration). The GSP also recognizes data gaps with respect to ISW in the Las Flores watershed and northeast of Los Alamos on Price Ranch. The GSP states (p. 4-48): “Until flow of groundwater is better understood in these areas, meaningful SMCs related to interconnected surface water and supporting associated GDEs cannot be developed. If analysis of these areas indicates interconnected surface water with the Paso Robles Formation or the Careaga Sand, SMCs will be developed pursuant to avoid undesirable results as described below.” As noted above in the ISW section of this letter, the GSP did not utilize groundwater elevation data to identify ISWs in the basin. Therefore, in addition to the data gap areas noted above (i.e., Las Flores watershed and northeast of Los Alamos on Price Ranch), additional analyses may be required to develop depletion of interconnected surface water SMC after further identification of ISWs based on groundwater elevation data. RECOMMENDATIONS - Define chronic lowering of groundwater SMC directly for environmental beneficial users of groundwater. When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact on GDEs. Undesirable results to environmental users occur when ‘significant and unreasonable’ effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining	The groundwater dependent analysis described in Section 3.2.6 refers to the period described by the SGMA Emergency Regulations included in the blue box at the beginning of that section [§354.16(g)]: “including data from January 1, 2015, to current conditions.” The choice of the period selected is described to be a relatively dry year. As noted in that section: groundwater elevations are generally the highest in the spring, following recharge from winter rains. Spring-time groundwater elevations in 2015, a relatively dry year, are considered representative of average modern conditions as measured throughout the spring-summer months, during the period of maximum annual evapotranspiration. It also represents the period when SGMA was enacted; GDEs observed after January 2015 are subject to evaluation under SGMA. Depth to groundwater in areas where populations of Valley Oak were indicated were greater than 100 feet based on the Spring 2015 groundwater elevations. Effects of sustainable management criteria for the Depletion of Interconnected Surface Water Sustainability Indicator is included in Section 4.10.2.3. The GSP states the need for additional analysis of Barka Slough and actions are described in Section 6. An EVI analysis of Barka Slough was completed and described in Section 3.2.6. No original and complete biological assessment has been completed on the Slough. Consequently, other than satellite-based data such as EVI and ET, measurable changes regarding existing species populations within the Slough is impossible to evaluate. The minimum threshold at the downgradient Casmalia stream gage of 0.15 cfs is representative of baseflow conditions since SGMA enactment in 2015 and, based on the EVI analysis, adequate to support existing GDE conditions in Barka Slough. This flow rate ensures that there is water in the slough to support GDEs. This MT may be revised as additional data regarding the slough water budget is obtained and the character of this GDE is further evaluated as discussed in Section 6 projects and management actions. Groundwater elevation data was used evaluate GDEs in the Basin (see Section 3.2.6 for description of the analysis). Based on the analysis depth to groundwater in the location of the potential GDE located in Las Flores watershed was greater than 30 feet. However, based on stakeholder feedback, field observations, satellite imagery, and reported artesian conditions in this area, the Plan states, similar to Barka Slough, that further analysis is needed to better understand the hydrology and plant species in this area. Actions to do so are included in Section 6. Additionally, unlike Barka Slough, a downgradient stream gage with an adequate historical period of record is not available. Therefore, it is not well understood how historical changes in groundwater levels have impacted the potential discharge rates. Until further analysis can be completed (including determination of potential groundwater source), meaningful sustainable management criteria for the potential GDE cannot be established.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					undesirable results in the basin. Defining undesirable results is the crucial first step 13 before the minimum thresholds can be determined.14 - When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the basin are reached.15 The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts on both environmental beneficial users of groundwater and surface water as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.6,16 - When establishing SMC for the basin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems".	
Samantha Arthur (Audubon Society)					2. Climate Change The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures 17. The effects of climate change will intensify the impacts of water stress on GDEs, making available shallow groundwater resources especially critical to their survival. Condon et al. (2020) shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.18 When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded. The integration of climate change into the projected water budget is insufficient. The GSP incorporates climate change into the projected water budget using DWR change factors for 2030 and 2070. However, the plan does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for the basin. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant and their inclusion can help identify important vulnerabilities in the basin's approach to groundwater management. The GSP incorporates climate change into key inputs (e.g., precipitation, evapotranspiration, and surface water flow) of the projected water budget. However, while climate change is acknowledged to be a likely influence on future basin yields, the GSP does not provide a sustainable yield based on the projected water budget with climate change incorporated. If the water budgets are incomplete, including the omission of extremely wet and dry scenarios, and sustainable yield is not calculated based on climate change projections, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems and domestic well owners.	As stated in your comment, the projected water budget incorporates DWR climate change factors for 2030 and 2070 as required by the SGMA Emergency Regulations (§354.18). The regulations do not explicitly require extreme climate change factors. The projected water budget includes a calculated basin yield with DWR climate change factors for 2030 and 2070 incorporated. Based on the proposed sustainable management criteria, the basin yield is equal to the sustainable yield for the Basin calculated for the historical period. Future updates to the GSP will include reevaluation of the water budget and sustainable yield based on conditions observed during that time. All elements of the projected water budget, basis for development of sustainable management criteria and projects and management actions considered DWR climate change factors for 2030 and 2070.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
					RECOMMENDATIONS - Integrate climate change, including extremely wet and dry scenarios, into all elements of the projected water budget to form the basis for development of sustainable management criteria and projects and management actions. - Estimate sustainable yield based on the projected water budget with climate change incorporated. - Incorporate climate change scenarios into projects and management actions.	
Samantha Arthur (Audubon Society)					3. Data Gaps The consideration of beneficial users when establishing monitoring networks is insufficient, due to lackof specific plans to increase the Representative Monitoring Sites (RMSs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, GDEs, and ISWs in the basin. Figure 5-1 (Groundwater Level Monitoring Network) shows insufficient representation of drinking water users and DACs for groundwater elevation monitoring. Figure 5-4 (Groundwater Quality Monitoring Network) shows sufficient spatial representation of drinking water users and DACs for water quality monitoring, but depth representation cannot be verified. Refer to Attachment E for maps of these monitoring sites in relation to key beneficial users of groundwater (note we were only able to prepare water quality monitoring maps with publicly available information). These beneficial users may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.19 The GSP provides some discussion of data gaps for GDEs and ISWs in Sections 5.8 (Depletion of Interconnected Surface Water Monitoring Network), Section 5.8.2 (Assessment and Improvement of Monitoring Network), and 6.3 (Tier 1 Management Action 1 – Address Data Gaps), but does not provide specific plans, such as locations or a timeline, to fill the data gaps. RECOMMENDATIONS - Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, GDEs, and ISWs to clearly identify monitored areas. - Increase the number of RMSs in the shallow aquifer across the basin as needed to adequately monitor all groundwater condition indicators across the basin and at appropriate depths for all beneficial users. Prioritize proximity to DACs, domestic wells, GDEs, and ISWs when identifying new RMSs. - Ensure groundwater elevation and water quality RMSs are monitoring groundwater conditions spatially and at the correct depth for all beneficial users - especially DACs, domestic wells, and GDEs.	Section 5.3.2 describes the GSAs continued effort to expand the monitoring network, including contacting landowners to request their wells be added to the groundwater level monitoring network and land access agreements be established. The rationale for the selection of the existing monitoring network is included in Section 5.3. The existing groundwater level monitoring network can adequately demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features. The existing groundwater level monitoring network provides a sufficient density of monitoring wells to collect representative measurements through depth-discrete perforated intervals that characterize the groundwater table or potentiometric surface for each principal aquifer (§ 354.34). Principal aquifers in the Basin include the Paso Robles Formation and the Careaga Sand. Shallower units including the channel alluvium are not considered principal aquifers based on criteria of a Principal Aquifer defined by SGMA ("aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater") because it does not reliably store, transmit, or yield enough water to wells. Based on Basin stakeholder feedback, available well completion reports, and the hydrogeologic conceptual model, no wells completed in the channel alluvium were identified. The proposed groundwater quality monitoring network adequately allows for collection of sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues (§ 354.34). Section 5.6.2 describes the GSAs continued effort to expand the monitoring network, including contacting landowners to request their wells be added to the groundwater level monitoring network and land access agreements be established.

Reviewer	Section Number	Page Number	Figure Number	Table Number	Comment	Response
Samantha Arthur (Audubon Society)					4. Addressing Beneficial Users in Projects and Management Actions The consideration of beneficial users when developing projects and management actions is insufficient due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for all beneficial users. The GSP fails to include projects and management actions with explicit near-term benefits to the environment. While Section 6.11 documents In Lieu Recharge Projects, they are described as being in the conceptual phase and may be considered by the GSA in the future. The plan includes a municipal well mitigation program. However, the GSP fails to specify the mitigation program's benefits to DACs, if any. RECOMMENDATIONS - For DACs and domestic well owners, include a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program. The GSP includes a discussion of an offsite well impact mitigation program in Section 6.3, however this program is for municipal wells, not domestic wells. If this program will have benefits to DACs, describe them in detail. - For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts. - Recharge ponds, reservoirs, and facilities for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For further guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document."20 - Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.	The GSP has been revised to address this comment. A sentence has been added in Section 6.5, which states "The information to be acquired through the well registration program can be used by the GSA for the purposes of potential risk and impact assessment with regard to the water supply adequacy and water quality for domestic and community drinking water wells within the Basin. If the information obtained through the well registration program indicates that there is a potential for adverse impacts to the future water supply adequacy or water quality of domestic and / or community drinking water supply wells then the GSA can elect to develop and implement a Drinking Water Well Impact Mitigation Program." No disadvantaged communities (DACs) were identified within the Basin, based on several datasets (refer to the IRWMP (Dudek, 2019); California Air Resources Board's (CARB) California Climate Investments (CCI) Priority Populations online mapping tool; California Office of Environmental Health Hazard Assessment's CalEnviroScreen online mapping tool of Senate Bill 535 DACs; and DWR's DACs online mapping tool using 2018 data at the places and tracts scale).

Chris Wrather comments on San Antonio Creek Valle y Basin GSP – Draft Chapter 3.
10/31/2020

Really well-done piece of work!

Introduction: No mention of USGS new study? (Oh, I see you mention it later.)

Fig 3.2 – I find it difficult to identify the regions on the map that correspond to the coloring of the legend. Would it be possible to use different colors or shading that makes it clearer?

Response: The colors to represent the different hydrologic soil groups were revised on Figure 3-2.

3.1.2.1. Would it be possible to draw the axes of these two synclines on one of the maps, and label them? I have a tough time following the textual descriptions.

Response: The Los Alamos Syncline and San Antonio Syncline are included on Figure 3-4. Note the projection of the Los Alamos Syncline is based on Dibblee et al. 1989, 1993, and 1994 in which both synclines were mapped as a single geologic structure.

What does "conformably" and "unconformably" mean?

Response: A conformity and unconformity are geology terms, stratigraphy specifically, describing a geologic contact between two rock layers in terms of the geologic record. If there is a large time gap between the two layers, the contact is referred to as an unconformity. Large time gaps between rock units can be caused by periods of non-deposition or erosion. Conversely, if the age of rock layers indicate there is no time gap in the geologic record, the contact is referred to as a conformity.

3.1.2.3 You use the word "Subbasin" in the heading. Is this different from "Basin"?

Response: This was a typo and has been corrected.

Fig 3.8 – Is this figure really necessary? It only shows the lateral boundaries of the basin. The lateral boundaries have already been shown in a number of other maps.

Response: The former Figure 3-8 was removed and the in-text references to the DWR Bulletin 118 basin boundary was changed to Figure 3-1.

Figure 3.10 – I notice you didn't include the "pond" on the Harris Ranch just NE of Los Alamos. I do see you included it in Fig. 3-11. Isn't it a spring?

Response: According to the U.S. Geological Survey National Hydrology Dataset, the locations of springs or seeps identified in the Basin are included on Figure 3-9. It is possible that more springs or seeps exist, or formerly existed within the Basin. It is also possible that surface water features exist due to surrounding land use or infrastructure (anthropogenic). Springs or seeps located in Las Flores watershed and Price Ranch were added to Figure 3-9 based on landowner observations.

Fig 3-13 – 3.16 (Ground water elevations) – These maps appear to show the groundwater elevations of the Careaga (600') as being higher than the Paso Robles (450') in the vicinity of Los Alamos. That doesn't make sense to me because the Careaga formation lies below the Paso Robles. What am I missing?

Response: The water levels are collected from wells completed in the Paso Robles Formation and Careaga Sand aquifers, which occur at different depths. The data indicate that the hydraulic head, or pressure within the Careaga Sand is higher than that of the Paso Robles Formation, and so the water levels in a well screened within the Careaga Sand are higher than those screened within the Paso Robles Formation. Nested well sets are useful for determining vertical groundwater gradients (which way is the groundwater flowing vertically, up or down?).

Fig 3-17 What would you think about running a linear regression analysis on the Annual Precipitation numbers to see if there is a trend?

Response: Cumulative departure from mean precipitation was used to indicate rainfall trends because this helps us understand the antecedent conditions that determine whether we have conditions that could drive more recharge (positive slope to the cumulative departure trend line) versus conditions that would create a moisture deficit and reduce recharge to the aquifer (negative slope).

3.2.1.2.1 "Notably, since 2016, water levels have begun to increase in the majority of monitoring wells as normal rainfall conditions returned after 2016." This strikes me as a bit misleading. We noted previously that in the most recent period during which the cumulative rainfall has achieved the long-term average, there was a significant decrease in static water levels in most wells, especially those in the Los Alamos "pumping center." I think the sentence as written leaves one with the impression that things might be turning around. I don't believe the data supports that they are.

Response: This sentence will be removed.

It would be helpful to add a vertical grid to the hydrographs so it is easier to match the data point to the year on the x-axis.

Response: The hydrographs were revised.

"thalweg" – Had to Google that one!

Response: The use of "thalweg" was removed from the text.

Fig. 3-24, 3-25, 3-27 and 3-27 It would be helpful to add a horizontal grid to make the decline over time clearer, and a vertical grid to better identify data point by year.

Response: The hydrographs were revised.

Table 3-5 – I'm a bit confused. In the 5th column (Number of Samples at or above WQ Standard), what is the WQ standard being used? It can't be WQO or SMCL, because those are not defined for most of the constituents.

Response: The table has been revised.

Fig 3-29 The red markers mark "Lust Cleanup" sites. What is that?

Response: It is an acronym meaning Leaking Underground Storage Tank (LUST). The State and Regional Water Quality Control Boards oversee and track LUST Cleanup sites. The SWRCB's online GeoTracker tool lists these sites and any correspondence and documents related to the site for public access.

3.2.3.4.2 – "Increasing chloride concentrations have been detected in a public supply well (LACSD 4) east of Los Alamos." Should this well be shown in Fig 3-32? I don't see it there.

Response: Yes. In the Notes section of Figure 3-37 (formerly 3-32), sample location 4210002-004 is defined as synonymous with LACSD 4. We left the 421002-004 naming scheme to be consistent with the groundwater sample names from the database source.

3.2.3.4.5 – Sodium – The text describes and MQO of 100 mg/L. But Fig 3-36 shows values much less than 1 mg/L. Wondering if the units in the figure should be g/L, not mg/L?

Response: Figure 3-45 (formerly 3-36) shows Boron concentrations. We reported all constituent concentrations as mg/L (except for Arsenic which is reported as micrograms per liter) in the text, tables, and figures.

3.2.3.5 Oil and Gas. I understand that there are no results yet from the COGG program. But is the fact that the Cat Canyon, Zaca, Lompoc and Orcutt fields are categorized as "high priority" relevant? Looks like Table 3-7 describes the factors that go into this ranking. What do we do with this information?

Response: The purpose of this section to is communicate that a study evaluating potential impacts of nearby oil and gas fields on local groundwater quality is being conducted and that the existence of the nearby oil and gas fields and the nature of oil and gas exploration is being considered in terms of water quality of the Basin. The figures and tables in the section are to provide context and further explanation of the COGG program. When the COGG program releases any findings/recommendation we can implement into the GSP where appropriate.

The 487 onshore oil and gas fields in California were prioritized based on potential risk to groundwater from oil and gas development. The USGS developed a criteria-based approach to prioritize the oil and gas fields, the criteria include petroleum-well density, volume of water injected in oil fields, vertical proximity of groundwater resources to oil and gas resource development, and water-well density (Davis et al., 2018).

3.2.5 Surface water systems. Suggested addition to text to make it unambiguous:
"[Surface water systems] gain water from inflow of groundwater through the stream bed."

Response: The suggested text was added to the three level one bullets in Section 3.2.5.

California Professional Geologist License No. 7676
California Certified Hydrogeologist No. 821

March 19, 2021

Bryan Bondy, President
Bondy Groundwater Consulting, Inc.
10488 Graham Ct.
Ventura, CA 93004

Anna Olsen, Executive Director
San Antonio Basin Groundwater Sustainability Agency
920 East Stowell Rd
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RE: Peer Review of Draft Water Budget for the San Antonio Creek Valley Basin GSP

Via E-mail to aolsen@sanantoniobasingsa.org

Dear Anna:

As requested, I have completed a peer review of the draft water budget prepared by GSI Water Solutions, Inc. for the San Antonio Creek Valley Basin (the Basin) Groundwater Sustainability Plan (GSP). As part of the water budget review, I found it necessary to read the draft hydrogeologic conceptual model (HCM) for the Basin to gain a prerequisite understanding of the geologic and hydrogeologic framework of the Basin. Comments on the HCM are included in this letter, with the caveat that a full peer review of that document was not performed.

Summary of Peer Review Findings

BGC agrees with the general conclusion that groundwater storage is in a state of chronic decline. This is clear from measured groundwater level data alone. There is, however, significant uncertainty in the volumetric rate of groundwater storage decline both historically and projected into the future. This uncertainty should be communicated in the document to help inform forthcoming planning decisions and schedules.

The uncertainty stems from the fact that the water budget was developed using a spreadsheet tool that cannot be calibrated to measured groundwater levels. There is the potential for significant error in the estimates of individual water budget components. Moreover, errors for multiple terms can be cumulative or offsetting[1]. There is currently no reliable method for producing

[1] Even though many of the water budget terms are derived from the USGS Basin Characterization Model (BMC), there are significant uncertainties in its results because it is a statewide scale model that is not calibrated to local measured data. In basins where the BCM is calibrated, the calibration is limited to the runoff term.

independent estimates of groundwater storage change for comparison with the spreadsheet tool results. This is primarily due to the fact that the Basin has deep, confined aquifers that transition to an unconfined condition where they are folded upward and exposed along the Basin periphery. Groundwater storage properties change by orders of magnitude where the aquifer transitions from a confined to unconfined condition and the location of this transition changes as groundwater levels change. This complexity can only be reliably accounted for using a properly calibrated numerical flow model of the Basin.

Preliminary results from the USGS numerical model were provided to BGC for consideration during this peer review. BGC notes that, in general, the USGS model calculated similar rates groundwater storage depletion as the spreadsheet tool. However, BGC notes that the spreadsheet tool and USGS model water budget differ dramatically in their estimated inflows terms. Notably, the spreadsheet tool inflow terms have much more annual variability than the USGS model. For example, the USGS model total inflow values during the recent drought are not materially different that the wetter period prior to the drought. In contrast the spreadsheet tool inflows drop dramatically during the drought, as would be expected. Intuitively, the greater variability exhibited in the spreadsheet tool makes much more sense. However, as mentioned earlier, the spreadsheet tool is not calibrated to groundwater levels. The fact that these two independent analyses of the Basin storage depletion arrived as similar storage change rates should <u>not</u> be taken as evidence that the storage depletion rates are well constrained because the independent estimates employed very different assumptions about the recharge processes.

Key Findings:

In summary, BGC agrees with the author that groundwater levels and storage are clearly in a state of chronic decline. However, there is significant uncertainty in the rate of groundwater storage depletion, both historically and projected into the future that is not characterized and communicated in the document. This uncertainty should be evaluated quantitatively and clearly communicated to the stakeholders and GSA Board for consideration when developing sustainable management criteria and projects/management actions for the GSP. The GSP should lay out a path to reducing uncertainty in the rate of storage depletion over time, commensurate with the costs of projects/management actions necessary to address the storage depletion. Actions that may be most impactful in reduce uncertainty include streamflow gauging and groundwater extraction reporting/metering.

As written, the water budget does not meet all of the GSP Emergency Regulations requirements. Additionally, the text is not clear about the assumptions and/or methods used in specific water budget calculations in many instances. The detailed comments provide specific feedback on these points. In general, the document would benefit from more discussion of methods and assumptions. This may help reduce comments from stakeholders and DWR and will provide a more defensible basis for projects and management actions.

Detailed Comments

The following are detailed comments on the documents. Most comments highlight aspects that were unclear to the reviewer. Addressing these comments may help stakeholders better understand the information and may streamline DWR's review of the GSP.

Water Budget

1. Section 3.3.2.1 - Surface Water Inflow Components, Page 10:
    a. Footnote 1: It is unclear why streamflow adjustments are exclusively taken from / added to the BCM recharge component as opposed to the BCM ET term or both terms. More explanation would be helpful.

    b. More explanation is needed in Section 3.3.2.2.2 for the reader to be able to understand the assumptions and methodology utilized in the streamflow percolation calculations.

2. It is unclear what modifications were made to the BCM datasets. Table 3-9 mentions that the BCM data are "calibrated" to either gage data (streamflow) or meteorological data (recharge). Section 3.3.2.1 discusses "adjustments" to the BCM data but does not mention "calibration." Section 3.3.2.3.1 says the BCM data were "adjusted" and "calibrated". It seems clear that the BCM data were adjusted. It is not clear whether or how the BCM data were "calibrated." More information is needed for the reader to understand what calibration, if any, was performed and what methods were used.

3. Section 3.3.2.3.4. - Percolation of Treated Wastewater (Effluent Spray Irrigation), Page 11: The author concludes that the effluent spray irrigation activities do not result in groundwater recharge, presumably because the applied water is equal to or less than the crop water requirement. It is unclear whether rainfall was accounted for in this analysis. In other words, if the crop water requirement is met by effluent spray irrigation, then precipitation would become recharge instead of being transpired by crops.

4. Section 3.3.2.3.6. - Irrigation Return Flow, Page 12:
    a. It is unclear whether irrigation system uniformity is accounted for in the calculations.

    b. Consider providing references for the three efficiency factors discussed in this section.

5. Section 3.3.2.4.1. - LACSD Pumping, Page 12: The calculations for pre-1994 LACSD pumping does not make sense to the reviewer.
    a. In the example provided, how can you calculate 1992 LACSD pumping using 1993 LACSD pumping if 1993 LACSD pumping is not known to begin with?

b. It is unclear why scaling using rural domestic pumping would be relevant to estimating LACSD pumping. More explanation is needed for the reader to understand.

6. Section 3.3.2.4.5. - Riparian Evapotranspiration, Page 13:
   a. Consider providing a reference for the riparian water duty factor.

   b. Are there invasive species (e.g., *Arundo donax*) present that might justify a higher water duty factor?

7. Section 3.3.2.4.6. - Discharge to Surface Water, Page 13:
   a. The calculations described in this section are unclear, especially the text stating "…or determined using monitoring well data and surficial topography." (Please note that Appendix D-4 was not provided for the peer review).

   b. It is unclear what the calculation described in the last sentence of this section is for and how it relates to the calculations described earlier in this section.

   c. It is unclear whether vertical hydraulic conductivity values were considered in the calculations.

   d. The document should describe the potential range of uncertainty in these calculations.

8. Section 3.3.3.1 - Historical Surface Water Budget, Pages 14-15: It is unclear why the average surface water inflow (5,000 AFY [Table 3-11]) is not balanced with the average surface water outflow (5,400 AFY [Table 3-12]), given that all of the years shown in Figure 3-48 appear to be balanced. Is groundwater discharge to surface water included in the outflow, but just not shown on Figure 3-48? If so, groundwater discharge should be included as a surface water inflow in Table 3-11 and shown explicitly in Table 3-12.

9. Section 3.3.4.1 – Current Surface Water Budget, Pages 27-28: Similar question as in Water Budget Comment No. 8.

10. Section 3.3.5.1 - Projected Water Budget Calculation Methods, Pages 36-38:
    a. BGC was unable to determine what 50-year period of historical hydrology was used to develop the project water budget. Page 37, last full paragraph, discusses the time periods of various data sets, but does not state what historical period is used to develop the projected water budgets. This paragraph says, "The precipitation and ET change projections are computed relative to a baseline period of 1981 to 2011." Is that the period that was used? If so, the reviewer notes that this period is only 31 years whereas a 50-yr period is required. The historical period needs to be stated explicitly for the reader.

b. Concerning the statement "The USGS BCM, as discussed in Section 3.3.2.1.1, was calibrated to the DWR Variable Infiltration Capacity (VIC) hydrology model…" It does not appear the VIC model was used to calibrate the BCM model. It appears that author instead means to say that the climate change factors derived from the VIC model were used to adjust the BCM results to account for climate change in the water budget. The term "calibrate" is used in this same context in Section 3.3.5.1.2 and Table 9. Consider revising.

11. Section 3.3.5.2 – Projected Surface Water Budget, Pages 38-39: Similar question as in Water Budget Comment No. 8.

12. Sections 3.3.5.2 - 3.3.5.3, Tables 3-23 – 3-27, and Figures 3-55 – 3-56:
    a. 2042 and 2072 water budgets are presented and compared with the historical water budget. It is unclear what the 2042 and 2072 water budgets represent. Are they single year water budgets? Alternatively, do they represent average conditions over some period projected in the future?

    b. The projected water budget information presented in these sections does not meet the GSP Emergency Regulations requirement for annual quantification of the water budget for the 50-yr projection period (GSP Emergency Regulations § 354.18).

    c. The projected water budget information presented in these sections does not meet the GSP Emergency Regulations requirement for including a baseline future conditions against which effects of climate change and projected water demand are compared (GSP Emergency Regulations § 354.18(c)(3(A)&(B)).

    d. An annual water budget table and bar chart like that provided for the historical water budget (Table 3-16 and Figure 3-50) should be provided for the future water budget in the GSP.

13. Section 3.3.5.3.1. - Projected Water Demand, Pages 41-42, and Table 3-27:
    a. It is unclear how the projected agricultural water demand was calculated. Based on the text description of the approach, BGC calculated 2072 Ag Demand as follows: 13,459 acres X 1.75 AF/acre X 1.08 (i.e., the 2070 ET change factor) = 25,440 AF. The text and Table 3-27 indicate 26,800 AF. More clarifying explanation would be helpful.

    b. It would be helpful to explain that imported water became available to VAFB during the historical period to provide context for why the VAFB water demand is projected to decrease in the future relative to historical demand.

14. Section 3.3.5.3.2. - Projected Water Budget and Change in Groundwater Storage, Page 44: The statement "Average annual precipitation for the projected period is equal to the historical period average annual precipitation for the 2042 projected period and—interestingly—2.6 percent greater than the historical period average for the 2072 projected period" appears to conflict with the following statements on Page 38: "Annual precipitation increases by approximately 1 percent projected under 2030 conditions relative to the baseline period. Under 2070 conditions, small decreases in annual precipitation, of approximately 2 percent, are projected."

15. Section 3.3.5.3.4. - Basin Yield Estimate, Page 48: The statement "The projected average annual amount of groundwater in storage is estimated to decrease by…" is incorrect. This statement should refer to the *change in* groundwater storage, not the amount of groundwater in storage.

16. Section 3.3.6 – Spreadsheet Tool Assumptions and Uncertainty, Page 49:

    a. The text states that "The GSP spreadsheet tool is based on…calibrated USGS BCM for the Basin." It is unclear whether the BCM model was actually calibrated to measured data for the San Antonio Creek Valley Basin. The BCM model is a statewide model and has only been calibrated to surface water flow and only in selected basins. The memo does not describe whether San Antonio Creek Valley Basin is one of those basins. If it is, more information should be provided concerning the quality of the calibration and clarify that the calibration only applies to streamflow (i.e., recharge is uncalibrated). If it is not, the text should not say the BCM model is calibrated for the Basin.

    b. The text states that "Uncertainty inherent in the spreadsheet tool has been considered in the development of management actions and projects discussed in Section 6." It is unclear how the uncertainty in the spreadsheet tool can be considered in other GSP sections because the uncertainty is not characterized here. A more comprehensive descriptive assessment of the uncertainty in the spreadsheet tool results should be presented in this section together with quantitative estimates of the uncertainty.

    c. The text states that "It is GSI's opinion that the results of the water budget analysis using the spreadsheet tool are sufficient to establish the magnitude of the annual and cumulative change in groundwater in storage." Building on the prior comment, this statement should tempered by including discussion of the estimated magnitude of potential errors in the annual and cumulative change in storage.

    d. The text describes an independent calculation of storage change for the period 2015-2018 using groundwater levels and assumed aquifer storage coefficients. The text concludes that the spreadsheet tool 2015-2018 storage change result compares favorably with the independent storage change calculation for the same period. However, this does not appear to be correct. The spreadsheet tool 2015-2018 storage change result of 52,100 AF does not compare favorably with the independent calculation result of 83,800 AF (61% difference). Moreover, the independent calculation is very error-prone given the lack of knowledge concerning the location where groundwater transitions from confined to unconfined conditions.

HCM

1. It would be helpful to label Harris Canyon on one or more figures because it is frequently referred to in the text.

2. Los Alamos and San Antonio Synclines should be depicted on the geologic map, as they are important structures discussed in the text (Figure 3-4).

3. Potential Groundwater Dependent Ecosystems (pGDEs):

    a. The pGDEs discussed in Section 3.1.3.2.2. and depicted on Figure 3-11 should be reviewed to screen out pGDEs that are not actually dependent on groundwater in a principal aquifer. Top of aquifer and groundwater elevation data should be used for this screening. The screening should also include review of aerial photos to identify and screen out and pGDEs that appear to be reliant discharges from human-made structures, such as irrigation canals, irrigated fields reservoirs, septic systems, cattle ponds, or water treatment works. It is highly recommended that these tasks be completed before developing sustainable management criteria.

    b. The wetland areas called out on Figure 3-11 should be screened to assess whether they are actually wetlands and whether they are connected to groundwater in a principal aquifer. BGC reviewed Google Earth and groundwater levels from Figures 3-13 and 3-15. BGC's found that some mapped wetlands lack visual evidence of a wetland or may be an irrigation reservoir. With one exception, BGC found that the mapped wetlands are at elevations that are at least 25 feet above the groundwater elevation in the underlying aquifer, with most being 100 feet or more above. This suggests that the mapped wetland features are not likely connected to groundwater in a principal aquifer and should be screened out. In the one exception, further evaluation is needed to determine if the groundwater is confined or unconfined before concluding the mapped wetland is hydraulically connected to the principal aquifer.

    c. Page 26, last sentence: "Additional field reconnaissance is necessary to verify the existence of these potential GDEs." The screening described above can be completed without field reconnaissance and should be performed. Field reconnaissance may only be necessary for pGDEs that cannot be screened out or confirmed via the desktop screening methods.

4. The Section 3.1.4 discussion of data gaps and uncertainty should be revised to be consistent with the SGMA definitions of those terms. The definitions are as follows. GSP Emergency Regulations §351(l) define the term “data gap” as "a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed." GSP Emergency Regulations §351(ai) define the term "uncertainty" as "a lack of understanding of the basin setting that significantly affects an Agency’s ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed." Essentially, these definitions mean that a data limitation or lack of information must materially impact the ability to sustainably manage the basin to be considered a "data gap" or "uncertainty". Section 3.1.4 does not make the case that the items listed would materially impact the ability to sustainably manage the Basin. Further explanation is needed, or the discussion of these items should be revised to make clear they are not “data gaps” as the term is defined for SGMA. This is important because the implication is that "data gaps" and "uncertainties" identified in the GSP must be filled to sustainably manage the basin, likely at a significant cost to the groundwater users.

   Similarly, Page 39 states that “The limited spatial coverage of publicly available groundwater level data for the Paso Robles Formation Aquifer is a significant data gap.” A similar statement is made for the Careaga Sand Formation Aquifer on Page 44. These statements seem inconsistent with groundwater level contour maps which show data coverage across the basin for contour preparation. More information is needed to justify the conclusion that the current well network is so limited that it materially impacts the ability of the GSA to sustainably manage the basin. Specific data gaps in the monitoring network should be identified and tied to specific sustainable management issues.

5. Groundwater Contours (Figures 3-13 and 3-14) – Consider dashing contours that lack data control.

6. Section 3.2.4 concerning land subsidence should discuss the possibility that the small measured land surface elevation changes could be related to tectonic activity. The Basin is located in a tectonically active region and is itself a down warping synclinal trough. The lack of discussion about tectonics creates an impression that the land surface elevation changes are exclusively attributed to groundwater withdrawal. The text should be revised to eliminate this impression. Over time, it will likely be possible to distinguish land surface elevation changes due to tectonic motion from those caused by groundwater

withdrawal by comparing InSAR and long-term groundwater level date with UNAVCO continuous GSP elevation trends.

<u>Closing</u>
Thank you for the opportunity to peer review the water budget. Please contact me if you have any questions about the review findings.

Sincerely,

Bryan Bondy, President
Bondy Groundwater Consulting, Inc.

cc: Jeff Barry, GSI

GSI Water Solutions, Inc.

TECHNICAL MEMORANDUM

San Antonio Creek Valley Groundwater Basin – Draft Water Budget Peer Review

To:	San Antonio Creek Valley Groundwater Basin Groundwater Sustainability Agency Ad Hoc Committee
From:	Michael McAlpin, GSI Water Solutions, Inc. Jeff Barry, GSI Water Solutions, Inc. Nate Page, GSI Water Solutions, Inc.
CC:	Jim McCord, IRP Water
Attachments:	Appendix D-4
Date:	November 19, 2021

Introduction

The purpose of this document is to address comments made by Mr. Bryan Bondy of Bondy Groundwater Consulting, Inc. on March 19, 2021 regarding the Draft Water Budget (Section 3.3) of the Groundwater Sustainability Plan for the subject basin.

Comments made by Mr. Bondy are shown in *italicized* and **bold** font. Mr. Bondy's comments include a reference to a specific sub-section followed by associated comments. GSI's response is shown as regular body text following each comment.

Draft Water Budget Peer Review Comments and Response

Water Budget

1. Section 3.3.2.1 - Surface Water Inflow Components, Page 10:

a. Footnote 1: It is unclear why streamflow adjustments are exclusively taken from / added to the BCM recharge component as opposed to the BCM ET term or both terms. More explanation would be helpful.

Response: Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

b. More explanation is needed in Section 3.3.2.2.2 for the reader to be able to understand the assumptions and methodology utilized in the streamflow percolation calculations.

Response: Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

2. It is unclear what modifications were made to the BCM datasets. Table 3-9 mentions that the BCM data are "calibrated" to either gage data (streamflow) or meteorological data (recharge). Section 3.3.2.1

discusses "adjustments" to the BCM data but does not mention "calibration." Section 3.3.2.3.1 says the BCM data were "adjusted" and "calibrated". It seems clear that the BCM data were adjusted. It is not clear whether or how the BCM data were "calibrated." More information is needed for the reader to understand what calibration, if any, was performed and what methods were used.

Response: Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

The BCM precipitation data was adjusted to regional precipitation station data (by adjusting the BCM precipitation data to honor the regional precipitation station data for the pixels where the precipitation gages are located). Initial adjustments to BCM recharge and runoff terms were based on the adjusted precipitation ratio (adjusted precipitation ÷ raw precipitation). Subsequent adjustments were made between recharge and runoff terms to match surface water flow gauge data or to match general understanding of runoff to recharge relationships in the area. This was based on a simple hydrologic conceptual model (rejected recharge and streambed percolation of runoff) and related mathematical models were calibrated to the surface water gauge flow data. All the BCM generated recharge and runoff in the basin was always accounted for, no mass was lost or removed. Rejected recharge was accounted for as surface water and all runoff generated during drier years percolated as streambed percolation.

3. Section 3.3.2.3.4. - Percolation of Treated Wastewater (Effluent Spray Irrigation), Page 11: The author concludes that the effluent spray irrigation activities do not result in groundwater recharge, presumably because the applied water is equal to or less than the crop water requirement. It is unclear whether rainfall was accounted for in this analysis. In other words, if the crop water requirement is met by effluent spray irrigation, then precipitation would become recharge instead of being transpired by crops.

Response: Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

4. Section 3.3.2.3.6. - Irrigation Return Flow, Page 12:

a. It is unclear whether irrigation system uniformity is accounted for in the calculations.

Response: Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

For irrigated agriculture in the Basin, an irrigation efficiency of 80 percent is assumed for all crops except vineyards, which are generally irrigated using a drip system at an efficiency of 90 percent.[1] The urban landscape irrigation efficiency is assumed to be 70 percent. These irrigation return flow proportions were based on feedback with the Basin's GSA Special Advisory Committee and with representatives from the Santa Ynez EMA, CMA, and WMA GSAs. These irrigation return flows were used throughout the Basin. Irrigation return flow volumes have been calculated using these efficiencies multiplied by the calculated annual volumes of irrigation water applied to each crop type (based on land use surveys within the Basin in from 1959, 1968, 1977, 1986, 1996, 2006, 2016, and 2020) and assigned crop-specific water duty factors.

b. Consider providing references for the three efficiency factors discussed in this section.

Response: References will be included in the revised text.

5. Section 3.3.2.4.1. - LACSD Pumping, Page 12: The calculations for pre-1994 LACSD pumping does not make sense to the reviewer.

[1] Irrigation efficiencies within vineyards have increased from 70 percent in the 1970s to 80 percent in the 1980s, and to 90 percent more recently, based on personal conversations with regional irrigators.

a. In the example provided, how can you calculate 1992 LACSD pumping using 1993 LACSD pumping if 1993 LACSD pumping is not known to begin with?

Response: The projected historical (1981-1993) and future (2022-2072) LACSD pumping is calculated using reported LACSD pumping data (1994-2018). The WYs used for the example calculations in the text will be revised to include a WY with reported LACSD pumping. Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

b. It is unclear why scaling using rural domestic pumping would be relevant to estimating LACSD pumping. More explanation is needed for the reader to understand.

Response: The population data (historical and projected) used for scaling of LACSD pumping and rural domestic pumping is the same. Therefore, the scaling factors for both groundwater budget components were equal. The calculations were completed first on the projected rural domestic pumping and subsequently used to calculate the LACSD projected pumping. Further explanation of calculations of surface and groundwater budget components will be included in the revised text and or as Appendix E.

6. Section 3.3.2.4.5. - Riparian Evapotranspiration, Page 13:

a. Consider providing a reference for the riparian water duty factor.

Response: References will be included in the revised text.

b. Are there invasive species (e.g., Arundo donax) present that might justify a higher water duty factor?

Response: Currently, no complete biological survey has been conducted or made available for review to identify specific plant species that may be contributing to riparian ET. Thus, we have no information concerning invasive species in the basin. Surveys completed adjacent to the Basin have been reviewed and the identified plant species will be considered during revision of the riparian ET groundwater budget component.

7. Section 3.3.2.4.6. - Discharge to Surface Water, Page 13:

a. The calculations described in this section are unclear, especially the text stating "…or determined using monitoring well data and surficial topography." (Please note that Appendix D-4 was not provided for the peer review).

Response: The monitoring well data referred to nested monitoring wells located adjacent to Barka Slough used to calculate vertical gradient. The surficial topography was used to calculate the hydraulic gradient of the alluvium located east of Barka Slough. Explanation of these calculations were included as Appendix D-4 which we neglected to include in the review package.

The Discharge to Surface Water groundwater budget component has been revised since the release of the subject draft section.

GSI revised the groundwater discharge to surface water and surface water discharge components of the water budgets to directly incorporate surface water flow data from the Casmalia stream gage, located on San Antonio Creek downstream (west) of the slough. This allowed a direct calculation of the Barka Slough outflows utilizing available recorded flow data in San Antonio Creek as described below.

The USGS BCM runoff model (adjusted to regional rain gauge data) was used directly to estimate the annual surface water inflow to the Barka Slough (**SswIN**). The annual surface water flow discharging from the slough (**SswOUT**) was estimated by subtracting the USGS BCM runoff model flows for the watershed areas contributing flow to San Antonio Creek downstream of the slough and upstream of the Casmalia gage (**BCMds**) and adding the estimated annual agricultural ET for the crops located adjacent to the creek between the slough and the gage (**AgET**) to the annual surface water flow measured at the Casmalia gage (**Cas**), as shown here:

$$SswOUT = Cas - BCMds + AgET$$

The agriculture ET (**AgET**) was estimated using a fixed annual water duty factor of 2.1 AF/ac-yr (for truck and berry crops per the 2018 LandIQ dataset available on SGMA DataViewer) and an assumed 20 percent irrigation return flow rate. The **AgET** estimate is based on the assumption that crop irrigation water is derived from shallow alluvial wells in direct communication with San Antonio Creek and that irrigation return flows wind up back in direct communication with the creek[2].

The estimated total annual volume of groundwater discharge to surface water in the slough (**GWdis**) was estimated as follows:

$$GWdis = SswOUT - SswIN + SET$$

where, **SswIN** is the surface water inflows to the Slough and **SET** is the estimated annual slough riparian evapotranspiration.

Appendix D will be included in the revised document.

b. It is unclear what the calculation described in the last sentence of this section is for and how it relates to the calculations described earlier in this section.

Response: The Discharge to Surface Water groundwater budget component has been revised since the release of the subject draft section. See response to comment 7a.

c. It is unclear whether vertical hydraulic conductivity values were considered in the calculations.

Response: The Discharge to Surface Water groundwater budget component has been revised since the release of the subject draft section. See response to comment 7a.

d. The document should describe the potential range of uncertainty in these calculations.

Response: A discussion of uncertainty regarding calculation of each groundwater budget component will be included in the revised text.

8. Section 3.3.3.1 - Historical Surface Water Budget, Pages 14-15: It is unclear why the average surface water inflow (5,000 AFY [Table 3-11]) is not balanced with the average surface water outflow (5,400 AFY [Table 3-12]), given that all of the years shown in Figure 3-48 appear to be balanced. Is groundwater discharge to surface water included in the outflow, but just not shown on Figure 3-48? If so, groundwater discharge should be included as a surface water inflow in Table 3-11 and shown explicitly in Table 3-12.

Response: Groundwater discharge to surface water will be included as an inflow term in the revised Surface Water Budget (including text, tables, and figures); consequently, resulting in a balance of average surface water inflow and outflow.

9. Section 3.3.4.1 – Current Surface Water Budget, Pages 27-28: Similar question as in Water Budget Comment No. 8.

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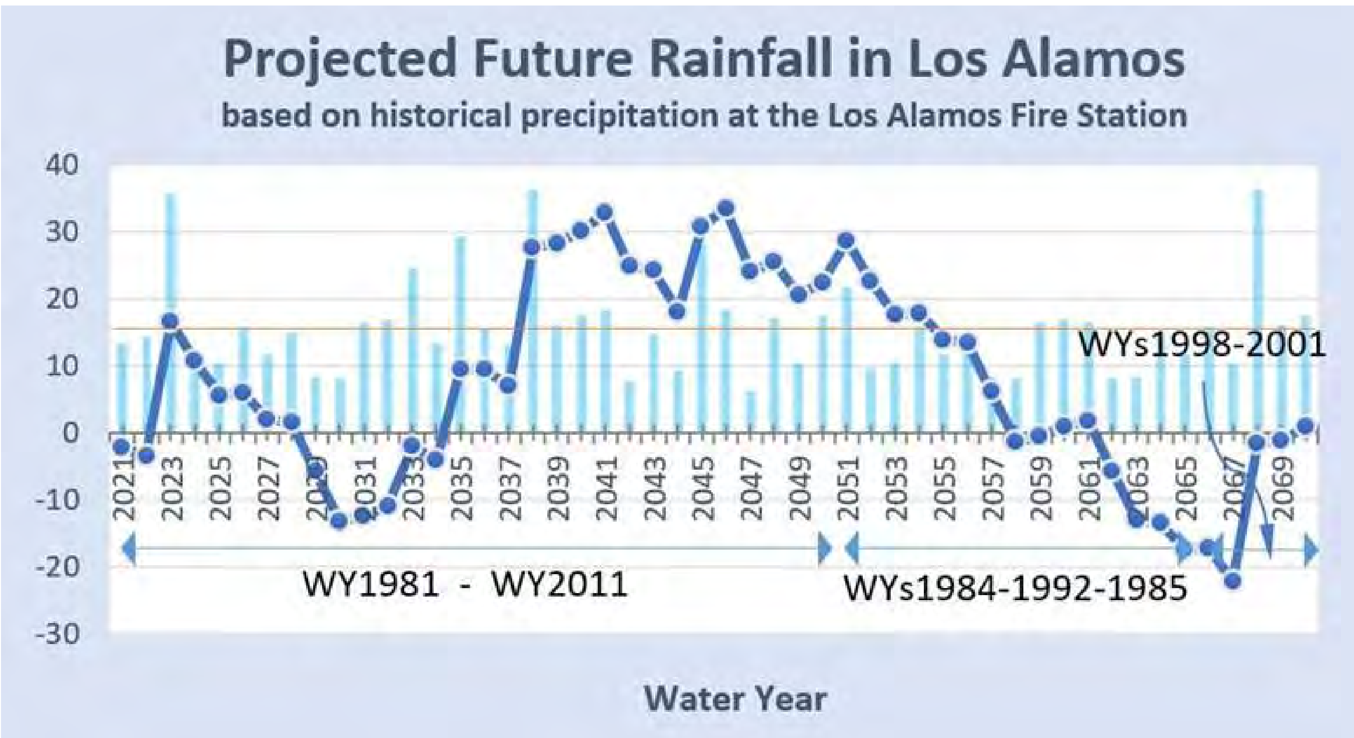
[2] This assumption is supported by geologic mapping showing that San Antonio Creek is contained within a narrow package of recent alluvium underlain by relatively impermeable bedrock between Barka Slough and the Casmalia gage (Dibblee and Ehrenspeck, 1989).

Response: Groundwater discharge to surface water will be included as an inflow term in the revised Surface Water Budget (including text, tables, and figures); consequently, resulting in a balance of average surface water inflow and outflow.

10. Section 3.3.5.1 - Projected Water Budget Calculation Methods, Pages 36-38:

a. BGC was unable to determine what 50-year period of historical hydrology was used to develop the project water budget. Page 37, last full paragraph, discusses the time periods of various data sets, but does not state what historical period is used to develop the projected water budgets. This paragraph says, "The precipitation and ET change projections are computed relative to a baseline period of 1981 to 2011." Is that the period that was used? If so, the reviewer notes that this period is only 31 years whereas a 50-yr period is required. The historical period needs to be stated explicitly for the reader.

Response: The historical period included the following sequence of WYs and a graphic is included for illustration below: 1981-2011, 1984-1992-1985, and 1998-2001.



WYs used in the projected 50-year base period were limited by the following data sets: the historical water budget period (1981-2018), the USGS BCM data set (1980-2018), and the VIC model data set (1915-2011).

The revised text will include further clarification of the 50-year period used for historical hydrology to develop the projected water budget.

b. Concerning the statement "The USGS BCM, as discussed in Section 3.3.2.1.1, was calibrated to the DWR Variable Infiltration Capacity (VIC) hydrology model…" It does not appear the VIC model was used to calibrate the BCM model. It appears that author instead means to say that the climate change factors derived from the VIC model were used to adjust the BCM results to account for climate change in the water budget. The term "calibrate" is used in this same context in Section 3.3.5.1.2 and Table 9. Consider revising.

Response: The use of terms such as "calibrated" and "adjusted" will be reviewed and revised appropriately in the revised text.

11. Section 3.3.5.2 – Projected Surface Water Budget, Pages 38-39: Similar question as in Water Budget Comment No. 8.

Response: Groundwater discharge to surface water will be included as an inflow term in the revised Surface Water Budget (including text, tables, and figures); consequently, resulting in a balance of average surface water inflow and outflow.

12. Sections 3.3.5.2 - 3.3.5.3, Tables 3-23 – 3-27, and Figures 3-55 – 3-56:

a. 2042 and 2072 water budgets are presented and compared with the historical water budget. It is unclear what the 2042 and 2072 water budgets represent. Are they single year water budgets? Alternatively, do they represent average conditions over some period projected in the future?

Response: The 2042 and 2072 water budgets represent average conditions over a 50-year projected period (see response to comment 10a for 50-year base period). Further clarification will be included in the revised text.

b. The projected water budget information presented in these sections does not meet the GSP Emergency Regulations requirement for annual quantification of the water budget for the 50-yr projection period (GSP Emergency Regulations § 354.18).

Response: The projected water budgets were developed using a 50-year projection period (see response to comment 10a for 50-year base period). An average of the annual conditions is used for in text discussion and graphics. Annual quantification of the water budget for the 50-year projection was completed to calculate the average for the 2042 and 2072 projected future water budgets. A table (like the Spreadsheet Tool) representing annual quantification over the 50-year projected water budget period will be included in the revised text and or Appendix E.

c. The projected water budget information presented in these sections does not meet the GSP Emergency Regulations requirement for including a baseline future conditions against which effects of climate change and projected water demand are compared (GSP Emergency Regulations § 354.18(c)(3(A)&(B)).

(A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.
(B) Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate.

Response: A 50-year baseline period was used in the development of the projected water budget (see response to comment 10a for 50-year base period). In order to develop a projected water budget with climate change factors and projected water demand incorporated, a 50-year baseline period had be to developed first; consequently satisfying regulations 354.18(c)(3(A)&(B) in GSI's interpretation. Tables similar to the Spreadsheet Tool for the 50-year baseline period and projected periods are included in Appendix E.

d. An annual water budget table and bar chart like that provided for the historical water budget (Table 3-16 and Figure 3-50) should be provided for the future water budget in the GSP.

Response: The projected water budgets were developed using a 50-year projection period. An average of the conditions is used for in text discussion and graphics. A table (like 3-21) representing annual quantification over the 50-year projected water budget period was developed to calculate average conditions will be included in the revised text or Appendix E. Generation of a chart showing annual water budget factors (like Figure 3-50) from this table will be considered.

13. Section 3.3.5.3.1. - Projected Water Demand, Pages 41-42, and Table 3-27:

a. It is unclear how the projected agricultural water demand was calculated. Based on the text description of the approach, BGC calculated 2072 Ag Demand as follows: 13,459 acres X 1.75 AF/acre X 1.08 (i.e., the 2070 ET change factor) = 25,440 AF. The text and Table 3-27 indicate 26,800 AF. More clarifying explanation would be helpful.

Response: This was a mathematical error using the incorrect change factor and will be revised.

b. It would be helpful to explain that imported water became available to VAFB during the historical period to provide context for why the VAFB water demand is projected to decrease in the future relative to historical demand.

Response: Further clarification will be included in the revised text regarding SWP water becoming available to VAFB via the CCWA during the historical period.

14. Section 3.3.5.3.2. - Projected Water Budget and Change in Groundwater Storage, Page 44: The statement "Average annual precipitation for the projected period is equal to the historical period average annual precipitation for the 2042 projected period and— interestingly—2.6 percent greater than the historical period average for the 2072 projected period" appears to conflict with the following statements on Page 38: "Annual precipitation increases by approximately 1 percent projected under 2030 conditions relative to the baseline period. Under 2070 conditions, small decreases in annual precipitation, of approximately 2 percent, are projected."

Response: This was a typo and will be revised.

15. Section 3.3.5.3.4. - Basin Yield Estimate, Page 48: The statement "The projected average annual amount of groundwater in storage is estimated to decrease by..." is incorrect. This statement should refer to the change in groundwater storage, not the amount of groundwater in storage.

Response: GSI interprets the change of groundwater storage as storage capacity (e.g., land subsidence resulting from collapse of pore space and a loss of groundwater storage). GSI understands change of groundwater in storage as the change in the volume of groundwater in storage, rather than the loss of groundwater storage capacity.

16. Section 3.3.6 – Spreadsheet Tool Assumptions and Uncertainty, Page 49:

a. The text states that "The GSP spreadsheet tool is based on...calibrated USGS BCM for the Basin." It is unclear whether the BCM model was actually calibrated to measured data for the San Antonio Creek Valley Basin. The BCM model is a statewide model and has only been calibrated to surface water flow and only in selected basins. The memo does not describe whether San Antonio Creek Valley Basin is one of those basins. If it is, more information should be provided concerning the quality of the calibration and clarify that the calibration only applies to streamflow (i.e., recharge is uncalibrated). If it is not, the text should not say the BCM model is calibrated for the Basin.

Response: The use of terms such as "calibrated" and "adjusted" will be reviewed and revised appropriately in the revised text. Further clarification of the use of the USGS BCM will be included in the revised text.

b. The text states that "Uncertainty inherent in the spreadsheet tool has been considered in the development of management actions and projects discussed in Section 6." It is unclear how the uncertainty in the spreadsheet tool can be considered in other GSP sections because the uncertainty is not characterized here. A more comprehensive descriptive assessment of the uncertainty in the spreadsheet tool results should be presented in this section together with quantitative estimates of the uncertainty.

Response: A discussion of uncertainty regarding calculation of each groundwater budget component used in the spreadsheet tool will be included in the revised text.

c. The text states that "It is GSI's opinion that the results of the water budget analysis using the spreadsheet tool are sufficient to establish the magnitude of the annual and cumulative change in groundwater in storage." Building on the prior comment, this statement should be tempered by including discussion of the estimated magnitude of potential errors in the annual and cumulative change in storage.

Response: A discussion of uncertainty regarding calculation of each groundwater budget component and, if feasible, potential errors in the estimated magnitude of annual and cumulative change in storage will be included in the revised text.

d. The text describes an independent calculation of storage change for the period 2015-2018 using groundwater levels and assumed aquifer storage coefficients. The text concludes that the spreadsheet tool 2015-2018 storage change result compares favorably with the independent storage change calculation for the same period. However, this does not appear to be correct. The spreadsheet tool 2015- 2018 storage change result of 52,100 AF does not compare favorably with the independent calculation result of 83,800 AF (61% difference). Moreover, the independent calculation is very error-prone given the lack of knowledge concerning the location where groundwater transitions from confined to unconfined conditions.

Response: The spreadsheet tool calculation of change in storage for the period 2015-2018 includes 4 water years (2015, 2016, 2017, and 2018) resulting in a change in storage value of 77,600 AF (7 percent difference when compared to the groundwater level elevation-based calculation of 83,800 AF).

HCM

1. It would be helpful to label Harris Canyon on one or more figures because it is frequently referred to in the text.

Response: The location of Harris Canyon is labeled on Figure 3-1. The labeling of Harris Canyon will be considered during revision of other figures.

2. Los Alamos and San Antonio Synclines should be depicted on the geologic map, as they are important structures discussed in the text (Figure 3-4).

Response: The Los Alamos Syncline and San Antonio Syncline are included on Figure 3-4. Note the projection of the Los Alamos Syncline is based on Dibblee et al. 1989, 1993, and 1994 in which both synclines were mapped as a single geologic structure.

3. Potential Groundwater Dependent Ecosystems (pGDEs):

a. The pGDEs discussed in Section 3.1.3.2.2. and depicted on Figure 3-11 should be reviewed to screen out pGDEs that are not actually dependent on groundwater in a principal aquifer. Top of aquifer and groundwater elevation data should be used for this screening. The screening should also include review of aerial photos to identify and screen out and pGDEs that appear to be reliant discharges from human-made structures, such as irrigation canals, irrigated fields reservoirs, septic systems, cattle ponds, or water *treatment works. It is highly recommended that these tasks be completed before developing sustainable management criteria.*

Response: Further evaluation of pGDEs was conducted after the distribution of the draft HCM section of the Basins GSP. The analysis considered elements included in the above comment.

b. The wetland areas called out on Figure 3-11 should be screened to assess whether they are actually wetlands and whether they are connected to groundwater in a principal aquifer. BGC reviewed Google Earth and groundwater levels from Figures 3-13 and 3-15. BGC's found that some mapped wetlands lack visual evidence of a wetland or may be an irrigation reservoir. With one exception, BGC found that the mapped wetlands are at elevations that are at least 25 feet above the groundwater elevation in the underlying aquifer, with most being 100 feet or more above. This suggests that the mapped wetland features are not likely connected to groundwater in a principal aquifer and should be screened out. In the one exception, further evaluation is needed to determine if the groundwater is confined or unconfined before concluding the mapped wetland is hydraulically connected to the principal aquifer.

Response: Further evaluation of pGDEs (including wetlands) was conducted after the distribution of the draft HCM section of the Basins GSP. The analysis considered elements included in the above comment.

c. Page 26, last sentence: "Additional field reconnaissance is necessary to verify the existence of these potential GDEs." The screening described above can be completed without field reconnaissance and should be performed. Field reconnaissance may only be necessary for pGDEs that cannot be screened out or confirmed via the desktop screening methods.

Response: Further evaluation of pGDEs (including wetlands) was conducted after the distribution of the draft HCM section of the Basins GSP. The analysis considered elements included in the above comment.

4. The Section 3.1.4 discussion of data gaps and uncertainty should be revised to be consistent with the SGMA definitions of those terms. The definitions are as follows. GSP Emergency Regulations §351(l) define the term "data gap" as "a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed." GSP Emergency Regulations §351(ai) define the term "uncertainty" as "a lack of understanding of the basin setting that significantly affects an Agency's ability to develop sustainable management criteria and appropriate projects and management actions in a Plan, or to evaluate the efficacy of Plan implementation, and therefore may limit the ability to assess whether a basin is being sustainably managed." Essentially, these definitions mean that a data limitation or lack of information must materially impact the ability to sustainably manage the basin to be considered a "data gap" or "uncertainty". Section 3.1.4 does not make the case that the items listed would materially impact the ability to sustainably manage the Basin. Further explanation is needed, or the discussion of these items should be revised to make clear they are not "data gaps" as the term is defined for SGMA. This is important because the implication is that "data gaps" and "uncertainties" identified in the GSP must be filled to sustainably manage the basin, likely at a significant cost to the groundwater users.

Response: The use of the terms "data gap" and "uncertainty" will be evaluated for consistency with SGMA definitions.

Similarly, Page 39 states that "The limited spatial coverage of publicly available groundwater level data for the Paso Robles Formation Aquifer is a significant data gap." A similar statement is made for the Careaga Sand Formation Aquifer on Page 44. These statements seem inconsistent with groundwater level contour maps which show data coverage across the basin for contour preparation. More information is needed to justify the conclusion that the current well network is so limited that it materially impacts the ability of the

GSA to sustainably manage the basin. Specific data gaps in the monitoring network should be identified and tied to specific sustainable management issues.

Response: The use of the terms "data gap" and "uncertainty" will be evaluated for consistency with SGMA definitions.

Groundwater contour figures were revised to identify areas that lack data control.

5. Groundwater Contours (Figures 3-13 and 3-14) – Consider dashing contours that lack data control.

Response: Groundwater contour figures were revised to identify areas that lack data control.

6. Section 3.2.4 concerning land subsidence should discuss the possibility that the small measured land surface elevation changes could be related to tectonic activity. The Basin is located in a tectonically active region and is itself a down warping synclinal trough. The lack of discussion about tectonics creates an impression that the land surface elevation changes are exclusively attributed to groundwater withdrawal. The text should be revised to eliminate this impression. Over time, it will likely be possible to distinguish land surface elevation changes due to tectonic motion from those caused by groundwater withdrawal by comparing InSAR and long-term groundwater level data with UNAVCO continuous GSP elevation trends.

Response: Further discussion will be included regarding land subsidence including consideration of the regional geomorphic setting as well as oil and gas extraction in Section 3.2.4.

BONDY Groundwater Consulting, Inc.

California Professional Geologist License No. 7676
California Certified Hydrogeologist No. 821

October 31, 2021

Bryan Bondy, President
Bondy Groundwater Consulting, Inc.
10488 Graham Ct.
Ventura, CA 93004

Anna Olsen, Executive Director
San Antonio Basin Groundwater Sustainability Agency
920 East Stowell Rd
Santa Maria, CA 93454

RE: Peer Review of Draft GSP Sustainable Management Criteria and Projects and Management Actions

Via E-mail to aolsen@sanantoniobasingsa.org

Dear Anna:

As requested, I have completed a peer review of the draft Groundwater Sustainability Plan (GSP) for the San Antonio Creek Valley Basin (the Basin) prepared by GSI Water Solutions, Inc. As you may recall, I previously reviewed the draft water budget and hydrogeologic conceptual model sections of the GSP; those sections were not reviewed again. Also, pursuant to your request, this review focused on the sustainable management criteria (Section 4) and projects and management actions (Section 6). Monitoring Networks (Section 5) and GSP Implementation (Section 7) were not reviewed.

Overall, the GSP is well written and seeks to comply with the GSP Emergency Regulations. Many of the comments offered below highlight aspects that were unclear to the reviewer. Addressing these comments may help stakeholders better understand the information and may help avoid some DWR comments. Some of the comments below address potential concerns that the GSA may wish to evaluate prior to adopting the GSP or during the first 5-year GSP assessment period.

Section 4: Sustainable Management Criteria

1. Section 4 – Sustainable Management Criteria, Page 4-1: End of second paragraph: Consider noting that the SMC reevaluation and potential modification will happen no less frequently than the required 5-year GSP assessments.

2. Section 4.1 – Definitions, Page 4-3: Definition of "Undesirable result" differs from the definition in the cited Water Code section. The text "…caused by groundwater pumping…" should read "…caused by groundwater conditions…" There may be other differences; this just happens to be the one I noticed.

3. Section 4.2.1 – Qualitative Objectives for Meeting Sustainability Goals, Page 4-4: It may be helpful to qualify the objectives for "Avoid Degraded Groundwater Quality" by noting that the GSA is only responsible for groundwater quality degradation caused by groundwater pumping or GSP implementation and explain the nexus between pumping or GSP implementation and potential water quality changes.

4. Section 4.3.2 – Criteria for Defining Undesirable Results, Page 4-6: Bullet List:

    a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively.

    b. Third bullet – There is a concern with the use of the term "Impacts" because not all impacts may be significant and unreasonable. Consider replacing "Impacts" with "Significant and unreasonable impacts" to better align with the SGMA definition of undesirable results.

5. Section 4.5.1 –Undesirable Results for Groundwater Levels, Page 4-13: Bullet List:

    a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively.

    b. First bullet – It may be helpful to explain the basis for selecting 50% of representative wells exceeding the minimum thresholds.

    c. Second bullet – There is a concern with the use of the term "impact" because not all impacts may be significant and unreasonable. Consider replacing "impact" with "significant and unreasonable impacts" to better align with the SGMA definition of undesirable results.

    d. Third bullet –

        i. What are the historical average production rates that will be used as the baseline for evaluation of this criterion (I did not find the values in the GSP)?

        ii. The logic for the third bullet seems questionable. The average historical production likely includes some years with lower-than-average values. Why would it be significant and unreasonable in the future to not be able to produce at average historical rates when the historical rates themselves include years with less than average production, which was not considered an undesirable result historically?

iii. Consider providing quantitative measures. Is one well unable to produce historical average quantities of water considered significant and unreasonable, or is it some larger number (or percentage) of wells?

6. Section 4.5.2 – Minimum Thresholds for Groundwater Levels, Pages 4-14 – 4-16: It is noted that the well impact analysis used to support the minimum thresholds is not very sensitive to the groundwater elevation, as indicated by the small change in the percentages of wells with various groundwater levels below top of screen. The well impact analysis results for the range of groundwater levels considered appears to be controlled by a small number of wells that are located in apparently unconfined areas near the edges of the basin and some wells that appear to be outliers compared to nearby wells. For these reasons, the well impact analysis results may not be representative of most wells in the basin and the resulting minimum thresholds may not be as representative as thought. It is suggested this analysis be revisited during the first 5-year GSP assessment period and refined by including additional wells (assuming more well construction information become available) and/or other approaches to evaluating potential significant and unreasonable impacts.

7. Section 4.8 – Degraded Groundwater Quality Sustainable Management Criteria, Page 4-31: The text states: "The SABGSA has no responsibility to manage groundwater quality unless it can be shown that water quality degradation is caused by pumping in the Basin, or the SABGSA implements a project that degrades water quality." It is suggested that the GSP include a discussion about the potential for pumping or GSP implementation to degrade water quality and describe criteria for evaluating whether those conditions are occurring (or describe how and when those criteria will be developed).

8. Section 4.9.1 –Undesirable Results for Land Subsidence, Page 4-40m, bullet list in middle of page:

    a. It is unclear whether the three criterion bullets are intended to be applied conjunctively or disjunctively.

    b. Consider caveating all criteria as only applying if groundwater levels are below historical low levels during the period in question.

9. Land Subsidence Minimum Threshold and Measurable Objective: The text on page 4-43 (minimum threshold) and page 4-46 (measurable objective) both say the criteria are based on the measured subsidence at the UNAVCO CGPS Station ORES from 2000-2020. However, the minimum threshold and measurable objective values are different (0.05 vs 0.04 feet per year). The text suggests that the values should be the same; therefore, it is unclear why the values are different.

10. Section 4.10.2 - Minimum Thresholds for Surface Water Depletion:

There are concerns with using the Casmalia stream gage to establish the minimum threshold for depletion of interconnected surface water:

First, the GSP Emergency Regulations require the minimum threshold to be the rate of depletion of surface water flow caused by groundwater pumping, not the surface water flow rate itself.

Second, because the gage is downstream of the basin, it is measuring unused water leaving Barka Slough area. In theory, some of water measured by the gage is available for transpiration in Barka Slough if it is needed. In other words, the surface water flows at the gage could potentially decrease before undesirable results occur in Barka Slough. It is possible that flows at the gage could go to zero before significant and unreasonable effects at the Barka Slough manifest.

Lastly, the flows measured by the gage may be impacted by processes unrelated to depletion by pumping, which are beyond the GSA's authority and control. These include: (1) flows from the four tributaries that confluence with San Antonio Creek downstream of the basin boundary; (2) variability in transpiration rates within the Barka Slough; and (3) transpiration along the portion of San Antonio Creek located between the basin boundary and the gage.

The GSP discusses a historical depletion rate estimate developed using Darcy's Law. It is suggested that consideration be given to setting the initial minimum threshold based on the Darcy's Law calculation using the chronic lowering of groundwater levels minimum thresholds as a calculation input. This approach may align better with the GSP Emergency Regulations (using a depletion rate instead of surface water flow) and would eliminate concerns about other physical processes affecting the measurement of flow. The minimum threshold could be revisited, as planned, using the numerical model during the first 5-year GSP assessment period.

If the current approach of using the Casmalia gage is retained, it is recommended that the minimum threshold be better explained and set lower. Page 4-54 says "This threshold was selected based on the analysis of historical base flow at the Casmalia stream gage presented on Figure 4-2." That is not enough information to understand the basis for the selected minimum threshold value. Based on visual inspection of Figure 4-2, it appears that the minimum threshold was exceeded in 2015, yet the GSP says "the EVI analysis indicates no discernible long-term trend in Barka Slough vegetative health" (p. 3-117). This suggests that there have not been undesirable results historically, including 2015. If undesirable results did not occur at the 2015 flows, then the minimum threshold is probably too high.

Section 6: Projects and Management Actions

11. The projects and management actions described in this section appear to be reasonable.

    Other projects that may be worth investigating or considering include:

    a. Bedrock wells – consideration could be given to pumping and treating groundwater from bedrock formations to create an alternative water supply.

    b. Oilfield-produced water – consideration could be given to working with the owners of the active oil production wells surrounding the basin to evaluate the feasibility of treating and using oilfield-produced water for irrigation.

    c. Water exchanges – consideration could be given to funding local water projects in other regions in exchange for State Water Project allocation.

12. Table 6-1: Header row - Groundwater Dependent Ecosystems is not a sustainability indicator identified in SGMA.

13. Section 6.9 Tier 2 Management Action 7 – Voluntary Agricultural Crop Fallowing Programs: It is noted that voluntary fallowing would likely only occur if a cap-and-trade system is in place (i.e., the proposed "Base Pumping Allocation" and "Groundwater Extraction Credit Marketing and Trading Program"). Therefore, it is suggested that this dependency be noted in the description of the management action. It is also noted that the program may potentially be enhanced (or a separate program could be implemented, depending on who it is framed) by the having the GSA lease or purchase agricultural land for fallowing. The GSA could use fees to lease/purchase the lands, if necessary or desired. The GSA could also consider purchasing groundwater extraction credits.

Closing
Thank you for the opportunity to peer review the draft GSP. Please contact me if you have any questions about the review findings.

Sincerely,

Bryan Bondy, President
Bondy Groundwater Consulting, Inc.

cc: Jeff Barry, GSI

October 31, 2021

San Antonio Basin GSA
920 East Stowell Rd
Santa Maria, CA 93454

Submitted via web: https://portal.sanantoniobasingsa.org/comment/new

Re: Public Comment Letter for San Antonio Creek Valley Groundwater Basin Draft GSP

Dear Anna Olsen,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the San Antonio Creek Valley Groundwater Basin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.

2. Climate change **is not sufficiently** considered.
3. Data gaps **are not sufficiently** identified and the GSP **does not have a plan** to eliminate them.
4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to deficiencies of the San Antonio Creek Valley Groundwater Basin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment E	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists

Samantha Arthur
Working Lands Program Director
Audubon California

Danielle V. Dolan
Water Program Director
Local Government Commission

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Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy

Attachment A

Specific Comments on the San Antonio Creek Valley Groundwater Basin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes,[1] groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities and Drinking Water Users

The identification of Disadvantaged Communities (DACs) and drinking water users is **insufficient**. We note the following deficiencies with the identification of these key beneficial users.

- The GSP fails to identify and map the locations of DACs and describe the size of each DAC population within the basin.
- While the plan provides a density map of domestic wells in the basin (Figure 2-4), the GSP fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the basin.
- The GSP fails to identify the population dependent on groundwater as their source of drinking water in the basin. Specifics are not provided on how much each DAC community relies on a particular water supply (e.g., what percentage is supplied by groundwater).

These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, and to support the consideration of beneficial users in the development of sustainable management criteria and selection of projects and management actions.

RECOMMENDATIONS
• Map the locations of DACs and provide the population of each identified DAC. The DWR DAC mapping tool can be used for this purpose.[2] Identify the sources of drinking water for DACs, including an estimate of how many people rely on groundwater (e.g., domestic wells, state small water systems, and public water systems).

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[1] Our letter provides a review of the identification and consideration of federally recognized tribes (Data source: SGMA Data viewer) within the GSP from non-tribal members and NGOs. Based on the likely incomplete information available to our organizations for this review, we recommend that the GSA utilize the California Department of Water Resources' "Engagement with Tribal Governments" Guidance Document (https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) to comprehensively address these important beneficial users in their GSP.

[2] The DWR DAC mapping tool is available online at: https://gis.water.ca.gov/app/dacs/.

- Include a map showing domestic well locations and average well depth across the basin.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISWs) is **insufficient**, due to lack of supporting information provided for the ISW analysis. The GSP presents a conceptual representation of gaining and losing streams (Figure 3-52. Gaining and Losing Streams). The GSP also presents a map (Figure 3-53. Stream Classification) of the basin's stream reaches, as classified by the USGS National Hydrography Dataset (NHD), with labels `Intermittent' and 'Perennial'.

The GSP states (p. 3-102): *"Figure 3-53 is a stream classification map of the Basin as defined by the USGS NHD (USGS, 2020b). Based on the USGS NHD, all the streams in the Basin are classified as intermittent and likely to be losing streams. The stream channels located in Barka Slough are classified as perennial and likely to be gaining streams."* The GSP continues (p. 3-103): *"Interconnected surface water and groundwater within the Paso Robles Formation and Careaga Sand is indicated by the Barka Slough and perennial classification of streams in that area."* With these two statements, the GSP implies that interconnected reaches are defined by perennial conditions. However, this is an incorrect conclusion. Note the regulations [23 CCR §351(o)] define ISW as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". "At any point" has both a spatial and temporal component. Even short durations of interconnections of groundwater and surface water can be crucial for surface water flow and supporting environmental users of groundwater and surface water.

Using seasonal groundwater elevation data over multiple water year types is an essential component of identifying ISWs. The GSP does not present or analyze depth to groundwater data when identifying ISWs in the basin.

RECOMMENDATIONS

- Provide a map showing all the stream reaches in the basin, with reaches clearly labeled as interconnected or disconnected. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP.

- Provide depth-to-groundwater contour maps using the best practices presented in Attachment D, to aid in the determination of ISWs. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth to groundwater contours across the landscape. This will provide accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

- Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate, when mapping ISWs. We recommend the 10-year pre-SGMA baseline period of 2005 to 2015.

- Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**. The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). However, insufficient groundwater data was used to characterize groundwater conditions in the basin's GDEs. The GSP states (3-90): "*Contoured groundwater elevation data for spring 2015 were used to determine areas where the Natural Communities polygons were within 30 feet depth to groundwater. Spring 2015 groundwater elevations were chosen for this analysis because this marked a period of the greatest recent data availability. These data are considered representative of average spring-summer conditions within the last 5 years.*" We recommend using groundwater data from multiple seasons and water year types to determine the range of depth to groundwater around NC dataset polygons. Using seasonal groundwater elevation data over multiple water year types is an essential component of identifying GDEs and is necessary to capture the variability in environmental conditions inherent in California's climate.

We commend the GSA for including an inventory of flora and fauna species in the basin's GDEs. Section 3.2.6.1 presents a discussion of potential GDE vegetation classifications and their acreage, and each of these GDE units is mapped individually on Figure 3-10 (Natural Communities Commonly Associated with Groundwater Dataset). Table 3-9 presents the plants and their rooting depths likely present in Barka Slough. Table 3-12 presents the special-status species that may be located within the basin, which are further discussed in the GSP text and mapped on Figure 3-57 (Special-Status Species Critical Habitat).

Within Section 3.2.6.1 (Identification of Potential GDEs), the GSP states that the maximum rooting depth of Valley Oak (*Quercus lobata*) is 80 feet. However, this deeper rooting depth was not used when verifying whether Valley Oak polygons from the NC Dataset are supported by groundwater. Figure 3-10 shows acreage of Valley Oak polygons across the basin in areas covered by the > 30 ft depth to water area mapped on Figure 3-55. Of the 495 acres of Valley Oak mapped on Figure 3-10, no acreage is retained as a potential GDE in the GSP.

RECOMMENDATIONS

- Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.

- Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a pre-SGMA baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types.

- Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth-to-groundwater contours across the landscape. The GSP maps the 30-foot groundwater depth contour on Figure 3-55, showing two areas (<= 30 ft Depth To Water and > 30 ft Depth To Water). However, full depth to groundwater contours are needed to evaluate the valley oak NC dataset polygons.

- Re-evaluate the 495 acres of valley oak present in the basin. Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as valley oak (*Quercus lobata*). We recommend that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget.[3,4] The integration of native vegetation into the water budget is **sufficient**. We commend the GSA for including the groundwater demands of this ecosystem in the historical, current and projected water budgets. Managed wetlands are not mentioned in the GSP, so it is not known whether or not they are present in the basin.

RECOMMENDATION

- State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.

B. Engaging Stakeholders

Stakeholder Engagement During GSP Development

Stakeholder engagement during GSP development is **insufficient**. SGMA's requirement for public notice and engagement of stakeholders is not fully met by the description in the Communication and Engagement Plan (Appendix C).[5]

[3] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[4] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

[5] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

The Communication and Engagement Plan describes engagement with environmental stakeholders during the GSP development process through the inclusion of an environmental representative on the GSA Advisory Committee. However, we note the following deficiencies with the overall stakeholder engagement process:

- The opportunities for public involvement are described in very general terms. They include public notices, meetings, and workshops. No specific outreach was described for DACs and drinking water users. DACs were mentioned once in the initial list of stakeholders and interested parties within the basin, but were not otherwise mentioned in the GSP.

- The plan does not include a plan for continual opportunities for engagement through the *implementation* phase of the GSP for any stakeholders, including DACs, domestic well owners, and environmental stakeholders.

RECOMMENDATIONS
• In the Communication and Engagement Plan, describe active and targeted outreach to engage DAC members, drinking water users, and environmental stakeholders through the GSP development and implementation phases. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process. • Describe efforts to consult and engage with DACs and domestic well owners within the basin. • Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the basin within the GSP.[6]

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.[7,8,9]

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[6] Engagement with Tribal Governments Guidance Document. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[7] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[8] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[9] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, the GSP presents a well impact analysis in Section 3.2.1.3. The GSP states (p. 3-50): *"Fall 2018 groundwater elevations measured in basin monitoring wells were used to assess how many wells have static water levels that are below the top of screen elevation as of that date and how many would be below top of screen if groundwater levels were lower. The results of the analysis presented on Figure 3-23 indicate that groundwater water elevations in fall 2018 were below top of screen in 20 percent of domestic wells and 12 percent of agricultural wells in the Basin."*

Minimum thresholds for groundwater levels are set at 25 feet below fall 2018 water levels. The GSP states (p. 4-15): *"The analysis indicates that water levels declining 25 feet below fall 2018 water levels do not result in a substantial increase in the number of wells affected by this condition. If water levels continue to decline, the analysis indicates well owners could observe some depletion of supply. Based on this analysis, stakeholders in the Basin believe that setting the minimum threshold for water levels at 25 feet below fall 2018 water levels will not result in depletion of supply or undesirable results. Setting the minimum threshold at this level allows time for project and management actions to be implemented before minimum thresholds are reached. The well impact analysis presented in Section 3.2 indicates that the majority of the agricultural and domestic wells can tolerate additional groundwater level decline without experiencing undesirable results."* Despite this well impact analysis, the GSP does not sufficiently describe whether minimum thresholds are consistent with California's Human Right to Water policy and will avoid significant and unreasonable loss of drinking water, especially given the absence of a domestic well mitigation plan in the GSP.[10]

Furthermore, undesirable results are characterized by groundwater levels dropping below the minimum threshold after periods of average and above-average precipitation in 50 percent of representative wells for two consecutive years. Using 50% as the threshold suggests that minimum thresholds reached during dry years or periods of drought will not result in an undesirable result. This is problematic since the GSP is failing to manage the basin in such a way that strives to minimize significant adverse impacts to beneficial users, which are often felt greatest in below-average, dry, and drought years.

In addition, the GSP does not sufficiently describe or analyze direct or indirect impacts on DACs when defining undesirable results, nor does it describe how the existing groundwater level minimum thresholds will avoid significant and unreasonable impacts to DACs and domestic well users beyond 2015 and be consistent with Human Right to Water policy.[10]

For degraded water quality, the GSP presents water quality standards for constituents of concern (COCs) in Table 4-3. The GSP establishes minimum thresholds pertaining to salts and nutrients as follows (p. 4-34): *"The WQOs presented in Table 4-3 are the minimum thresholds for TDS, chloride, sulfate, boron, sodium, and nitrate as measured by SWRCB ILRP and DDW programs in 20 percent of wells monitored. In cases where the ambient (prior to January 2015) water quality exceeds the WQO, the minimum threshold concentration is 110 percent of the ambient water quality in 20 percent of the wells."* The GSP does not, however, state which COCs have ambient concentrations that exceed the WQO, or provide a summary table of the resulting minimum thresholds.

The GSP states (p. 4-32): *"No minimum thresholds have been established for contaminants because state regulatory agencies, including the RWQCB and the Department of Toxic Substances Control, have the responsibility and authority to regulate and direct actions that address contamination."* However, SMC should be established for all COCs in the basin that may

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[10] California Water Code §106.3. Available at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=106.3

be impacted by groundwater use and/or management, in addition to coordinating with water quality regulatory programs.

The GSP only includes a very general discussion of impacts on drinking water users when defining undesirable results and evaluating the impacts of proposed minimum thresholds. The GSP does not, however, mention or discuss direct and indirect impacts on DACs or drinking water users when defining undesirable results for degraded water quality, nor does it evaluate the cumulative or indirect impacts of proposed minimum thresholds on DACs or drinking water users.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on drinking water users and DACs when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels.

Degraded Water Quality

- Describe direct and indirect impacts on drinking water users and DACs when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[11]

- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on drinking water users and DACs.

- In Table 4-3 (Water Quality Standards for Selected Constituents of Concern), compare WQOs, MCLs, and ambient (prior to January 2015) water quality concentrations. Present the final minimum threshold for each COC.

- Set minimum thresholds and measurable objectives for all water quality constituents within the basin that can be impacted and/or exacerbated as a result of groundwater use or groundwater management. Ensure they align with drinking water standards.[12]

Groundwater Dependent Ecosystems and Interconnected Surface Waters

When defining undesirable results for chronic lowering of groundwater levels, the GSP briefly mentions impacts to GDEs in the Barka Slough area. However, these impacts are not described or analyzed. This is problematic because without identifying potential impacts on GDEs, groundwater level minimum thresholds may compromise these environmental beneficial users. Furthermore, our comments above in the GDE section note that insufficient shallow groundwater data was used to verify the NC dataset polygons and deeper rooting depths of valley oak were not considered. After re-analyzing GDEs based on our comments above, consider potential impacts to GDEs for the chronic lowering of groundwater levels sustainability indicator.

The GSP recognizes data gaps with respect to the interconnected surface water SMC. For the Barka Slough area, the GSP states (p. 4-54): *"Without an improved understanding of the slough*

[11] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

[12] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

water budget, it is not possible at this time to confidently establish a minimum threshold for depletion of interconnected surface water. Until more is known about the relationship between groundwater and surface water in the vicinity of the Slough and depletion can be quantified and monitored, an interim minimum threshold, based on the best available information, focuses on avoiding depletion and maintaining surface water and groundwater flow entering and leaving the Slough." The minimum threshold is 0.15 cfs of surface water flow measured at the Casmalia stream gage west of the Slough, selected based on the analysis of historical base flow at the Casmalia stream gage (Figure 4-2). However, no analysis or discussion is presented to describe how the SMC will affect GDEs, or the impact of this minimum threshold on GDEs in the basin. Furthermore, the GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the basin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

The GSP also recognizes data gaps with respect to ISW in the Las Flores watershed and northeast of Los Alamos on Price Ranch. The GSP states (p. 4-48): "*Until flow of groundwater is better understood in these areas, meaningful SMCs related to interconnected surface water and supporting associated GDEs cannot be developed. If analysis of these areas indicates interconnected surface water with the Paso Robles Formation or the Careaga Sand, SMCs will be developed pursuant to avoid undesirable results as described below."* As noted above in the ISW section of this letter, the GSP did not utilize groundwater elevation data to identify ISWs in the basin. Therefore, in addition to the data gap areas noted above (i.e., Las Flores watershed and northeast of Los Alamos on Price Ranch), additional analyses may be required to develop depletion of interconnected surface water SMC after further identification of ISWs based on groundwater elevation data.

RECOMMENDATIONS

- Define chronic lowering of groundwater SMC directly for environmental beneficial users of groundwater. When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact on GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the basin.[13] Defining undesirable results is the crucial first step before the minimum thresholds can be determined.[14]

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the basin are reached.[15] The GSP should confirm that minimum

[13] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]
[14] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]
[15] "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]

thresholds for ISWs avoid adverse impacts on both environmental beneficial users of groundwater and surface water as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.[6,16]

- When establishing SMC for the basin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems".

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.[17] The effects of climate change will intensify the impacts of water stress on GDEs, making available shallow groundwater resources especially critical to their survival. Condon *et al.* (2020) shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.[18] When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded.

The integration of climate change into the projected water budget is **insufficient**. The GSP incorporates climate change into the projected water budget using DWR change factors for 2030 and 2070. However, the plan does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for the basin. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant and their inclusion can help identify important vulnerabilities in the basin's approach to groundwater management.

The GSP incorporates climate change into key inputs (e.g., precipitation, evapotranspiration, and surface water flow) of the projected water budget. However, while climate change is acknowledged to be a likely influence on future basin yields, the GSP does not provide a sustainable yield based on the projected water budget with climate change incorporated. If the water budgets are incomplete, including the omission of extremely wet and dry scenarios, and sustainable yield is not calculated based on climate change projections, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems and domestic well owners.

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[16] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf
[17] "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]
[18] Condon et al. 2020. Evapotranspiration depletes groundwater under warming over the contiguous United States. Nature Communications. Available at: https://www.nature.com/articles/s41467-020-14688-0

RECOMMENDATIONS
• Integrate climate change, including extremely wet and dry scenarios, into all elements of the projected water budget to form the basis for development of sustainable management criteria and projects and management actions. • Estimate sustainable yield based on the projected water budget with climate change incorporated. • Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of specific plans to increase the Representative Monitoring Sites (RMSs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, GDEs, and ISWs in the basin.

Figure 5-1 (Groundwater Level Monitoring Network) shows insufficient representation of drinking water users and DACs for groundwater elevation monitoring. Figure 5-4 (Groundwater Quality Monitoring Network) shows sufficient spatial representation of drinking water users and DACs for water quality monitoring, but depth representation cannot be verified. Refer to Attachment E for maps of these monitoring sites in relation to key beneficial users of groundwater (note we were only able to prepare water quality monitoring maps with publicly available information). These beneficial users may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.[19]

The GSP provides some discussion of data gaps for GDEs and ISWs in Sections 5.8 (Depletion of Interconnected Surface Water Monitoring Network), Section 5.8.2 (Assessment and Improvement of Monitoring Network), and 6.3 (Tier 1 Management Action 1 – Address Data Gaps), but does not provide specific plans, such as locations or a timeline, to fill the data gaps.

RECOMMENDATIONS
• Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, GDEs, and ISWs to clearly identify monitored areas. • Increase the number of RMSs in the shallow aquifer across the basin as needed to adequately monitor all groundwater condition indicators across the basin and at appropriate depths for *all* beneficial users. Prioritize proximity to DACs, domestic wells, GDEs, and ISWs when identifying new RMSs.

[19] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

- Ensure groundwater elevation and water quality RMSs are monitoring groundwater conditions spatially and at the correct depth for *all* beneficial users - especially DACs, domestic wells, and GDEs.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient** due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

The GSP fails to include projects and management actions with explicit near-term benefits to the environment. While Section 6.11 documents In Lieu Recharge Projects, they are described as being in the conceptual phase and may be considered by the GSA in the future. The plan includes a municipal well mitigation program. However, the GSP fails to specify the mitigation program's benefits to DACs, if any.

RECOMMENDATIONS

- For DACs and domestic well owners, include a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program. The GSP includes a discussion of an offsite well impact mitigation program in Section 6.3, however this program is for municipal wells, not domestic wells. If this program will have benefits to DACs, describe them in detail.

- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts.

- Recharge ponds, reservoirs, and facilities for managed aquifer recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For further guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document."[20]

- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

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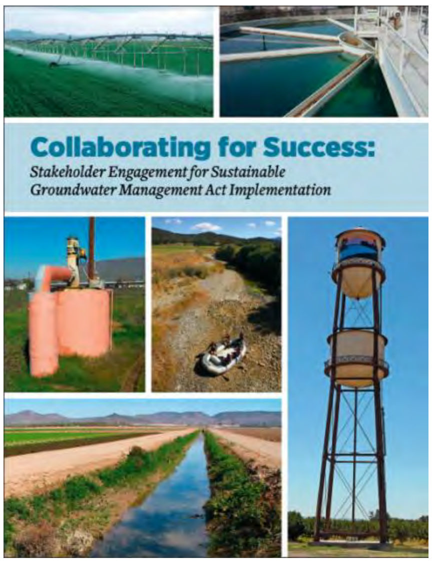
[20] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B
SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

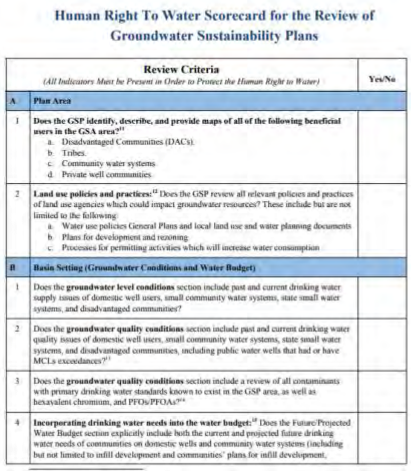
Stakeholder Engagement and Outreach



Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.
- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.
- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

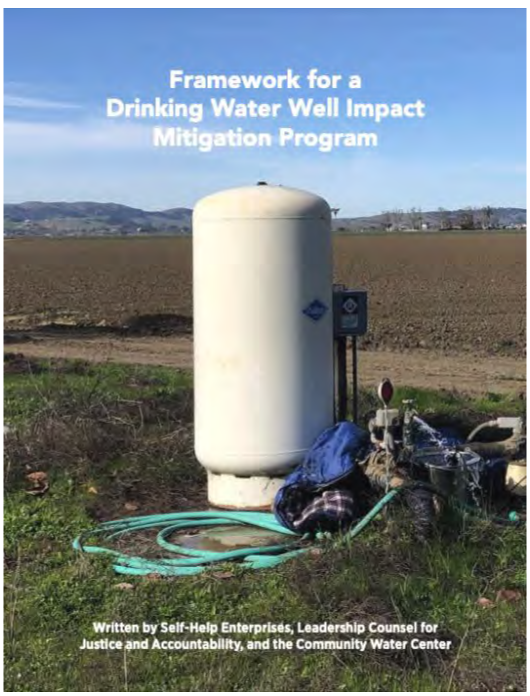


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

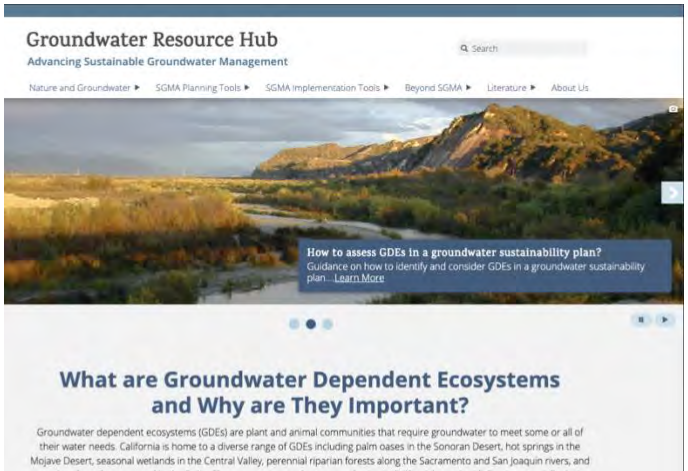
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



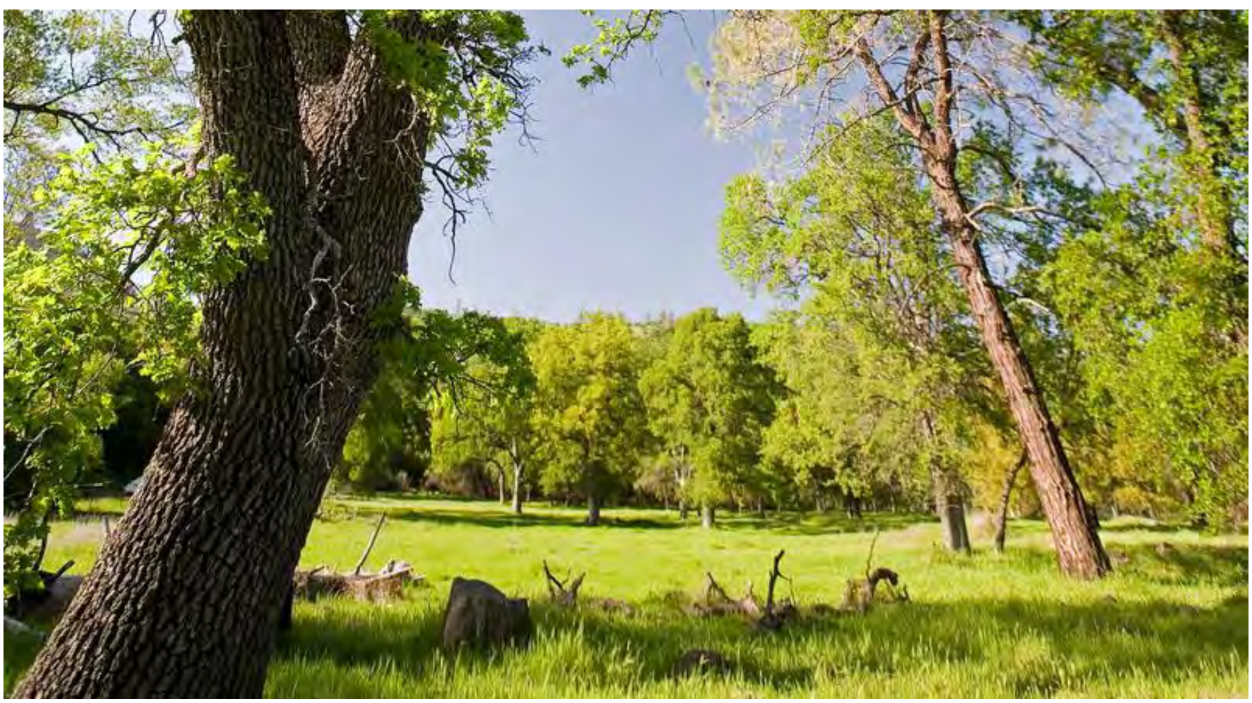
The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

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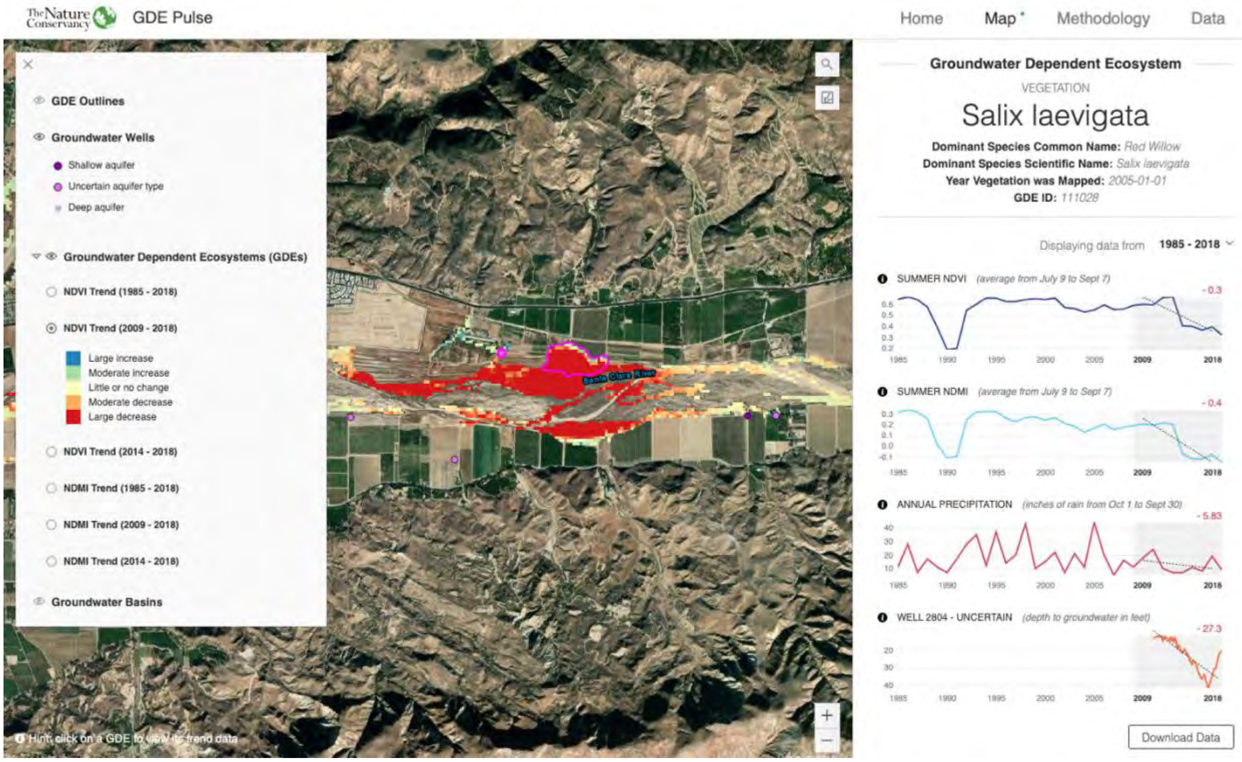
[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

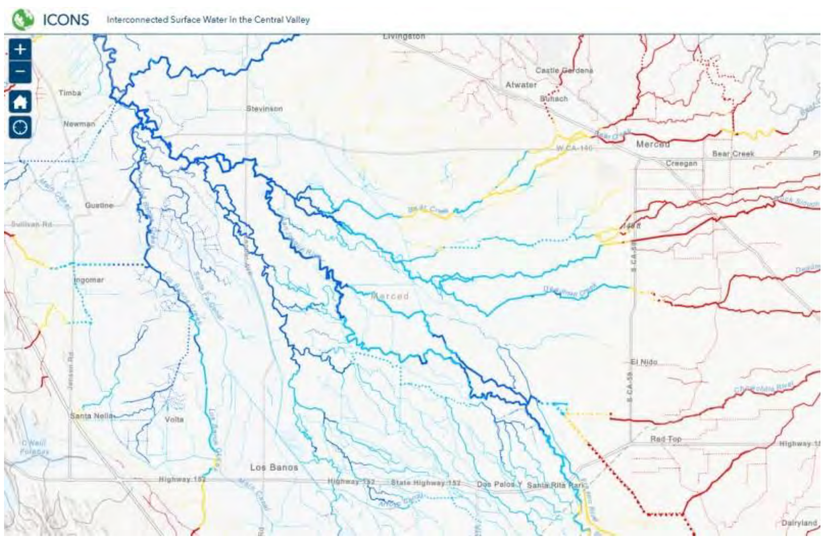
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



[ICONS](#) maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the San Antonio Creek Valley Basin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the San Antonio Creek Valley Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	**State**	**Other**
BIRDS				
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas cyanoptera	Cinnamon Teal			
Anas platyrhynchos	Mallard			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Bucephala albeola	Bufflehead			
Calidris minutilla	Least Sandpiper			
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Limnodromus scolopaceus	Long-billed Dowitcher			
Oxyura jamaicensis	Ruddy Duck			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			

[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

CRUSTACEANS				
Cyprididae fam.	Cyprididae fam.			
Hyalella spp.	Hyalella spp.			
FISH				
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	Endangered	Endangered	Endangered - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
Pseudacris regilla	Northern Pacific Chorus Frog			
Taricha torosa	Coast Range Newt		Special Concern	ARSSC
Thamnophis sirtalis infernalis	California Red-sided Gartersnake			Not on any status lists
INSECTS & OTHER INVERTS				
Acilius abbreviatus				Not on any status lists
Agabus spp.	Agabus spp.			
Apedilum spp.	Apedilum spp.			
Argia nahuana	Aztec Dancer			
Argia spp.	Argia spp.			
Argia vivida	Vivid Dancer			
Baetis spp.	Baetis spp.			
Chironomidae fam.	Chironomidae fam.			
Chironomus spp.	Chironomus spp.			
Cricotopus spp.	Cricotopus spp.			
Dicrotendipes spp.	Dicrotendipes spp.			
Dytiscidae fam.	Dytiscidae fam.			

Dytiscus marginicollis				Not on any status lists
Ephydridae fam.	Ephydridae fam.			
Fallceon quilleri	A Mayfly			
Hydrophilidae fam.	Hydrophilidae fam.			
Hydroptila spp.	Hydroptila spp.			
Labrundinia spp.	Labrundinia spp.			
Laccobius spp.	Laccobius spp.			
Limnophyes spp.	Limnophyes spp.			
Optioservus spp.	Optioservus spp.			
Oxyethira spp.	Oxyethira spp.			
Paracladopelma spp.	Paracladopelma spp.			
Parametriocnemus spp.	Parametriocnemus spp.			
Paratanytarsus spp.	Paratanytarsus spp.			
Peltodytes spp.	Peltodytes spp.			
Psychodidae fam.	Psychodidae fam.			
Rheotanytarsus spp.	Rheotanytarsus spp.			
Simulium spp.	Simulium spp.			
Sperchon spp.	Sperchon spp.			
Stictotarsus spp.	Stictotarsus spp.			
Tanytarsus spp.	Tanytarsus spp.			
Tricorythodes spp.	Tricorythodes spp.			
Tropisternus spp.	Tropisternus spp.			
MAMMALS				
Ondatra zibethicus	Common Muskrat			Not on any status lists
Castor canadensis	American Beaver			Not on any status lists
MOLLUSKS				
Physa spp.	Physa spp.			
PLANTS				
Alopecurus saccatus	Pacific Foxtail			
Callitriche marginata	Winged Water-starwort			
Cladium californicum	California Sawgrass		Special	CRPR - 2B.2
Eleocharis palustris	Creeping Spikerush			
Eleocharis rostellata	Beaked Spikerush			
Euthamia occidentalis	Western Fragrant Goldenrod			
Helenium puberulum	Rosilla			
Isolepis cernua	Low Bulrush			
Juncus textilis	Basket Rush			
Paspalum distichum	Joint Paspalum			

Persicaria lapathifolia				Not on any status lists
Phacelia distans	NA			
Plagiobothrys undulatus	NA			Not on any status lists
Psilocarphus tenellus	NA			
Salix lasiolepis lasiolepis	Arroyo Willow			
Veronica anagallis-aquatica	NA			
Veronica peregrina	NA			

Attachment D

July 2019

IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

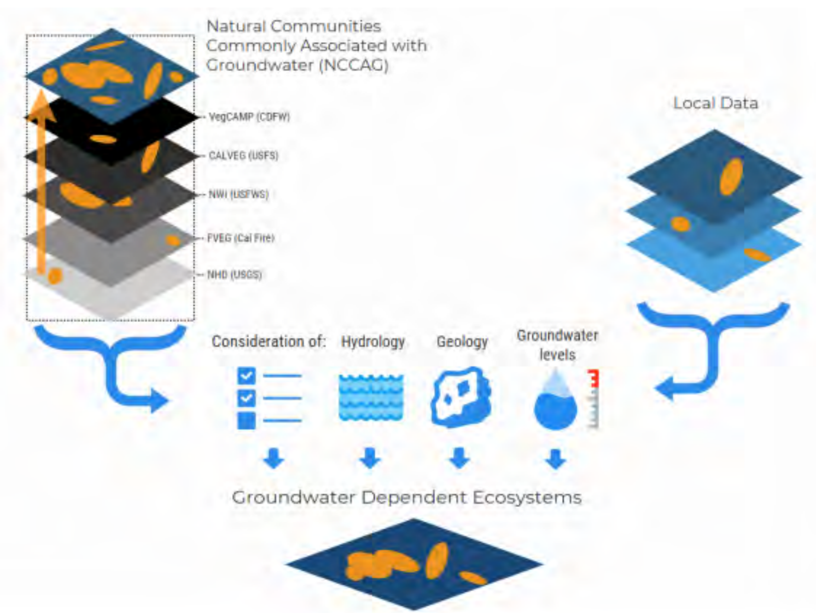


Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

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[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf

[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/

[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

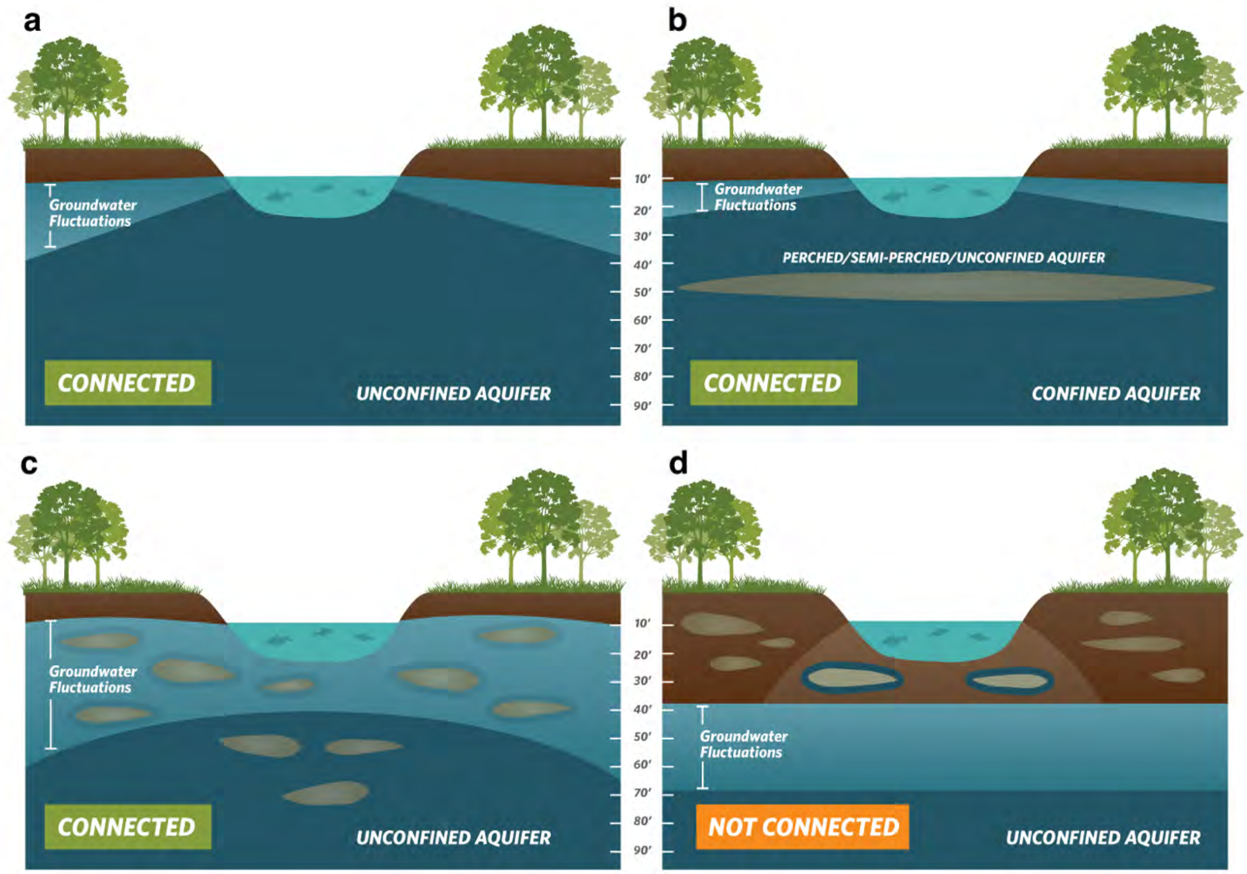

Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

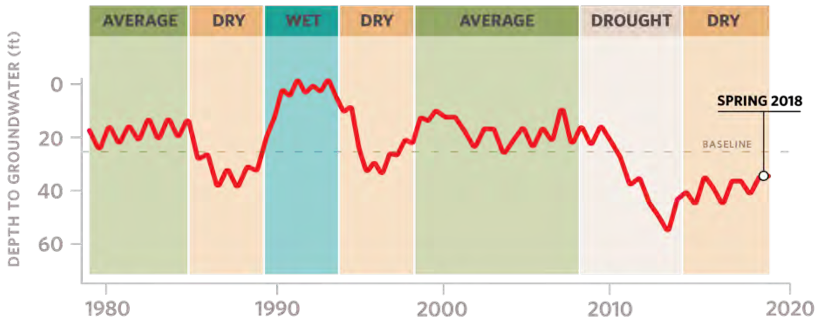

Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

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[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

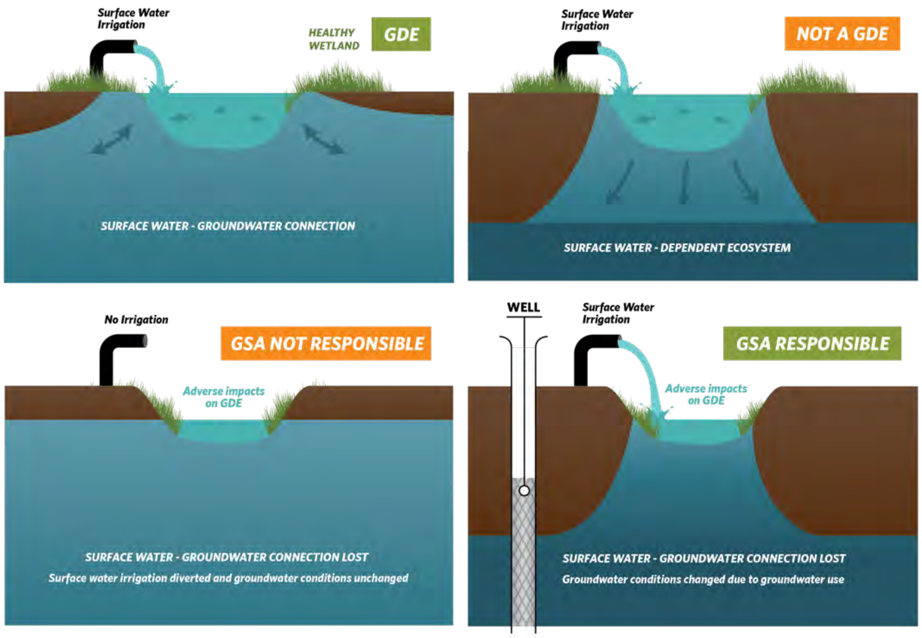

Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

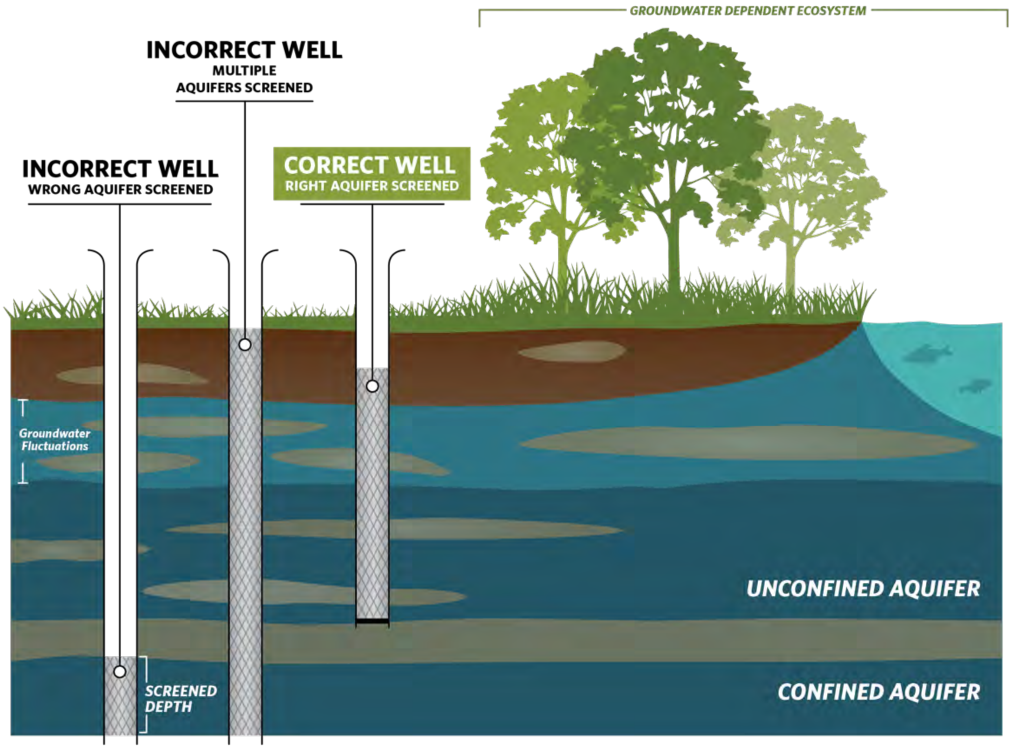

Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

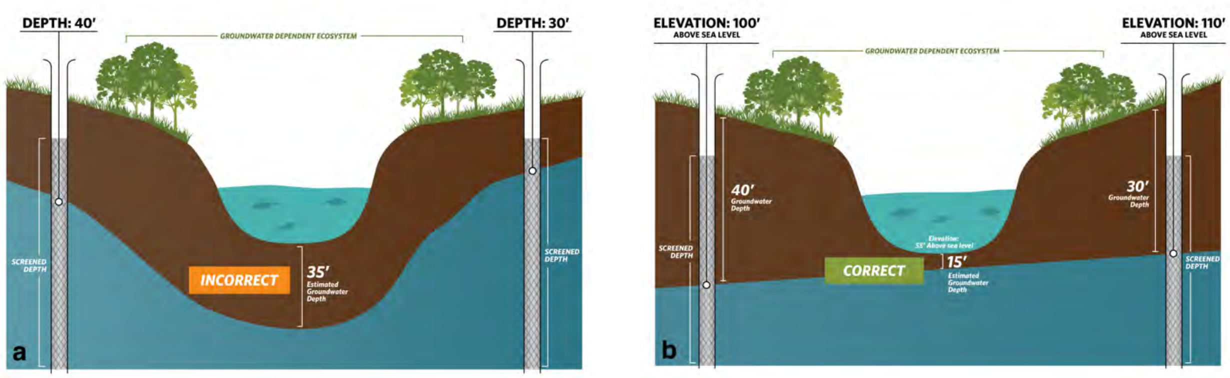

Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

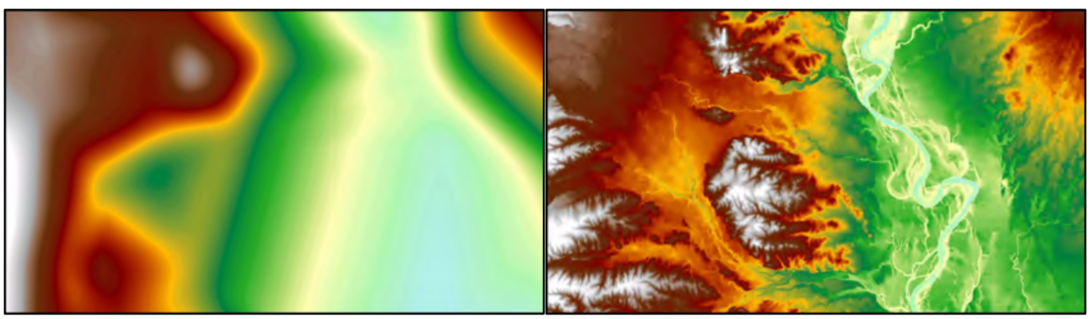

Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

Maps of representative monitoring sites in relation to key beneficial users

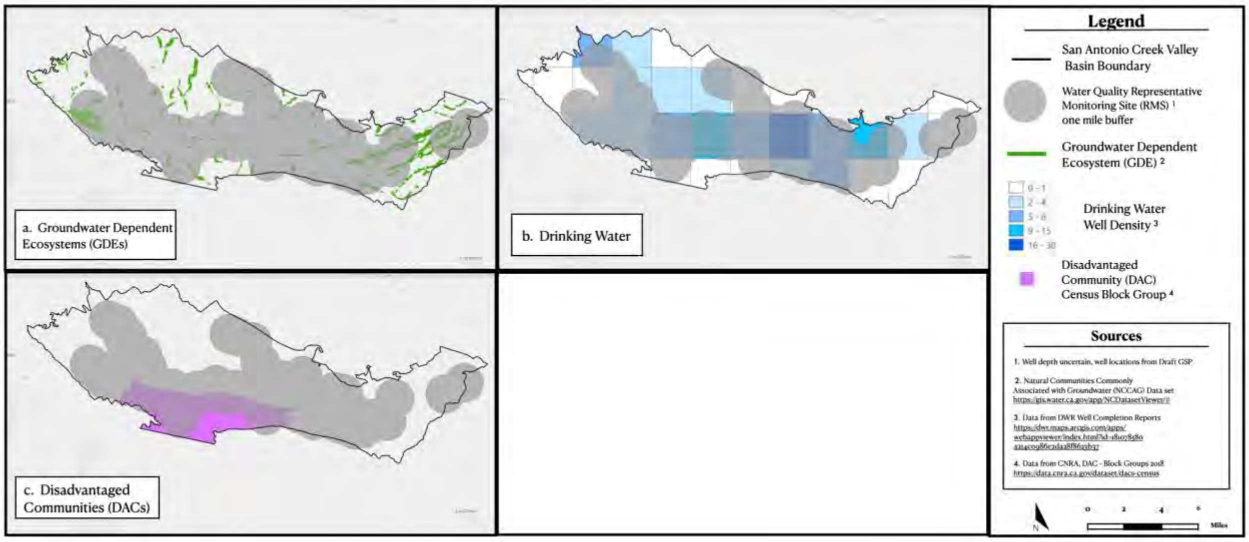

Figure 1. Groundwater quality representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

State of California – Natural Resources Agency
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

October 28, 2021

Via Electronic Mail and Online Submission

Anna Olsen
Executive Director
San Antonio Basin Groundwater Sustainability Agency
920 East Stowell Rd
Santa Maria, CA 93454
AOlsen@sanantoniobasingsa.org

Subject: California Department of Fish and Wildlife Comments on the San Antonio Creek Valley Groundwater Basin Draft Groundwater Sustainability Plan

Dear Ms. Olsen:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to provide comments on the San Antonio Basin Groundwater Sustainability Agency (SABGSA) San Antonio Creek Valley Basin (Basin) Draft Groundwater Sustainability Plan (Draft GSP) prepared pursuant to the Sustainable Groundwater Management Act (SGMA). The Basin is designated as medium priority under SGMA and must be managed under a GSP by January 31, 2022.

CDFW is writing to support ecosystem preservation and enhancement in compliance with SGMA and its implementing regulations based on CDFW expertise and best available information and science. As trustee agency for the State's fish and wildlife resources, CDFW has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & Game Code §§ 711.7 and 1802).

Development and implementation of GSPs under SGMA represents a new era of California groundwater management. The Department has an interest in the sustainable management of groundwater, as many sensitive ecosystems, species, and public trust resources depend on groundwater and interconnected surface waters (ISWs), including ecosystems on Department-owned and managed lands within SGMA-regulated basins.

SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to GSPs:

- GSPs must **consider impacts to groundwater dependent ecosystems** (GDEs) (Water Code § 10727.4(l); see also 23 CCR § 354.16(g));
- GSPs must consider the interests of all beneficial uses and users of groundwater, including environmental users of groundwater (Water Code § 10723.2) and GSPs must **identify and consider potential effects on all beneficial uses and users of groundwater** (23 CCR §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), and 354.34(f)(3));

- GSPs must **establish sustainable management criteria that avoid undesirable results** within 20 years of the applicable statutory deadline, including **depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water** (23 CCR § 354.22 *et seq*. and Water Code §§ 10721(x)(6) and 10727.2(b)) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters (23 CCR § 354.34(c)(6)(D)); and,
- GSPs must **account for groundwater extraction for all water use sectors,** including managed wetlands, managed recharge, and native vegetation (23 CCR §§ 351(al) and 354.18(b)(3)).

Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to surface waters is also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses. (*Environmental Law Foundation v. State Water Resources Control Board* (2018), 26 Cal. App. 5th 844; *National Audubon Society v. Superior Court* (1983), 33 Cal. 3d 419.) SABGSA has "an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible." (*National Audubon Society*, *supra*, 33 Cal. 3d at 446.) Accordingly, groundwater plans should consider potential impacts to and appropriate protections for ISWs and their tributaries, and ISWs that support fisheries, including the level of groundwater contribution to those waters.

Individually and collectively, the SGMA statutes and regulations, and Public Trust Doctrine considerations, necessitate that groundwater planning carefully consider and protect environmental beneficial uses and users of groundwater, including fish and wildlife and their habitats, GDEs, and ISWs.

The Basin supports both riparian and aquatic habitat. The Basin's riparian habitat supports several special status avian species including the least Bell's vireo (*Vireo belli pusillus*) and southwestern willow fly catcher (*Empidonax traillii extimus*). The aquatic habitat also supports several special status fish species including unarmored three-spined stickleback (*Gasterosteus aculeatus williamsoni*) and arroyo chub (*Gila orcuttii*). Pertaining to the protection of these species and their habitat, CDFW is providing comments regarding GDE monitoring and implementation of management actions to avoid a significant and unreasonable effect to GDEs and ISWs. CDFW is providing additional comments and recommendations as notated in Attachment A. Editorial comments or other suggestions are included for SABGSA's consideration during development of a final GSP.

If you have any questions related to CDFW's comments and/or recommendations on the San Antonio Creek Valley Basin GSP, please contact Steve Slack, Environmental Scientist, at Steven.Slack@wildlife.ca.gov.

Sincerely,

DocuSigned by:

B6E58CFE24724F5...

Erinn Wilson-Olgin
Environmental Program Manager
South Coast Region

Enclosure(s): Attachment A, Attachment B

ec: California Department of Fish and Wildlife

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Attachment A

CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE COMMENTS ON THE SAN ANTONIO CREEK VALLEY BASIN DRAFT GROUNDWATER SUSTAINABILITY PLAN

SPECIFIC COMMENTS AND RECOMMENDATIONS

CDFW's comments are as follows:

Comment #1 – GDEs based on the 30-foot Depth Groundwater Criterion in Section 3.2.6 of the Draft GSP

Issue: A 30-foot depth to groundwater criterion was applied to identify potential GDEs (Section 3.2.6.1). According to Figure 3-55 of the Draft GSP, the groundwater depth is greater than 30 feet throughout the Basin, except in certain areas within Barker Slough. San Antonio Creek within the entire Basin consists of a riparian corridor, despite seasonal surface flows, and despite the Creek being referenced as an area with a depth to groundwater greater than 30 feet. After applying the 30-foot criterion, CDFW is concerned that GDEs along San Antonio Creek and throughout the Basin were eliminated from being considered as potential GDEs.

Recommendation #1(a): CDFW recommends SABGSA clarify whether GDEs located where groundwater depth is greater than 30 feet below the surface, were eliminated as GDEs. If so, CDFW recommends the SABGSA identify these areas, and retain these areas as potential GDEs in the final GSP until future monitoring data can eliminate them as GDEs.

Recommendation #1(b): CDFW recommends SABGSA utilize The Nature Conservancy's (TNC) GDE Pulse web-map to view vegetation that have been identified as potential GDEs, with data that identifies long term temporal trends of vegetation metrics (TNC 2021).

Recommendation #1(c): CDFW recommends SABGSA utilize U.S. Fish and Wildlife Service's (USFWS)'s National Wetlands Inventory (2021) to identify potential GDEs such as riverine habitat, freshwater forested/shrub wetland, and freshwater emergent wetland.

Comment #2 – Unarmored Threespine Stickleback (UTS) Habitat

Issue: The maps and figures in the Draft GSP do not show open water habitat that support special-status species such as UTS, a federal Endangered Species Act (ESA) listed and California Endangered Species Act (CESA) listed species, that is also listed as a Fully Protected Species in California. Accordingly, it is unclear if open water habitat was mapped. According to the California Natural Diversity Database (CNDDB; CDFW 2021), San Antonio Creek has known occurrences of UTS within Barka Slough and upstream in Los Alamos. San Antonio Creek through Barka Slough is also considered a Southern California Threespine Stickleback Stream where there are small stands of cattails, overhanging willows in riparian areas that support native fish populations of UTS (*Gasterosteus aculeatus williamsoni*), prickly sculpin (*Cottus asper*), ESA-listed tidewater goby (*Eucyclogobius newberryi*), and arroyo chub (*Gila orcuttii*), a California Species of Special Concern (SSC) (CNDDB; CDFW 2021).

Recommendation #2: CDFW recommends SABGSA map and document open water habitat in addition to GDEs in the final GSP.

Comment #3 – Minimum Thresholds for Surface Water Depletion

Issue #3.1: CDFW has concerns with the Draft GSP's proposed interim minimum threshold, "0.15 cfs of surface water flow measured at the Casmalia stream gage west of the Slough. This threshold was selected based on the analysis of historical base flow at the Casmalia stream gage presented on Figure 4-2" (Pg. 4-54). The SABGSA has not provided enough information to confirm that low flow measurements below 0.50 cfs can be accurately measured at the Casmalia stream gage. Additionally, 0.15 cfs is considerably low for native fish species, including for UTS. Based on the information provided in the Draft GSP, CDFW is not able to determine if the minimum threshold is sufficient to ensure avoidance of significant and unreasonable adverse impacts (undesirable results) to UTS. Hydrologic connectivity should be maintained to provide suitable habitat for UTS.

Recommendation #3.1(a): CDFW recommends SABGSA establish the minimum thresholds at 0.50 cfs at the Casmalia gage instead of 0.15 cfs, to consider impacts to UTS, which are particularly sensitive to additional water reductions due to groundwater pumping, and other stressors which can increase with lower surface water levels, such as water quality, temperature, and turbidity.

Recommendation #3.1(b): CDFW recommends SABGSA establish a measurable surface water flow trigger of 0.75 cfs to begin the implementation of management actions and priority projects to avoid significant and unreasonable impacts to UTS. A reasonable timetable is also needed to ensure projects are ready to be implemented to avoid surface water flows reaching CDFW's proposed minimum threshold of 0.5 cfs.

Issue #3.2: CDFW expressed concerned in Comment #1 of GDEs along San Antonio Creek and throughout the Basin that were eliminated as potential GDEs. The USGS currently measures streamflow at three locations along San Antonio Creek; one upstream of the town of Los Alamos (Los Alamos gage # 11135800), one where San Antonio Creek leaves the basin (Casmalia gage #11136100), and one on a tributary to San Antonio Creek (Harris Canyon Creek gage #11136040) (USGS 2021). The Draft GSP only establishes minimum thresholds at the Casmalia gage.

Recommendation #3.2(a): CDFW appreciates SABGSA's efforts to utilize the Casmalia gage, however, CDFW recommends SABGSA incorporate the Harris Canyon and Los Alamos gages into SABGSA's monitoring efforts to supplement SABGSA's ability to assess impacts to interconnected surface waters and GDES within the Basin.

Recommendation #3.2(b): CDFW recommends minimum thresholds also be established for gage #1135900 and #11136040. This will ensure avoidance of impacts to any additional GDEs within the Basin, identified as a result of Recommendation #1(a).

Comment #4 – Section 3.2.6.2 Terrestrial and Aquatic Special-Status Species Occurrence

Issue #4.1: CDFW has concerns with the limited number of terrestrial and aquatic special-status species that the SABGSA lists in the Draft GSP. The San Antonio Creek Valley provides habitat that supports several sensitive species (some listed as endangered or threatened) throughout their life cycles, including the ESA and southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), tricolored blackbird (*Agelaius* *tricolor*), and arroyo chub, an SSC (CNDDB 2021; USFWS 2021). Habitats that support these species also consist of phreatophytes and other vegetation communities that are dependent on shallow aquifers that support surface water in each of these systems. Phreatophytic vegetation is a critical contributor to nesting and foraging habitat and forage for a wide range of species and can be affected by sensitive to depth to groundwater threshold impacts (Naumburg et.al. 2005) and (Froend et. al. 2010). This sensitivity to groundwater level thresholds means that localized pumping and recharge actions altering groundwater levels can impact the health and extent of phreatophyte vegetation health. Both decreasing (drying out) or increasing (drowning) groundwater elevation has the potential to stress phreatophytes depending on the plant species and the groundwater elevation and duration (e.g., short term wetness/dryness versus prolonged wetness/dryness).

Recommendation #4.1: CDFW recommends SABGSA add the following species to the final GSP: the southwestern willow flycatcher, least Bell's vireo, tricolored blackbird, and arroyo chub.

Issue #4.2: Based on the information provided in the Draft GSP, CDFW is not able to determine if southern California steelhead (*Oncorhynchus mykiss*; steelhead) is present within the Basin.

Recommendation #4.2: CDFW recommends SABGSA identify steelhead as a species that has the potential to occur within the Basin, and has the potential to be impacted by groundwater pumping.

Comment #5: Section 2.2.3 Land Use and General Plans Summary; Cannabis Cultivation (Cannabis Priority Watershed)

Issue: CDFW is concerned that cannabis groundwater use is not being fully accounted for when evaluating this SGMA area. Ignoring the growth potential of this industry could result in a lack of groundwater management accountability. There are approximately eight cannabis projects within the San Antonio Creek Watershed. Six of those are within 1000 feet of San Antonio Creek and all are likely using groundwater. Page 2-12 of the Draft GSP states that "*Land uses in the Basin are primarily agricultural. Of note, in 2019 the Santa Barbara County Board of Supervisors placed a limit on outdoor cannabis cultivation in the unincorporated areas of the County outside the Carpinteria Agricultural Overlay District County to no more than 1,575 acres (Santa Barbara County Code § 50-7) and requires a special land use permit".*

The Basin has sensitive, natural communities consisting of Coast Live Oak, Valley Oak, Riparian Mixed Hardwood and Willow habitats along Santa Antonio Creek and its tributaries. According to CNDDB, these habitats support several sensitive species (some listed as endangered or threatened) throughout their life cycles, including California red-legged frog (*Rana draytonii*), tricolored blackbird, La Graciosa thistle (*Cirsium scariosum var. loncholepis*), Gambel's water cress (*Nasturtium gambelii)*), and unarmored threespine stickleback, and California tiger salamander (CTS) (*Ambystoma californiense*). There are approximately 52 known/potential CTS ponds in the Basin (CNDDB; CDFW 2021).

Groundwater and interconnected surface water depletion is a major concern for fish and wildlife beneficial users in the Basin. Designating this area as a High Priority Cannabis Watershed requires groundwater to be monitored and sustainably managed for the benefit of all beneficial users, including groundwater dependent vegetated communities and interconnected surface waters that are necessary to support riparian and aquatic habitat, and the sensitive species therein such as steelhead. Decreased stream flow may contribute to direct mortality if fish eggs are exposed, covered with silt, or left without sufficient oxygenated water. Water degraded in temperature or chemical composition can displace or limit fish populations.

Recommendation #5: CDFW recommends the SABGSA monitor the Basin as a Cannabis High Priority Watershed. This High priority captures the documented impacts within the groundwater basin and the shifting groundwater consumption rates, as influenced by legalization of cannabis [Water Code §§ 10933. (b)(7,8)]. Based on the number of Departmental applications for legal cultivation, there is documented significant demand and potential adverse impacts to beneficial users of groundwater. The cannabis market growth is expected to increase almost ten times during an eight-year span (Fortune Business Insights 2021). North America is expected to lead the world cannabis market. Santa Barbara County recently approved a zoning permit for 87 acres of outdoor cannabis cultivation.

Comment #6: Section 2.2.3 Land Use and General Plans Summary; Cannabis Cultivation

Issue #6.1: Without the designation of the Basin as a Cannabis High Priority Watershed, evaluation of cannabis crop water usage may be overlooked throughout the Basin. Cannabis cultivation is a water intensive crop that can have a significant impact to environmental beneficial users of groundwater

Cannabis groundwater wells provide water for the irrigation of water-intensive cannabis cultivation (assuming six gallons of water per day per plant) (Bauer S. 2015). CDFW is concerned that without management of the two principal aquifers under SGMA by the SABGSA, significant and unreasonable surface water depletions may occur, compromising groundwater dependent ecosystems within and along the streams.

Recommendation #6.1(a): CDFW recommends a more careful review of the existing information on cannabis cultivation within the principal aquifers and recommends the information be considered when evaluating groundwater management. The majority of cannabis cultivation rely on groundwater for cannabis crops irrigation, and the likely interconnected nature between Basin groundwater levels and the Slough suggests that such uses (individually or cumulatively) should be considered when evaluating cannabis impacts in the underlying Careaga Sand water bearing formation.

Recommendation #6.1(b): CDFW recommends the Basin be classified as a Cannabis High Priority Watershed.

Issue #6.2: The majority reliance on groundwater for cannabis crops irrigation, and the possible areas of interconnected surface waters in San Antonio Creek and its tributaries and seeps suggest that such uses (individually or cumulatively) should be considered when evaluating cannabis impacts in the Paso Robles Formation and the Careaga Sand.

Recommendation #6.2: CDFW recommends a more careful review of the existing information on cannabis cultivation within the Basin and recommends the information be considered when evaluating groundwater management.

GENERAL COMMENTS AND RECOMMENDATIONS

Comment #7: SABGSA may need to revise the GSP before it is finalized and adopted by SABGSA.

Recommendation #7: CDFW recommends SABGSA provide a red-lined version of the final GSP to understand the changes made between the Draft GSP and final GSP. Alternatively, CDFW recommends SABGSA provide a summary of changes made and comments addressed by SABGSA in preparation of a final GSP.

CONCLUSION

CDFW appreciates the opportunity to comment on the Draft GSP. CDFW recommends SABGSA address the comments above to avoid a potential ‘incomplete’ or ‘inadequate’ GSP determination per SGMA Regulations, as assessed by the Department of Water Resources, for the following reasons derived from regulatory criteria for GSP evaluation:

1. The assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are not reasonable and/or not supported by the best available information and best available science. [CCR § 355.4(b)(1)] (See Comments # 1, 2, and 3);

2. The Draft GSP does not identify reasonable measures and schedules to eliminate data gaps. [CCR § 355.4(b)(2)] (See Comments # 1, 2, and 3);

3. The sustainable management criteria and projects and management actions are not commensurate with the level of understanding of the basin setting, based on the level of uncertainty, as reflected in the Draft GSP. [CCR § 355.4(b)(3)] (See Comments # 1, 2, 3, 4 and 5);

4. The interests of the beneficial uses that are potentially affected by the use of groundwater in the basin, have not been considered. [CCR § 355.4(b)(4)] (See Comments # 1, 2, 3, 4, 5, and 6).

Attachment B

LITERATURE CITED

Bauer S, Olson J Cockrill A, van Hattem M, Miller L, Tauzer M, et al. (2015) Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds.

CDFW. 2021. California Natural Diversity Data Base (CNDDB). Accessed: October 13, 2021. Available at: https://www.wildlife.ca.gov/data/cnddb

Fortune Business Insights. June 8, 2021. Cannabis Market Size to be Worth $97.35 Billion by 2026; Increased Use for Medical & Therapeutic Purposes to Aid Marijuana Industry Growth, Says Fortune Business Insights™

Froend, R., and B. Sommer. 2010. Phreatophytic vegetation response to climatic and abstraction-induced groundwater drawdown: Examples of long-term spatial and temporal variability in community response. Ecological Engineering, 36:1191:1200.

The Nature Conservancy (TNC). 2019. Identifying GDEs Under SGMA. Best Practices for using the NC Dataset.

Naumburg E., Mata-Gonzalez R., Hunter R.G., McLendon T., Martin D.W.
2005. Phreatophytic vegetation and groundwater fluctuations: a review of current research and application of ecosystem response modeling with an emphasis on great basin vegetation. Environment Management. 35(6):726-40.

United States Fish and Wildlife Service (USFWS) 2021. Information for Planning and Consultation. Accessed: October 13, 2021. Available at: https://ecos.fws.gov/ipac/

United States Geologic Survey (USGS) 2021. San Antonio Creek Water Availability. Accessed: October 13, 2021. Available at: https://ca.water.usgs.gov/projects/san-antonio-creek/san-antonio-creek-surface-water.html

APPENDIX C

Communication and Engagement

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San Antonio Basin Groundwater Sustainability Agency's Groundwater Sustainability Plan
Stakeholder Communication and Engagement Plan

GSP Stakeholder Communication and Engagement Plan

As Adopted by the San Antonio Basin Groundwater Sustainability Agency Board of Directors on July 17, 2018

Overview

In 2014, California enacted the Sustainable Groundwater Management Act (SGMA). The purpose of the SGMA is to ensure local sustainable groundwater management in medium- and high- priority groundwater basins statewide. SGMA requires that groundwater sustainability plans be adopted for these medium- and high-priority groundwater basins in California.

The San Antonio Creek Groundwater Basin ("Basin") is designated as a medium-priority basin. As such, SGMA requires formation of a locally-controlled groundwater sustainability agency (GSA) as the entity responsible for developing and implementing a groundwater sustainability plan (GSP). The primary goal of the GSP is to develop sustainable groundwater management practices for the future. As a medium-priority basin, the GSP must be submitted to the State by January 31, 2022 and to achieve sustainability by 2042.

After numerous meetings among stakeholders in the Basin regarding the optimal governance structure, the San Antonio Basin Groundwater Sustainability Agency (SABGSA) formed in May 2017 under a joint powers agreement between the Cachuma Resource Conservation District and the Los Alamos Community Services District. The SABGSA immediately commenced monthly Board of Directors meetings noticed and open to the public in compliance with the Ralph M. Brown Act.

In an effort to understand and involve stakeholders and their concerns in the decision-making and activities of the SABGSA, this Stakeholder Communication and Engagement Plan has been developed to achieve broad, enduring and productive involvement during the GSP development and implementation phases. This Stakeholder Communication and Engagement Plan describes how decisions regarding groundwater management will be made and will assist the SABGSA in providing timely information to stakeholders and receiving and incorporating input from interested parties during GSP development. This Stakeholder Communication and Engagement Plan identifies stakeholders who have an interest in groundwater in the Basin, and recommend outreach, education and communication strategies for engaging those stakeholders during the development and implementation of the GSP. In consideration of the interests of all beneficial uses and users of groundwater in the Basin, this Stakeholder Communication and Engagement Plan has been developed pursuant to California Water Code Section 10723.2 and the California Code of Regulations, Title 23, Section 354.10.

The purpose of the outreach activities described in this Stakeholder Communication and Engagement Plan is to provide individual stakeholders, stakeholder organizations, and other interested parties an opportunity to be involved in the development and evaluation of the GSP for the Basin. The projects and management actions necessary to implement the GSP could affect individuals and groups who have a stake in ensuring the Basin is sustainably managed as required by SGMA.

Stakeholder Communication and Engagement Strategy Goals

SGMA requires the SABGSA to consider the interests of all beneficial uses and users of groundwater, and encourage involvement of diverse social, cultural, and economic elements of the population within the Basin during GSP preparation and implementation. The goals of the Stakeholder Communication and Engagement Plan are to:

- Conduct an inclusive outreach and education process that facilitates the development of a well- prepared GSP that meets SGMA requirements and achieves SGMA's sustainability goal.
- Enhance understanding and inform the public about water governance and groundwater resources in the Basin and the purpose and need for the GSP.
- Engage a diverse group of interested parties and stakeholders and promote informed community feedback throughout the GSP preparation and implementation process.
- Coordinate communication and involvement between the GSA (Board, Advisory Committee and staff), and other local agencies (including other GSAs), elected and appointed officials, and the general public.
- Utilize the Advisory Committee to facilitate a comprehensive public engagement process.
- Employ a variety of outreach methods that make public participation easy and accessible. Hold meetings at times and venues that encourage broad participation.
- Respond to public concerns and provide accurate and up-to-date information.
- Manage the community engagement program in a manner that provides maximum value to the public and an efficient use of GSA and local agency resources.
- Evaluate and update the engagement methods throughout the GSP process as needed.
- Utilize and explain the 2020 United States Geological Survey (USGS) San Antonio Basin study, currently under development, which will provide groundwater data and modeling of the basin.Update stakeholders on the USGS San Antonio Basin study at the semi-annual update meetings.

Outreach Roles

SABGSA Board

The SABGSA Board of Directors ("Board"), which is comprised of appointed members, will make the ultimate decisions regarding how the groundwater basin will be managed and how the management actions described in the GSP will be financed. As required by the Joint Exercise of Powers agreement that created the GSA, the Board will consider the recommendations of the Advisory Committee (described below). The Board typically meets on the third Tuesday of the month at the Los Alamos

Community Services District office at 6pm.

In regards to outreach, the Board is responsible for:

- Adopting and overseeing implementation of the Stakeholder Communication and Engagement Plan;
- Receiving public comments made in writing, and verbally at Board meetings and public hearings;
- Considering the recommendations of the Advisory Committee.

GSP Advisory Committee
The GSP Advisory Committee**,** which is comprised of members appointed by the GSA Board, will become familiar with issues related to the GSP. The Advisory Committee is charged with developing recommendations on GSP-related issues and incorporating the community and stakeholder interests into these recommendations. This charge will be carried out through various venues and a variety of activities, but generally includes:

- Actively seeking input from the represented public and stakeholder groups on issues before the GSA;
- Sharing input and feedback with the full Advisory Committee at Advisory Committee meetings; and
- Making recommendations to the Board.

Advisory Committee meetings are typically the first Tuesday of the month at the Los Alamos Community Services District office at 1:30pm.

Executive Director
The Executive Director is considered SABGSA staff and will be available to provide information about SABGSA and the GSP status. The GSA's Executive Director is Anna Olsen and she may be reached by email at aolsen@sanantoniobasingsa.org or by telephone at 805-868-4013.

The Board, the Advisory Committee, and staff are committed to: keeping the public informed; providing balanced and objective information to assist the public in understanding SGMA, available options and recommendations; and creating an open process for public input on the development and implementation of the GSP. When evaluating the options and making decisions, the Board, Advisory Committee and staff will solicit public input through a variety of methods, including public workshops, written and verbal comments, meetings with stakeholder organizations and community events. Input will also be received during public comment periods at Advisory Committee and Board meetings and in writing. As noticed on all Board and Advisory Committee meeting agendas, comments made in writing can be submitted directly to the GSA's executive director at aolsen@sanantoniobasingsa.org.

Stakeholder Identification

SGMA mandates that a GSA establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents. (Water Code § 10723.4.) A list of interested persons wishing to receive information and/or participate has been compiled and will be updated and maintained throughout the GSP development phases. The initial list of stakeholders and interested parties include, but are not limited to, the following:

- Local land use planning agencies, including but not limited to the County of Santa Barbara
- Holders of overlying groundwater rights, including but not limited to the following:
  - Domestic well owners
  - Agricultural well owners, including farmers, ranchers, and dairy professionals
- Business
- Municipal well operators/Public water systems (Los Alamos Community Services District, represented on the SABGSA Board of Directors)
- Environmental uses of groundwater and environmental advocacy groups
- Land conservancies
- Surface water users
- Disadvantaged communities and environmental justice interests
- Vandenberg Air Force Base
- California Native American tribes (note: there are no presently known California Native American tribes within the Basin)
- Federal Government
- Other groundwater users identified through the communications and engagement process

Maintenance of the Interested Persons List

To distribute information about GSP development, an email list has been compiled into a database of interested persons and stakeholders. Board members and the agencies they represent, Advisory Committee members and staff can contribute names of organizations, agencies, and individuals to the list. The database will also be updated regularly to add names of attendees at public meetings along with those requesting information via email or the through the GSA's website.

The purpose of the interested persons list is broad and includes anyone who would like to stay informed about SGMA activities and anyone the Board and Advisory Committee thinks should be informed about GSP process and the outcome of other groundwater management efforts. This list will also be used for dissemination of information on public workshops, public meetings, release of draft documents, public comment deadlines, and other GSP milestones.

Outreach Methods

Anticipated outreach methods include facilitating the public's access to information and documents through the GSA's website and email distribution list, as well as making information available where needed in hard copy form. For instance, the GSA will use already-established outreach venues in the Basin's predominantly rural, agricultural community such as community posting locations for placement and/or distribution of informational materials (e.g. flyers or posters). Locations for posting of materials may include: Los Alamos Community Service District, Cachuma Resource Conservation District, Los Alamos Public Library, and the Los Alamos Post Office. Public meetings and project information will be disseminated through email or direct mail, if requested. This communication will provide information for the Basin community, public agencies, and other interested persons/organizations about milestones, meetings, and the progress of GSP development. The following are some of the outreach methods envisioned for this project:

1. **Public Notices**
   To ensure that the general public is apprised of local activities and allow stakeholders to access information, SGMA specifies several public notice requirements for GSAs. All meetings, hearings and workshops will be noticed in compliance with the Ralph M. Brown Act. As outlined below, there will be a variety of opportunities for people to participate in the development and implementation of the GSP, including workshops, public hearings, providing comments at Board of Director and Advisory Committee meetings and through written comments.

   In addition to open meeting requirements, three sections of the California Water Code require public notice before establishing a GSA, adopting (or amending) a GSP, or imposing or increasing fees:

   - Section 10723(b). "Before electing to be a groundwater sustainability agency, and after publication of notice pursuant to Section 6066 of the Government Code, the local agency or agencies shall hold a public hearing in the county or counties overlying the basin." In accordance with California Water Code Section 10723(b), the following occurred: on May 10 and May 16, 2017, at the duly noticed public meetings of the Los Alamos Community Services District and the Cachuma Resource Conservation District, respectively, the two agencies approved a Joint Exercise of Powers agreement creating the SABGSA. On June 14, 2017, SABGSA held a noticed public hearing to consider becoming a GSA for the San Antonio Basin, and voted to become such a GSA. The June 14, 2017 public hearing was noticed in the Santa Maria Times in accordance with Government Code Section 6066.

   - Section 10728.4. "A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. …"

   - Section 10730(b)(1). "Prior to imposing or increasing a fee, a groundwater sustainability agency shall hold at least one public meeting, at which oral or written presentations may be made as part of the meeting....(3) At least 10 days prior to the meeting, the groundwater sustainability agency shall make available to the public data upon which the proposed fee is based."

2. **Public Meetings/Hearings**
   Comprehensive stakeholder involvement will include regularly scheduled public meetings of the Board and the Advisory Committee to aid in developing and implementing the GSP. In addition to signing up to receive information about GSP development at the SABGSA webpage, interested parties may participate in the development and implementation of the GSP by attending and participating in public meetings. (Water Code Section 10727.8(a)). Public meetings or hearings are formal opportunities for people to provide official comments on programs, plans and proposals. During development of the GSP, topics associated with each chapter will be presented at various Board meetings to keep the Board and public informed about the progress of the GSP and to obtain input as the GSP is being prepared. Each meeting will have a scheduled time for public comments. Information about upcoming meetings can be found on the San Antonio Basin GSA website: https://sanantoniobasingsa.org/.

3. **Stakeholder Briefings**
Regular meetings of the Advisory Committee will facilitate technical review of GSP progress and allow for increased opportunity for discussion and input. Advisory Committee members will meet with and communicate regularly with organizations comprised of the stakeholder groups they represent. To facilitate cohesive communication and messaging, all briefings will be coordinated with staff. All meetings are open to the public and stakeholder groups.

4. **Public Input**
Meetings will also be held as GSP elements are being developed and will serve as opportunities for public input. Public educational meetings provide less formal opportunities for people to learn about groundwater, SGMA, and GSP elements. Meetings can be organized in a variety of ways, including open houses and traditional presentations with facilitated question and answer sessions. Whatever format of meeting is used, it will be designed to maximize opportunities for public input. Community meetings (workshops, open houses, town halls) may be conducted for key stakeholders where project experts share educational information by topic, clarify technical data and issues, and offer opportunities for public questions and input. The timing and precise format of public workshops will be informed by the key issues that arise and the input received during early stages of GSP development.
Meetings may be held in coordination with the following milestones/tasks:
    - Preparation of the Hydrogeologic Conceptual Model and draft groundwater conditions section of the GSP
    - Preparation of the Basin Model and Water Budget
    - Establishment of Basin Sustainability Criteria
    - Establishment of monitoring objectives and a monitoring network
    - Identification and prioritization of projects and management actions
    - Draft Sustainability Plan Implementation
    - GSP draft document

5. **Briefings for the JPA Member Agencies**
Cachuma Resource Conservation District (https://www.rcdsantabarbara.org/) and Los Alamos Community Service District (http://www.losalamoscsd.com/) staff will brief their respective board of directors regularly on GSA activities.

6. **Website**
The SABGSA website will house information about SGMA, the GSP process, SABGSA Board, Advisory Committee, public meetings, project reports and studies, and groundwater data and information. The project website, https://sanantoniobasingsa.org/, will be a tool for distributing and archiving meeting and communication materials as well as a repository for studies and other documents. Staff anticipates updating the website at least monthly, and more often when needed.

7. **Email / Direct Mailings**
Public meetings and other information will be disseminated through email, from the SABGSA office, or direct mail under special circumstances and/or if requested. This communication will provide information for the community, public agencies, and other interested

persons/organizations about milestones, meetings, and the progress of GSP development.

8. **Additional Opportunities**
   Additional opportunities for stakeholder participation will be considered as GSP development progresses and as stakeholder interests evolve.

Plan Evaluation

To determine the level of success of the Engagement Plan, the SABGSA will implement the following measures:

Attendance/Participation

A record of those attending public meetings will be maintained throughout the GSP development process. SABGSA will utilize sign-in sheets and request feedback from attendees to determine adequacy of public education and productive engagement in the GSP development and implementation process. Meeting minutes will also be prepared and will be provided on the SABGSA website once approved.

Plan Update

This Stakeholder Communication and Engagement Plan will be reviewed at least annually and updated if necessary.

Incorporation into the GSP

The GSP will include a section describing how public input and comments were addressed as necessary and incorporated into the GSP document.

APPENDIX D-1

Los Alamos Community Services District Pumping Test Data and Analysis - Wells 3a and 5

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A & A Pump and Well Service
(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3 A
DATUM POINT (ie top of casing): Top of casing DEPTH OF WELL:
DEPTH OF PUMP SETTING: HP & MOTOR TYPE:
DEPTH OF AIRLINE: BLOW

WaterLevelForm.xls

DATE	ON / OFF	TIME	FLOW RATE (aprx gpm)	TOOL LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)
				6" pipe	Sonic		
1.18.11	Off	8.15					Set air tool and air pipe
	Blow	10.55	60-70	190'			Blow slightly cloudy a few seconds
	Off	11.03					Surge with air 4x then blow out
	Blow	11.45		190			Slight color
	Off	11.51					Added to tool
	Blow	12.30		200			
	Off	12.53					Added to tool
	Blow	2.02		230			Slightly cloudy a few seconds
	Off	2.38					Added to tool
	Blow	3.08		240			No color
	Off	3.25					Tear down piping and secure site
	Leave	4.45					
1.19.11		8.00					On job, set up pipe and prepare compressor, set tool
	Blow	9.21		240			
	Off	9.23					Blew 2" well seal off of piping
	Blow	9.29					
	Off	9.51 ?					Added to tool
	Blow	11.55		260			
	Off	11.59					3" discharge hose blew out of piping, secure
	Blow	12.07					
	Off	12.21					Added to tool
	Blow	2.35		270			Color at start up, then milky for 5 min to clear
	Off	2.50					Surge with air
	Blow	4.07					Color on startup then milky 5 min, with fine sands
	Off	4.24					Set tool to next level Tear down piping and secure site
	Leave	4.45					
11.20.11		8.00					Prepare site to blow
	Blow	8.23					Color on startup then milky with fine silt
	Off	8.27					Fitting repair, then surge
	Blow	9.30					Slight yellowish color
	Off	10.03					Added to tool
	Blow	11.49		290			Slight color very minimal
	Off	12.05					Pulled 2" pipe, lower tool, re-install 2"
	Blow	2.53		350			Color on startup then milky with fine silt
	Off	3.08					Surge 3x
	Blow	3.30					Some silty color with fine sands, then clear
	Off	3.40					Set tool to next level Tear down piping and secure site
	Leave	5.00					
11.21.11		8.00					Onsite, rig batteries need replaced
	Blow	12.12		360			Cloudy yellowish with sandy grit
	Off	12.30					Surge 3x
	Blow	12.40					Slight color to clear
	Off	12.50					Pulled 2" pipe, lower tool, re-install 2"
	Blow	2.41		370			Slight color to clear
	Off	3.05					Pulled 2" pipe, lower tool, re-install 2", secure site

A & A Pump and Well Service
(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3 A
DATUM POINT (ie top of casing): Top of casing DEPTH OF WELL:
DEPTH OF PUMP SETTING: HP & MOTOR TYPE:
DEPTH OF AIRLINE: BLOW

WaterLevelForm.xls

DATE	ON / OFF	TIME	FLOW RATE (aprx gpm)	TOOL LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)
	Leave	4.45					
11.24.11		8.00					Prepare site to blow
	Blow	8.35		370			Slight color to clear
	Off	8.55					Pulled 2" pipe, lower tool, re-install 2"
	Blow	10.47		390			Surge of slight color, cloudy for 5 min then clear
	Off	11.09					Pulled 2" pipe, lower tool, re-install 2"
	Blow	1.00		400			Slight color to clear
	Off	1.25					Pulled 2" pipe, lower tool, re-install 2"
	Blow	3.25		435			Initial color, cloudy, for 6 min then clear
	Off	3.58					Tear down piping and secure site
	Leave	4.45					
Pulling tool out and revisiting several areas for a second time							
11.25.11		8.00					Pulled 2" pipe, raise tool, re-install 2" set up to blow
	Blow	9.37		370			Surge of slight color, cloudy for 5, with reddish tint
	Off	9.55					Pulled 2" pipe, raise tool, re-install 2" set up to blow
	Blow	11.36		360			10 sec color cloudy for 5 min then clear
	Off	11.50					Pulled 2" pipe, raise tool, re-install 2" set up to blow
	Blow	2.04		280			Slight brownish tint 30 sec, milky 30 sec then clear
	Off	2.20					Pulled 2" pipe, raise tool, re-install 2" set up to blow
	Blow	3.27		270			3 sec color surge then clear at 30 sec.
	Off	3.45					Pull tool out of well
	leave	4.45					

Development

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(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3 A
DATUM POINT (ie top of casing): DEPTH OF WELL:
DEPTH OF PUMP SETTING: 300 ft HP & MOTOR TYPE:
DEPTH OF AIRLINE:

WaterLevelForm.xls

DATE	ON / OFF	TIME	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)
11.27.11	Surge	9.47			114.9		Surge 21 x
	On	10.37	300				45 hz for 2 min then increase to 59 hz
			700				59 hz
			600				5 min run time
	Off	10.50					
	Surge	10.54			115.8		30 surges
	On	11.55	300				45 hz for 3 min then to 59 hz
			600				Slight brownish tint in flow
	Off	12.10					
	Surge	12.20					30 surges
	On	1.22	300		115.8		45 hz then to 60 hz
		1.25	600				Slight yellowish
		1.29	650			45psi	
		1.47				43psi	
	Off	1.49					
	Surge	1.52					30 surges
	On	2.52					50 hz start then to 60 hz w/in 30 sec.
			650				Slight tannish yellow
		2.55				46psi	
	Off	3.17				42psi	Very slight color
	Surge	3.20		116	115.9		
	On	4.14	650				Light tannish yellow color
		4.16		128			
		4.24		135		43psi	
	Off	4.30					
		4.43		117.6			
11.28.11	Off	6.55		114		80psi	
	Surge	7.00					30 surges
	On	8.18	650				59 hz little color cloudy for 10 min then clear
	Off	8.38					7 min recovery to 80psi
	Surge	8.45					30 surges
	On	9.50	650				Milky tan
		9.54					Clearing
		10.00		133.9		46psi	Clear
		10.10		136.2		45psi	
	Off	10.15					
	Surge	10.20					30 surges
	On	11.20	650				Tannish yellowfor 1.5 min, clear at 6min then cloudy then clear @ 9 min
		11.50				44psi	
	Off	12.05					
	Surge	12.10					30 surges
	On	1.11	650				59hz, slightly cloudy for 10 min then clear
		1.47				44psi	Valve back to 500gpm
	Off	1.52				77psi	After 16 min recovery

Development

A & A Pump and Well Service
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ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3 A
DATUM POINT (ie top of casing): DEPTH OF WELL:
DEPTH OF PUMP SETTING: 300 ft HP & MOTOR TYPE:
DEPTH OF AIRLINE:

WaterLevelForm.xls

DATE	ON / OFF	TIME	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)
				line	Sonic		
1.28.11	Surge	2.00					30 surges
	On	3.10					Tannish yellow for 5 min then clear
		3.15		135		47psi	
	Off	3.35					
	On	4.00					
	Off	4.25					
1.31.11	Off	8.30					
	Surge	8.50					
	On	9.00	650				Spurts of yellowish tan 1 min then clear
	9.05			184		47psi	
	Off	9.10					
	Surge	9.12					30 surges
	On	10.00					2 min then clear
		10.05	570			47psi	
	Off	10.11					
	Off	10.41		115.9		79psi	30 min recovery

Step Tests

A & A Pump and Well Service
(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3A
DATUM POINT (ie top of casing): Top Of Case DEPTH OF WELL:
DEPTH OF PUMP SETTING: 304 HP & MOTOR TYPE:
DEPTH OF AIRLINE: 300 4 hr test

WaterLevelForm.xls

DATE	ON / OFF	TIME	SAND CONTENT	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)	TOTAL WATERMETER
					line	Sonic		Old well	
1.31.11	Off			0	115.4	114.6	80		07416600
	On	11.00						57Hz	
		11.01			177	178			
		11.02			180.1	181.9			
		11.03			182	183.2	50		
		11.04			183	184.1			
		11.05			183.10	185			
		11.07			184.6	186	50		
		11.09			185.4	186.7	50		
		11.11		540	185.11	187.2			
		11.13			186.3	187.6			
		11.15			186.7	188.1		135	
		11.20		525	190.2	188.9	48.5	135.5	
		11.25			191	191.9		137 adjust to 58Hz	
		11.30		650	189.11	192.5		137.5	
		11.35		550	190	191.3		Adjust to 57.3Hz	
		11.40				191.6			
		11.45		520	190.3	191.9			
		11.50			190.9	192.2			
		11.55			191	192.4			
		12.00			191.1	192.6			
		12.05			191.3	193		140	
		12.10		520	191.5	193.1			
		12.15			191.8	193.4			
		12.20			191.11	193.5		140.7	
		12.25			192.1	193.6		Adjust to 56 Hz	
		12.30			186.2	187.5	49	140	
		12.35		470	186.1	187.5		139.6	
		12.40		470	186.1	187.5			
		12.45			186.1	187.5	49		
		12.50			186.1	187.6	49		
		12.55			186.2	187.6	49		
		1.00		470	186.3	187.8	49		
		1.10			186.6	188			
		1.15			186.9	188.1			
		1.16						350 gpm	
		1.20		410	178.10				
		1.23							
		1.25		380	175.8	176.6	54	138.3	
		1.30		380	175.5	176.4			
		1.35						Adjust to 50.7Hz	
		1.40			174.6	175.5		136.5	
		1.45			174.6	175.4		136.5	
		1.50			174.5	175.4	54	136.5	
		1.55			174.4	175.4		136.5	
		2.00			174.3	175.4		136.5	

A & A Pump and Well Service
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ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3A
DATUM POINT (ie top of casing): Top Of Case DEPTH OF WELL:
DEPTH OF PUMP SETTING: 304 HP & MOTOR TYPE:
DEPTH OF AIRLINE: 300 4 hr test

WaterLevelForm.xls

DATE	ON / OFF	TIME	SAND CONTENT	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)	TOTAL WATERMETER
					line	Sonic			
		2.05						Adjusted to 50.7Hz	
		2.10		300	163	163.6	60		
		2.15						Adjust gate valve for flow	
		2.20		260	156.1	156.5	62.5	132.5	
		2.25		250	155.10	156.1			
		2.30			155.7	156		132	
		2.35							
		2.40			155.4	155.6		131.5	
		2.45			155.2	155.5		131.2	
		2.50			155.1	155.5		131	
------	-----	------	-----------	-------	---------	---------	------	--	---------------
	Off	3.00							
		3.01			125.6				
		3.02			125.1	124.7			
		3.05			124.4	123.7		124	
		3.10			122.11	122.3		122	
		3.20			121.1	120.8		120.9	
		3.30			121	120.2		120	

Constant Run
24hr +

A & A Pump and Well Service
(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3A
DATUM POINT (ie top of casing): Top Of Case DEPTH OF WELL:
DEPTH OF PUMP SETTING: 304 to top of suction HP & MOTOR TYPE:
DEPTH OF AIRLINE: 300 Ft 24 hr test pump

WaterLevelForm.xls

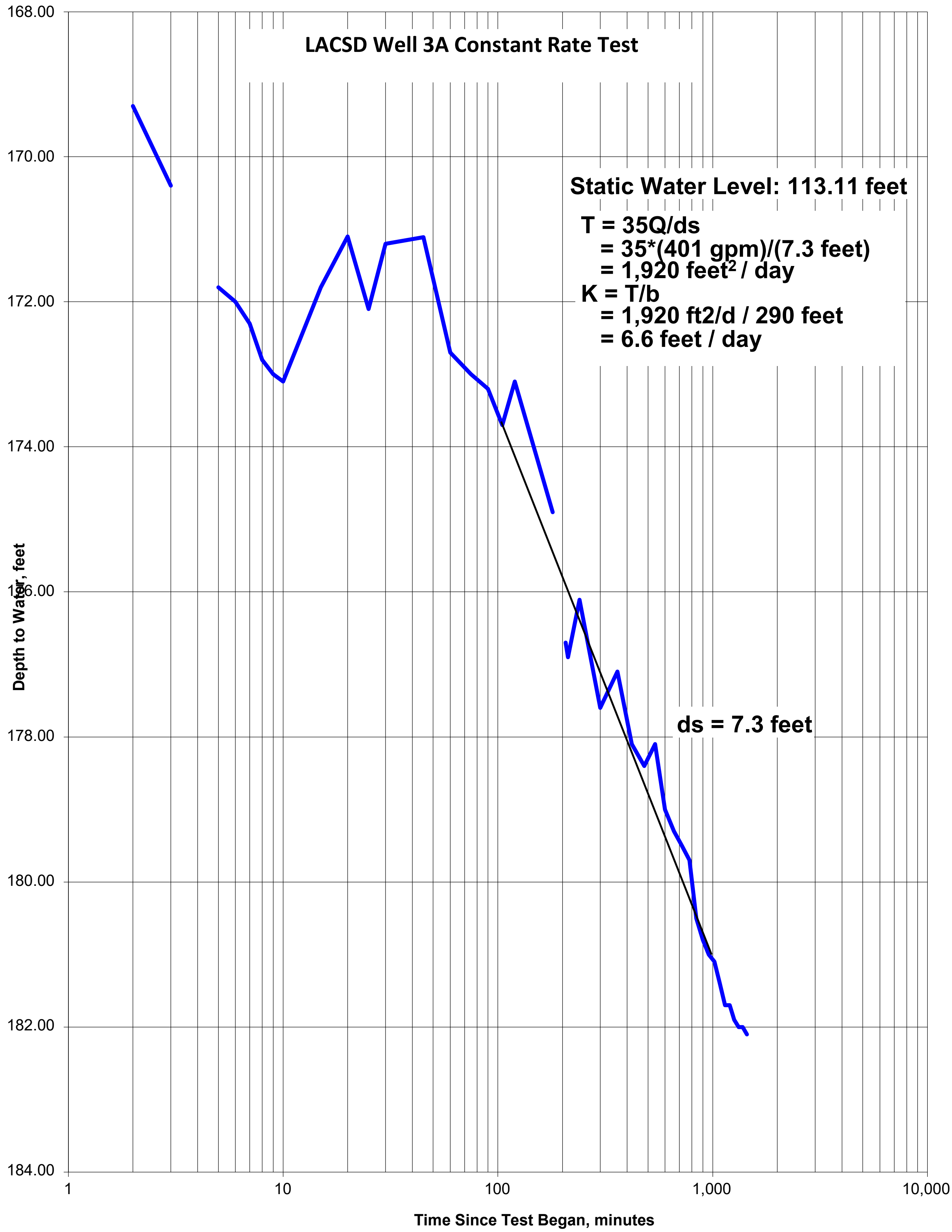
DATE	ON / OFF	TIME	SAND CONTENT	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)	TOTAL WATERMETER
					line	Sonic		Old Well water level	
2.2.11	Off	7:20	----------	------	113.11	113.1		113	7518800
	On	8.00		470					
		8.01				166			
		8.02			169.3	169.5			
		8.03			170.4	170.9		125	7520800
		8.04				171.8			
		8.05			171.8	172.3			
		8.06			172	173		128.5	
		8.07			172.3	173.1			
		8.08			172.8	173.4			
		8.09			173	173.6			7523100
		8.10		460	173.1	173.9		130 adjust Hz to 52	7524900
		8.15	Trace		171.8	172.1	55		
		8.20			171.10	172.6		131	7529250
		8.25		430	172.1	173		131.6 adjust Hz to 51.5	7531000
		8.30		420	171.2	172		132	7533100
		8.45		415	171.11	172.8	55	132.8	
		9.00			172.7	173.4	55	133.9	
		9.15		415	173	173.9			7550400
		9.30			173.2	174.2	54.5	134.6	7556500
		9.45			173.7	174.5		135	7562800
		10.00			173.10	174.7	54.5	135.2	7568700
		11.00		405	174.9	175.6	54	136.6	7592900
		11.10						adjust Hz to 51.7	7597000
		11.20						adjust Hz to 52	7600900
		11.22				177.1			7601700
		11.27			176.7	177.4			7603750
		11.32			176.9	177.5			7605800
2.3.11		12.00	Trace	410	176.11	177.8	53.5	138	7617300
		1.00		408	177.6	178.4		138.10	7641800
		2.00			177.10	178.8	53	139.4	7666000
		3.00		405	178.1	179.2	53	139.10	7690300
		4.00			178.4	179.5			7713650
		5.00		407	178.10	179.8	52.5	140.6	7738100
		6.00		397	179.0	180	52.5	140.10 adjust Hz to 52	7761900
		7.00		400	179.3	180.3	51.5	141.2	7785900
		8.00		397	179.5	180.58	51.5	141.5	7809700
		9.00		397	179.7	180.7	51	141.9 adjust Hz to 52.2	7833500
		10.00		402	180.5	181.6	50.5	142.3	7857600
		11.00		398	180.8	181.8	50	142.5	7881500
		12.00	Trace	400	181	182	50	142.9	7905500
		1.00		400	181.1	182.2	50	143.2	7929500
		2.00		400	181.4	182.5	50	142.6	7953500
		3.00			181.7	182.8	49	142.10	7977400
		4.00			181.7	182.8	49	142.11	8001000
		5.00		397	181.9	182.9	49	143.2	8024800

A & A Pump and Well Service
(805) 735-9797 (805) 688-8805
Mobil: (805) 452-5205 Fax: (805) 686-8282
ST Lic# 577455

WELL NAME: Los Alamos WELL LOCATION: 3A
DATUM POINT (ie top of casing): Top Of Case DEPTH OF WELL:
DEPTH OF PUMP SETTING: 304 HP & MOTOR TYPE:
DEPTH OF AIRLINE: 300 24hr test pump

WaterLevelForm.xls

DATE	ON / OFF	TIME	SAND CONTENT	FLOW RATE (gpm)	WATER LEVEL (feet)	WATER LEVEL	AIR LINE (psi)	REMARKS (adjust flow, odor, gas, color, sand, ect.)	TOTAL WATERMETER
					line	Sonic			
2.3.11	On	6.00	Trace	393	182	183	49	144.7	8048400
		7.00		394	182	183.1	49	144.7	8072050
	Off	8.00			182.1	183.2	49	144.9	8095750
-------	-----	------	------------	-------	---------	---------	-----	--	------------------
								Recovery	
		8.05		0	133	132.7	72	132	
		8.10		0	131	130.6		130.2	
		8.15		0	130	129.5		129.1	
		8.20		0	129.1	128.6		128.8	
		8.25		0	128.6	128			
		8.30		0	128.1	127.5	74		
		8.45		0	126.10	126.1	74	126	
		9.00		0	126	125.4	74	125.1	


LACSD Well 3A Constant Rate Test
Static Water Level: 113.11 feet
T = 35Q/ds
= 35*(401 gpm)/(7.3 feet)
= 1,920 feet² / day
K = T/b
= 1,920 ft2/d / 290 feet
= 6.6 feet / day
ds = 7.3 feet
168.00
170.00
172.00
174.00
176.00
178.00
180.00
182.00
184.00
Depth to Water, feet
1
10
100
1,000
10,000
Time Since Test Began, minutes

Cleath & Associates
Engineering Geologists
Hydrogeologists
(805) 543-1413
1390 Oceanaire Drive
San Luis Obispo
California 93405

December 13, 2006

Mr. Kevin Barnard
Los Alamos Community Services District
82 North St. Joseph Street
Los Alamos, California 93440

SUBJECT: Well construction and testing report for St. Joseph Street Well #5, Los Alamos Community Services District, Santa Barbara County.

Dear Mr. Barnard:

Cleath & Associates was retained by the Community Services District (District) of Los Alamos to supervise the construction and testing of a new supply well. This letter documents the results of these activities.

Background Information

The St. Joseph Street Well #5 is located approximately 350 feet west of St. Joseph Street, and approximately 280 feet north San Antonio Creek (Figure 1). The well taps unconsolidated sand and gravel aquifer zones of the Pleistocene and Pliocene age Paso Robles Formation. Land uses in the immediate vicinity of the site include open space and residential.

Test Hole Drilling

Prior to drilling and completing the new well, a test hole was drilled on March 29-31, 2005 to a depth of 1,000 feet by drilling contractor Floyd V. Wells, Inc. of Santa Maria, California, approximately 150 feet southeast of the well site. The test hole was documented in Cleath & Associates' letter report of April 13, 2005. The bore hole for the new well was drilled on October 5-14, 2006 by Best Drilling and Pump, Inc. of Highland, California. The lithology was logged by Cleath & Associates at both hole locations, and consisted of unconsolidated sands, gravels, silts and clays. Well completion report and lithologic log for the well are included in Appendix A. The bore hole was drilled by reverse rotary method, using water. No bentonite was used during drilling.

An electric log, natural gamma, and caliper log of the borehole were performed by Pacific Surveys on October 14, 2006 (Appendix A). The geophysical and lithologic logs indicated three main aquifer zones. The upper zone consists of alternating beds of sand and gravel with clay, clayey sand, and clay between a depth of 70 feet and a depth of 365 feet. To allow for the expected water level drawdown during production, only the lower portion of this upper zone can be tapped. A second permeable zone consists

Base Map: Google Earth
Scale: 1 inch = 2,000 feet

Figure 1
Location Map
St. Joseph Street Well (Well #5)
Los Alamos CSD
Los Alamos, California

Cleath & Associates

of two mostly sand beds, 15 feet and 30 feet thick respectively, between 580 feet and 675 feet. The lowest permeable zone consists of sand and gravelly sand beds approximately 15 feet and 55 feet thick respectively. A comparison of the geophysical and lithologic logs of the test hole and the well bore hole indicated that the beds are nearly flat lying in the vicinity of the two hole locations.

Well Construction

On October 5, 2006 a 36-inch diameter hole was drilled to a depth of 60 feet, and a 28-inch diameter, 5/16-inch thick mild carbon steel conductor casing was grouted in place to 60 feet depth. A 24-inch diameter bore hole was subsequently drilled to 1,010 feet depth. Photographs of the drilling and well construction activities are included in Appendix B.

The well was cased on October 14, 2006 using Roscoe Moss 1/4-inch wall, 12-inch diameter mild carbon steel blank from the wellhead through 212 feet depth; Roscoe Moss 12-inch diameter, 304 stainless steel 1/4-inch wall blank from 212-217 feet depth; 304 stainless steel wire wrap screen with 0.040-inch slots from 217-352 feet depth; 304 stainless steel 1/4-inch wall blank from 352-502 feet depth; 304 stainless steel wire wrap screen with 0.040-inch slots from 502-702 feet depth; 304 stainless steel 1/4-inch wall blank from 702-792 feet depth; 304 stainless steel wire wrap screen with 0.040-inch slots from 792-952 feet depth; and 304 stainless steel 1/4-inch wall blank casing with end cap from 952-962 feet depth. One carbon to stainless steel mechanical connector, two feet in length with 3/4-inch wall by 1-1/2-inch length mild carbon steel, was used to connect carbon steel blank sections to stainless steel screen sections at 210 feet depth. A summary of casing materials is included in Appendix C.

Nineteen sets of stainless steel centralizers were installed at approximately 40-foot intervals below the top of the highest screen interval, and one set of carbon steel centralizers was installed 67 feet above the top of the highest screen. The filter pack was composed of RMC Lapis #3 (8 x 20) sand and placed from the total depth up to 120 feet depth. A deep grout seal was placed from 120 feet depth to the ground surface. Well construction details are shown in Figure 2.

Development and Testing

The St. Joseph Street Well #5 was developed initially by air lift from during the week of October 18. The drilling rig was moved off-site the following week, and a pump rig was brought in to continue pump surge development with a test pump through October 27.

On November 2, 2006, a 4-hour step test was performed (data and graphs in Appendix D). Four successive 60 minute steps were run at nominal flow rates of 600 gallons per minute (gpm), 800 gpm, 1,000 gpm and 1,200 gpm, as measured by an in-line flow meter. The static water level was 92.52 feet depth prior to pumping and reached pumping water levels of 147.4 feet, 185.9 feet, 216.9 feet, and 252.2 feet at the end of the respective steps. The incremental specific capacity values show a 5.7 gpm/ft loss

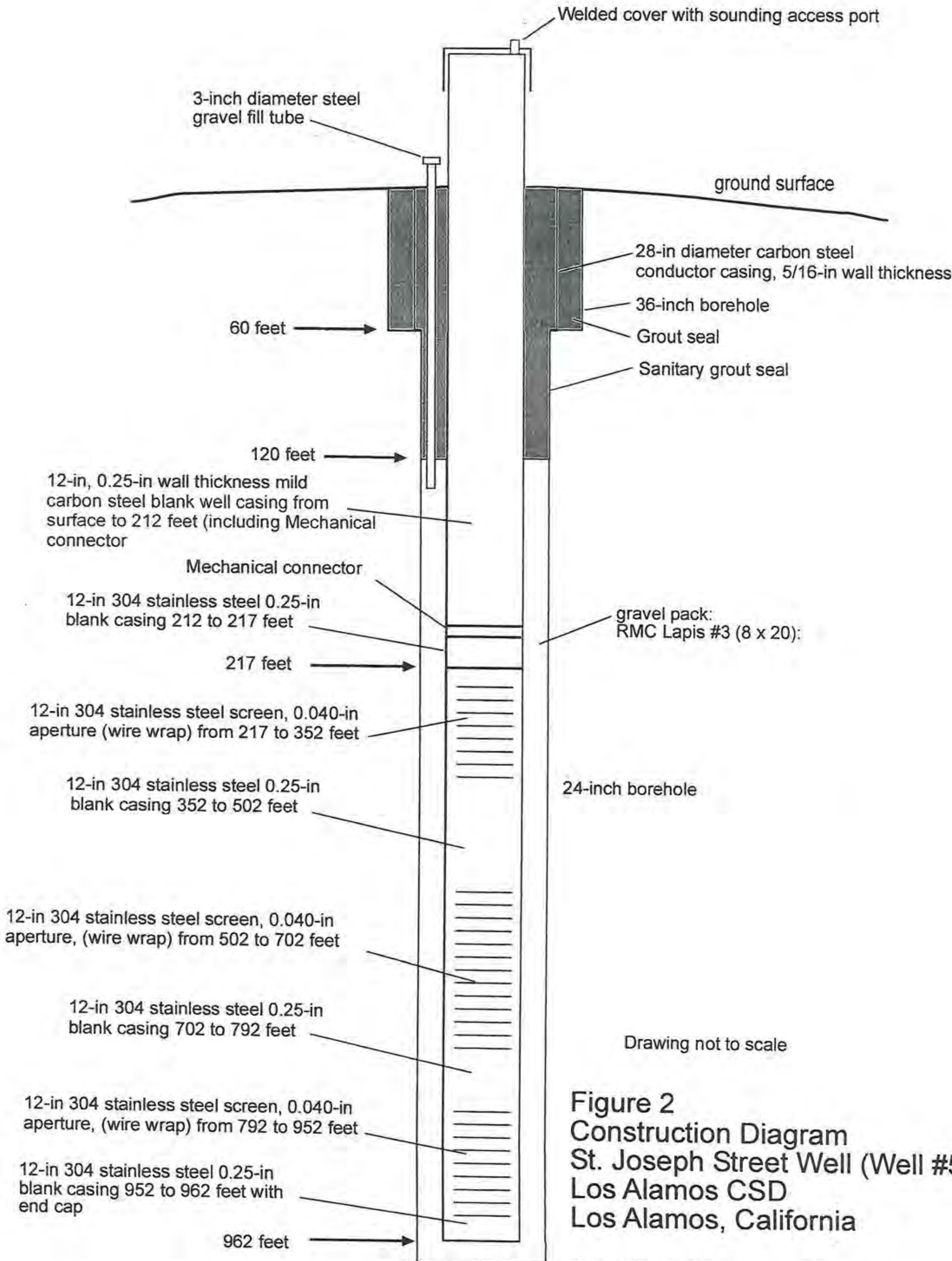


Figure 2
Construction Diagram
St. Joseph Street Well (Well #5)
Los Alamos CSD
Los Alamos, California

Cleath & Associates

in capacity during the second step when comparing specific capacities at flow rates of 600 gpm and 800 gpm. A flow rate of 800 gpm was selected for the constant discharge test, based on the step test results.

A 72-hour constant discharge test was performed at an average rate of 785 gpm on November 7 to 10, 2006 (data and graphs in Appendix D). Static water level prior to the test was at 89.3 feet depth. The one-hour specific capacity at 783 gpm measured 8.8 gpm/ft, and the one-day specific capacity at 778 gpm measured 7.12 gpm/ft. Total drawdown at the conclusion of the test measured 115.66 feet. The aquifer transmissivity measured 14,594 gallons per day per foot (gpd/ft) over the three days of pumping, based on an average rate of water level drawdown of 14.2 feet per log cycle of time. Flow rate adjustments on three occasions during the pump test resulted in short-term water level drops.

Water levels at the St. Joseph Street Well #5 recovered to within 22.3 feet of original static after 2 hours following pump shut down. The recovery curve (Appendix D) can be extrapolated to full recovery at a t/t(0) ratio of close to 1.4, indicating a normal response for a laterally extensive aquifer with no active recharge during the test.

A Rossum sand tester was used to measure sand production during the step test and the 72-hour pump test. Negligible sand was produced during the tests.

Well Efficiency

The theoretical one-day specific capacity of the St. Joseph Street Well #5 at 778 gpm is 7.3 gpm/ft, based on the Cooper-Jacob equation, assuming the following aquifer parameters:

Transmissivity = 14,594 gpd/ft (from pump test)
Storativity = 0.0005 (estimate)
Borehole radius = 1 foot (actual)

The actual one-day specific capacity for the St. Joseph Street Well #5 was 7.12 gpm/ft at 778 gpm during the constant discharge test. The resulting estimated well efficiency is approximately 97 percent, which is very good for a high-capacity well.

Design Flow

The pumping test was conducted during early fall conditions when the ground water level is expected to be at its seasonal low, however, static water level can be expected to drop following the onset of production, due to the establishment of a local pumping depression. For example, at the District's Well #4, a static water level of 77 feet was recorded immediately following well completion in May 1988, and had declined 26 feet to 103 feet depth in May 1990.

For the purpose of pump discharge recommendations, future static water levels at the St. Joseph Street Well #5 in late fall are assumed to drop 30 feet from current conditions, due to the anticipated pumping depression and regional pumping. Therefore, rather than beginning a 72-hour pumping cycle from the November 2006 static of 89.3 feet depth, future pumping cycles would likely begin from static water levels of close to 119 feet depth.

Cleath & Associates recommends sizing a pump based on the pumping schedule anticipated by the District. The pump design and recommended flow rate would allow up to 10 hours of operation per day over a seven-day period without dewatering the production zones. For the St. Joseph Street Well #5, the corresponding design flow would be 713 gpm from a maximum pumping level of 217 feet. We recommend setting the pump at 240 feet depth within the screened interval, or below within the blank casing interval (approximately 355 feet depth. This yield estimate is based on the Cooper-Jacob (1946) modification of the Theis Equation. The yield calculations are included in Appendix D.

Pump sizing based on the seven-day cycle requires careful water level monitoring to ensure that the well is not over pumped. Over pumping occurs when pumping water levels drop into the screened casing, causing cascading water and aquifer zone dewatering, which decreases the well capacity and may result in sanding and plugging problems at the well.

Water Quality

Ground water samples were collected on November 9, 2006, and submitted to Clinical Laboratory of San Bernardino, Inc., in Lompoc for analyses. Water quality samples were analyzed for general mineral, general physical, inorganics, boron, volatile organic compounds, semi-volatile organic compounds, gross alpha and beta radionuclides, uranium, radium 226 and 228, strontium 90, and tritium. At the time of this report, results were not available for gross beta, radium 226 and 228, strontium, and tritium.

The water quality is good and suitable for domestic use. The total dissolved solids (TDS) concentration was reported at 620 milligrams per liter (mg/l). This TDS concentration is above the recommended secondary drinking water standard maximum contaminant level (MCL) of 500 mg/l established by the California Department of Health Services (DHS), but below the upper MCL of 1,000 mg/l. The specific conductance (E.C.) of 930 umhos/cm was also slightly above the recommended MCL of 900 umhos/cm for secondary drinking water standards, but below the upper MCL of 1600 umhos/cm. Contaminants listed by the DHS under secondary standards are regulated to maintain the aesthetic qualities of the water. Their presence in tap water does not pose a health hazard. All other compound concentrations were below their respective MCLs.

Samples were also analyzed for various organic compounds, none of which tested above laboratory detection limits. A summary of the water quality results for general mineral, general physical, and inorganics is shown on Table 1. A complete listing of the water quality results is attached in Appendix E.

Table 1
Analytical Results of Water Samples, November 9, 2006
St. Joseph Street Well #5, Los Alamos CSD

Analyte	Results	MCL	DLR
Total Hardness (as $CaCO_3$) (mg/L)	350	--	5.0
Calcium (mg/L)	90	--	1.0
Magnesium (mg/L)	34	--	1.0
Sodium (mg/L)	71	--	1.0
Potassium (mg/L)	3.8	--	1.0
Total Alkalinity, (as $CaCO_3$) (mg/L)	210	--	5.0
Sulfate (mg/L)	190	500	0.50
Chloride (mg/L)	73	500	1.0
Nitrate (as NO_3) (mg/L)	7.4	45	2.0
Fluoride (mg/L)	0.16	2	0.10
pH (Std. Units)	7.2	--	--
Electrical Conductance (umhos/cm)	930	1,600	2.0
Total Dissolved Solids (mg/L)	620	1,000	5.0
Aluminum (ug/L)	ND	1,000	50
Antimony (ug/L)	ND	6	6.0
Arsenic (ug/L)	ND	10	2.0
Barium (ug/L)	ND	1,000	100
Beryllium (ug/L)	ND	4	1.0
Cadmium (ug/L)	1.6	5	1.0
Chromium (ug/L)	ND	50	10
Copper (ug/L)	ND	1,000	50
Iron (ug/L)	ND	300	100
Lead (ug/L)	ND	15	5.0
Manganese (ug/L)	35	50	20
Mercury (ug/L)	ND	2	1.0
Nickel (ug/L)	ND	100	10
Selenium (ug/L)	ND	50	5.0
Silver (ug/L)	ND	100	10
Thallium (ug/L)	ND	2	1.0
Zinc (ug/L)	ND	5,000	50
Boron (ug/L)	130	--	100
Nitrate + Nitrite as Nitrogen (N) (ug/L)	1700	10,000	400
Nitrite as Nitrogen (N) (ug/L)	ND	1,000	400
Cyanide (ug/L)	ND	150	100
Vanadium (ug/L)	6.6	--	3.0

mg/L = milligrams per liter

ug/L = micrograms per liter

MCL = maximum contaminant level

DLR = Detection levels for purposes of reporting

ND = Not detected above the DLR

Summary

A new water well for the Community of Los Alamos, St. Joseph Street Well #5, was completed west of St. Joseph Street, and north of San Antonio Creek in Los Alamos. The well is constructed with 12-inch diameter mild carbon steel and stainless steel wire wrap screen to a total depth of 962 feet, with perforations from 217-352, 502-702, and 792-952 feet.

The pumping tests indicate excellent well efficiency. The recommended **pump design flow is 713 gpm** from a pumping water level of **217 feet depth** (not including system pressures required at the wellhead) with the **pump setting at a minimum of 240 feet depth**. If you have any questions regarding this report, please call our office.

Sincerely,

David R. Williams
Associate Geologist

Timothy S. Cleath, HG 81
Principal Hydrogeologist

Appendix A

Well Construction Information:

Well Completion Report
Lithologic Log
Electric/Gamma Logs
Caliper Log

The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752

Page 1 of 2

Owner's Well Number WELL NO5

Date Work Began 10-4-06 Date Work Ended 11-18-06

Local Permit Agency LOS ALAMOS COMM. SERV. DIST

Permit Number N.A Permit Date N.A

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ☒ Vertical ○ Horizontal ○ Angle Specify

Drilling Method Drilling Fluid

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	90	BROWN SAND
90	110	GRAVEL AND SAND
110	230	CLAY W/ SAND AND GRAVEL
230	360	BROWN SAND CLAY
360	500	HARD BROWN CLAY
500	700	BROWN GRAVELLY CLAY AND SAND
700	800	BROWN CLAY W/ SAND
800	900	SANDY CLAY
900	970	BROWN GRAVELLY SAND
970	1010	HARD GREY CLAY

Total Depth of Boring 1010 Feet

Total Depth of Completed Well 962 Feet

Well Owner

Name LOS ALAMOS COMM. SERV. DISTRICT

Mailing Address 82 NORTH ST. JOSEPH ST

City LOS ALAMOS State CA Zip 93440

Well Location

Address 33 ST JOSEPH ST

City LOS ALAMOS County SANTA BARBARA

Latitude Deg. Min. Sec. N Longitude Deg. Min. Sec. W

Datum Decimal Lat. Decimal Long.

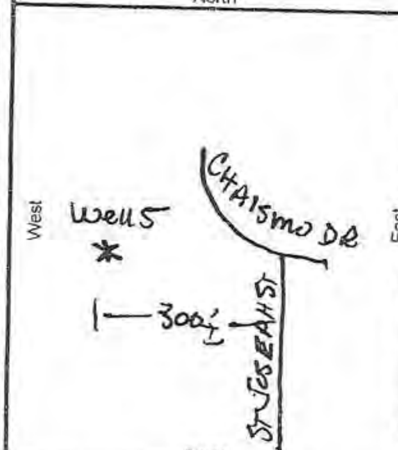
APN Book 101 Page 110 Parcel 035

Township Range Section

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North



West East South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

☒ New Well

○ Modification/Repair

○ Deepen

○ Other

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

☒ Water Supply

☐ Domestic ☒ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

○ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7-06

Estimated Yield * 800 (GPM) Test Type CONSTANT

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	60	36	COND	STEEL	5/16	28		
+2	210	24	BLANK	STEEL	1/4	12 3/4		
210	212	"	MECHICAL CONNECTOR			12 3/4		
212	217	"	BLANK	T304 SS	1/4	12 3/4		
217	352	"	SCREEN	T304 SS		12 3/4	WSW	
352	502	"	BLANK	T304 SS	1/4	12 3/4		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	60	CEMENT	10.5 SK
60	120	CEMENT	10.5 SK
120	1010	GRAVEL	RMC #3

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BEST DRILLING AND PUMP, INC.
Person, Firm or Corporation

2950 OLETA LANE, HIGHLAND CA 92346
Address City State Zip

Signed [signature] C-57 Licensed Water Well Contractor

Date Signed 12-7-06 C-57 License Number 826672

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

File Original with DWR

Page 2 of 2

Owner's Well Number Well 5

Date Work Began ______ Date Work Ended ______

Local Permit Agency ______

Permit Number ______ Permit Date ______

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752 CONT.

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation: ○ Vertical ○ Horizontal ○ Angle Specify ______

Drilling Method ______ Drilling Fluid ______

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)

Total Depth of Boring ______ Feet

Total Depth of Completed Well ______ Feet

Well Owner

Name ______

Mailing Address ______

City ______ State ______ Zip ______

Well Location

Address ______

City ______ County ______

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ______ Decimal Lat. ______ Decimal Long. ______

APN Book ______ Page ______ Parcel ______

Township ______ Range ______ Section ______

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

○ New Well
○ Modification/Repair
○ Deepen
○ Other ______
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

☒ Water Supply
☐ Domestic ☒ Public
☐ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
○ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ______

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7

Estimated Yield* 800 (GPM) Test Type CONSTANT

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
502	702	24	Screen	T304 SS		12¾	WW	.040
702	792	24	Blank	T304 SS	1/4	12¾		
792	952	24	Screen	T304 SS		12¾	WW	.040
952	962	24	Blank	T304 SS	1/4	12¾		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ______

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name ______
Person, Firm or Corporation

______ Address ______ City CA State ______ Zip

Signed ______ C-57 Licensed Water Well Contractor ______ Date Signed ______ C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well Log
St. Joseph Street Well (Well #5)
Los Alamos Community Services District

Well ID: St. Joseph Street Well (Well #5)
Date: October 5 to October 14, 2006
Location: Saint Joseph Street, north of San Antonio Creek
Elevation: 560.20 ft above sea level (from survey)
Geologists: D. Williams, and D. Burke, Cleath & Associates.
Drilling Company: Best Drilling and Pump, Inc.
Drilling Method: reverse rotary
Total depth: 1,010 feet

Lithologic Log
Depth to top and bottom in feet

Top	Bottom	Thickness	Description
0	7	7	**Sandy Silt;** trace gravel; dark yellowish brown (10YR 4/4); fine to medium grained sand, gravel to 3", subrounded shale gravel; damp.
7	8	1	**Sandy Clay;** yellowish brown (10YR 5/4); soft, fine to medium grained sand; moist.
8	16	8	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine grained sand; siliceous shale gravel to 3"; moist.
16	18	2	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4) to grayish brown (10YR 5/2); soft, fine grained sand; moist.
18	28	10	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine grained sand; gravel to 3". Becomes wet at 25' depth.
28	41	13	**Clayey Sand with Gravel;** light yellowish brown (10YR 6/4); fine grained sand; gravel to ½", subrounded; saturated. Hole sloughing.
41	45	4	**Clayey Sand;** light yellowish brown (10YR 6/4); fine grained sand. Base of alluvium.
45	47	2	**Gravelly Sand with Clay;** with cobbles; grayish brown (10YR 5/2); fine to medium grained sand; clasts to 6", porcelaneous shale gravel, subrounded to rounded; interbedded with clay.
47	50	3	**Sandy Clay;** grayish brown (10YR 5/2); stiff.
50	55	5	**Clayey Sand;** trace gravel; grayish brown (10YR 5/2); fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
55	70	15	**Clay;** trace sand; grayish brown (10YR 5/2); stiff, fine grained sand.
70	105	35	**Gravelly Sand**; pale brown (10YR 6/3); medium to coarse grained quartzose sand, subangular to subrounded; subrounded to rounded porcelaneous shale and chert gravel to 2".
105	115	10	**Clay with Sand;** brown (10YR 5/3); soft, fine to medium grained sand.
115	134	19	**Sand with Gravel;** pale brown (10YR 6/3); fine to coarse grained, lesser coarse; gravel to ½".
134	140	6	**Sandy Clay;** trace gravel; brown (10YR 5/3); soft clay; fine to coarse grained sand.
140	155	15	**Clayey Sand;** trace gravel; brown (10YR 5/3); fine to coarse grained sand; gravel to ½".
155	175	20	**Sandy Clay;** trace gravel; brown (10YR 5/3); soft clay; fine to coarse grained sand; gravel to ½".
175	185	10	**Sand with Clay and Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
185	200	15	**Gravelly Sand with Clay;** yellowish brown (10YR 5/4); fine to coarse grained sand; subrounded porcelaneous shale gravel.
200	205	5	**Clay;** brown (10YR 5/3); soft, sticky.
205	225	20	**Sand and Gravel with Clay;** yellowish brown (10YR 5/4); fine to coarse grained sand; shale gravel to 1".
225	245	20	**Clay with Sand;** trace gravel; brown (10YR 5/3); fine to medium grained sand; gravel to ½".
245	265	20	**Sandy Clay;** yellowish brown (10YR 5/4); soft; fine to medium grained sand.
265	275	10	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine to coarse grained, lesser coarse; gravel to ½".
275	278	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
278	285	7	**Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to 2", mostly siliceous shale and chert gravel.
285	298	13	**Clayey Sand with Gravel;** brown (10YR 5/3); fine to coarse grained, lesser coarse; gravel to 1".
298	315	17	**Clay;** brown (10YR 5/3); soft, sticky.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
315	327	12	**Sandy Clay;** brown (10YR 5/3); soft clay; fine to medium grained sand.
327	330	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained; gravel to ¾".
330	340	10	**Clay with Sand;** brown (10YR 5/3); soft; fine grained sand.
340	352	12	**Sand with Clay;** brown (10YR 5/3); fine to medium grained sand; olive yellow (5Y 6/6) clay from 251 to 352.
352	365	13	**Clayey Sand;** brown; (10YR 5/3); fine grained sand; soft clay.
365	385	20	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4); soft clay; fine to coarse grained sand; gravel to ½".
385	388	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to medium grained; gravel to ½".
388	391	3	**Clay with Sand;** yellowish brown (10YR 5/4); soft; fine to medium sand, lesser medium.
391	430	39	**Clay with Sand;** brown (10YR 5/3); soft; fine to medium grained, mostly fine.
430	450	20	**Clayey Sand;** trace gravel; brown (10YR 5/3); fine to coarse grained; porcelaneous shale gravel to ½".
450	480	30	**Clay;** trace sand; grayish brown (10YR 5/2); soft; fine to medium grained sand.
480	490	10	**Clay;** grayish brown (10YR 5/2); soft, plastic.
490	510	20	**Clay with Sand;** grayish brown (10YR 5/2); soft; fine to medium grained sand.
510	578	68	**Clay;** trace sand; grayish brown (10YR 5/2), soft, mottled yellowish brown (10YR 5/4); fine grained sand.
578	590	12	**Sandy Clay;** brown; (10YR 5/3); soft; fine to medium grained sand.
590	595	5	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ½", subrounded porcelaneous shale gravel.
595	610	15	**Clayey, Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; porcelaneous shale gravel to ¾".
610	620	10	**Clay with sand;** grayish brown (10YR 5/2); soft to medium consistency; fine grained sand.
620	625	5	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4); soft; fine to medium grained sand; gravel to ½".
625	630	5	**Clay with Sand;** grayish brown (10YR 5/2); soft to medium consistency; fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
630	638	8	**Clay with Sand;** trace gravel; yellowish brown (10YR 5/4); soft to medium consistency; fine to coarse grained sand; gravel to ½".
638	660	22	**Gravelly Sand with Clay;** yellowish brown (10YR 5/4); fine to coarse grained; siliceous and cherty gravel to ¾".
660	664	4	**Gravelly Sand;** thinly interbedded with clay; yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
664	675	11	**Clay;** grayish brown (10YR 5/2); soft, sticky.
675	690	15	**Clay;** dark greenish gray (5GY 4/1); stiff.
690	698	8	**Clayey Sand;** trace gravel; dark greenish gray (5GY 4/1); fine to medium grained; shale and mudstone gravel to ½".
698	722	24	**Clay with Sand;** trace gravel; dark greenish gray (10Y 4/1); stiff clay; fine grained sand; gravel to ½".
722	725	3	**Clay;** trace sand; dark greenish gray (10Y 4/1); stiff clay; fine grained sand.
725	740	15	**Sandy Clay;** trace gravel; greenish gray (10Y 5/1); stiff clay; fine to medium grained sand; gravel to ½".
740	750	10	**Clay with Sand;** greenish gray (10Y 5/1); soft clay; fine to medium grained sand.
750	765	15	**Sandy Clay;** trace gravel; greenish gray (10Y 5/1); soft clay; fine to medium grained sand; gravel to ¾".
765	772	7	**Clay with Sand;** greenish gray (10Y 5/1); soft clay; fine to medium grained sand.
772	790	18	**Clay;** trace sand; dark greenish gray (10Y 4/1); stiff; fine to medium grained sand.
790	805	15	**Clay;** trace sand; olive (5Y 5/3); soft; fine grained sand.
805	810	5	**Clay with Sand;** olive (5Y 5/3); soft; fine to medium grained sand.
810	824	14	**Sandy Clay;** olive (5Y 5/3); soft; mostly fine grained sand, lesser medium to coarse.
824	835	11	**Clay;** trace sand; yellowish brown (10YR 5/4); stiff; fine grained sand.
835	852	17	**Clayey Sand;** yellowish brown (10YR 5/4); sand mostly fine grained, lesser medium to coarse.
852	880	28	**Clay with Sand;** yellowish brown (10YR 5/4); soft clay; fine grained sand.
880	898	18	**Sandy Clay;** yellowish brown (10YR 5/4); soft; fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
898	910	12	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; porcelaneous shale gravel to ½".
910	925	15	**Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; subrounded porcelaneous shale gravel to ¾".
925	930	5	**Clayey Sand with Gravel;** light brownish gray (10YR 6/2); fine to coarse grained; gravel to ½".
930	950	20	**Sand and Gravel with Clay;** grayish brown (10YR 5/2); fine to coarse grained sand; porcelaneous shale gravel to 1".
950	960	10	**Sand with Gravel;** trace clay; light brownish gray (10YR 6/2); fine to coarse grained sand; gravel to ½".
960	970	10	**Sand and Gravel;** grayish brown (10YR 5/2); medium to coarse grained; porcelaneous shale gravel to ¾".
970	980	10	**Sandy, Gravelly Clay;** gray (10YR 6/1); fine to coarse grained sand; gravel to 1".
980	990	10	**Clay with Sand and Gravel;** gray (10YR 6/1); fine grained sand; gravel to 1".
990	1000	10	**Clay;** gray (10YR 6/1).
1000	1010	10	**Clay with Sand;** trace gravel; gray (10YR 6/1); fine grained sand; gravel to ½".

PACIFIC SURVEYS

ELECTRIC LOG
GAMMA RAY

Job No. 12824

File No.

Company	BEST DRILLING
Well	WELL #5
Field	LOS ALAMOS
County	SANTA BARBARA State CA

Location:

END OF ST. JOSEPH ST.

Sec. Twp. Rge.

Other Services:

CALIPER

Permanent Datum	G.L.		Elevation	Elevation
Log Measured From	G.L.	0'	above perm. datum	K.B.
Drilling Measured From	G.L.			D.F.
				G.L.

Date	10-14-06		
Run Number	ONE		
Depth Driller	1011'		
Depth Logger	1010'		
Bottom Logged Interval	1009'		
Top Log Interval	35'		
Casing Driller	30" @ 60'		
Casing Logger	60'		
Bit Size	24"		
Type Fluid in Hole	WATER		
Density / Viscosity	N/A		
pH / Fluid Loss	N/A		
Source of Sample	PIT		
Rm @ Meas. Temp	12.8 @ 77F		
Rmf @ Meas. Temp	13.5 @ 77F		
Rmc @ Meas. Temp	N/A		
Source of Rmf / Rmc	MEAS		
Rm @ BHT	N/A		
Time Circulation Stopped	2:00 AM		
Time Logger on Bottom	8:45 AM		
Max. Recorded Temperature	N/A		
Equipment Number	PS-2		
Location	L.A.		
Recorded By	LAPORTE		
Witnessed By	D. BURKE		

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Comments

Comments

ELOG Calibration Report

Serial:	D1
Model:	DTQ
Shop Calibration Performed:	Tue Aug 01 12:21:23 2006
Before Survey Verification Performed:	Tue Aug 01 12:20:23 2006
After Survey Verification Performed:	Tue Aug 01 12:20:53 2006

Shop Calibration

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	7.913	99.350		10.200	102.200	Ohm-m	1.006	2.238
Long	6.484	96.090		10.200	102.200	Ohm-m	1.027	-17.567
IEE	103.705	4668.852	counts	0.113	5.110	A		
VSN	7.884	5226.093	counts	0.150	99.681	V		
VLN	126.600	1393.972	counts	2.415	26.588	V		

Before Survey Verification

Readings	References	Results

Short	7.913	99.350		10.200	102.200	Ohm-m	1.006	2.238
Long	6.484	96.090		10.200	102.200	Ohm-m	1.027	-17.567
IEE	103.705	4668.852	counts	0.113	5.110	A		
VSN	7.884	5226.093	counts	0.150	99.681	V		
VLN	126.600	1393.972	counts	2.415	26.588	V		

Before Survey Verification

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	8.407	99.675		6.767	99.630	Ohm-m	1.017	-1.787
Long	419.427	106.300		106.299	106.299	Ohm-m	1.049	-5.162
IEE	106.074	4729.556	counts	0.116	5.176	A		
VSN	10.019	5296.417	counts	0.191	101.023	V		
VLN	124.963	1412.120	counts	2.384	26.934	V		

After Survey Verification

	Readings			References			Results	
	Zero	Cal		Zero	Cal		Gain	Offset
Short	8.048	99.680		8.407	99.675	Ohm-m	0.996	0.391
Long	420.004	106.304		106.300	106.300	Ohm-m	0.998	0.190
IEE	105.787	4734.505	counts	0.116	5.181	A		
VSN	9.565	5302.234	counts	0.182	101.134	V		
VLN	124.796	1413.645	counts	2.380	26.964	V		

After Survey Verification compared to Before Survey Calibration

	Zero			Cal		
	Before	After		Before	After	
Short	6.767	8.407	Ohm-m	99.630	99.675	Ohm-m
Long	434.627	419.427	Ohm-m	106.299	106.300	Ohm-m

Gamma Ray Calibration Report

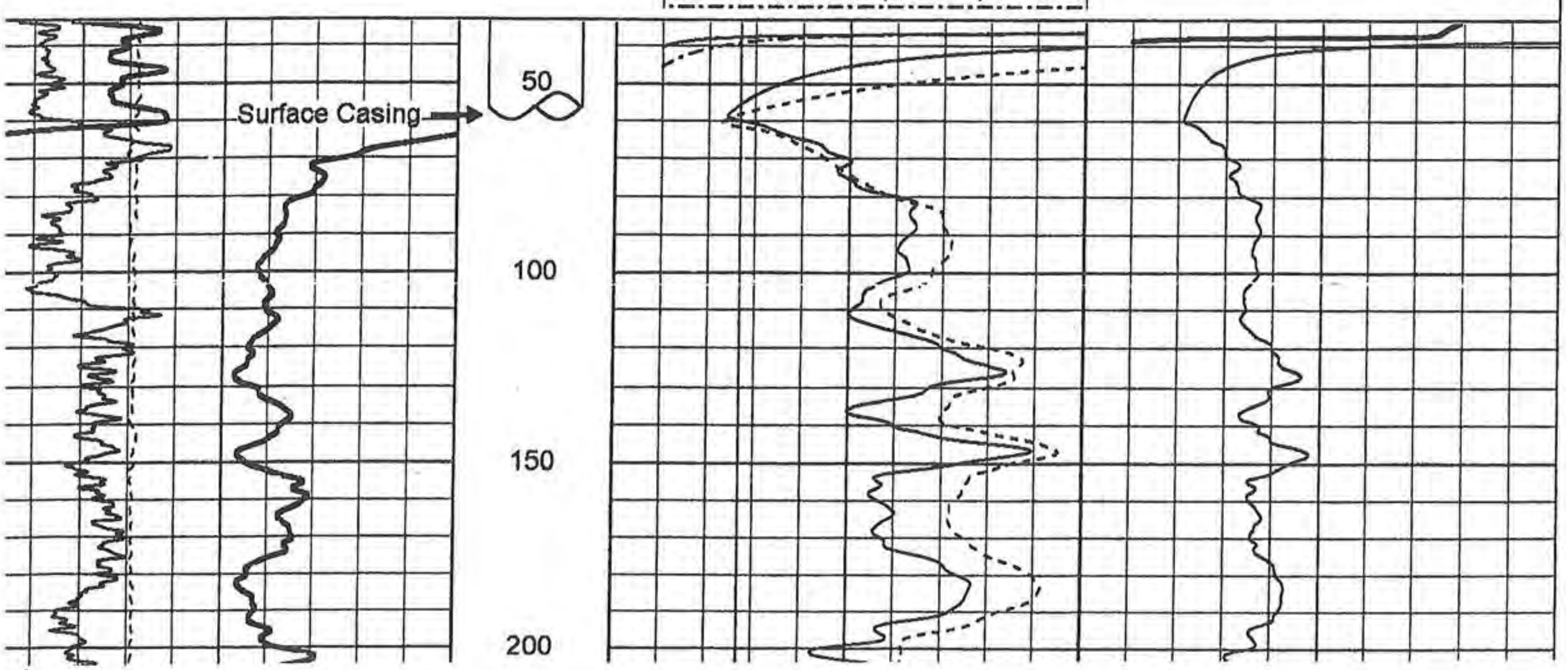
Serial Number:	D1	
Tool Model:	ELOG	
Performed:	Tue Aug 01 12:19:10 2006	
Calibrator Value:	162	GAPI
Background Reading:	167.616	cps
Calibrator Reading:	722.887	cps

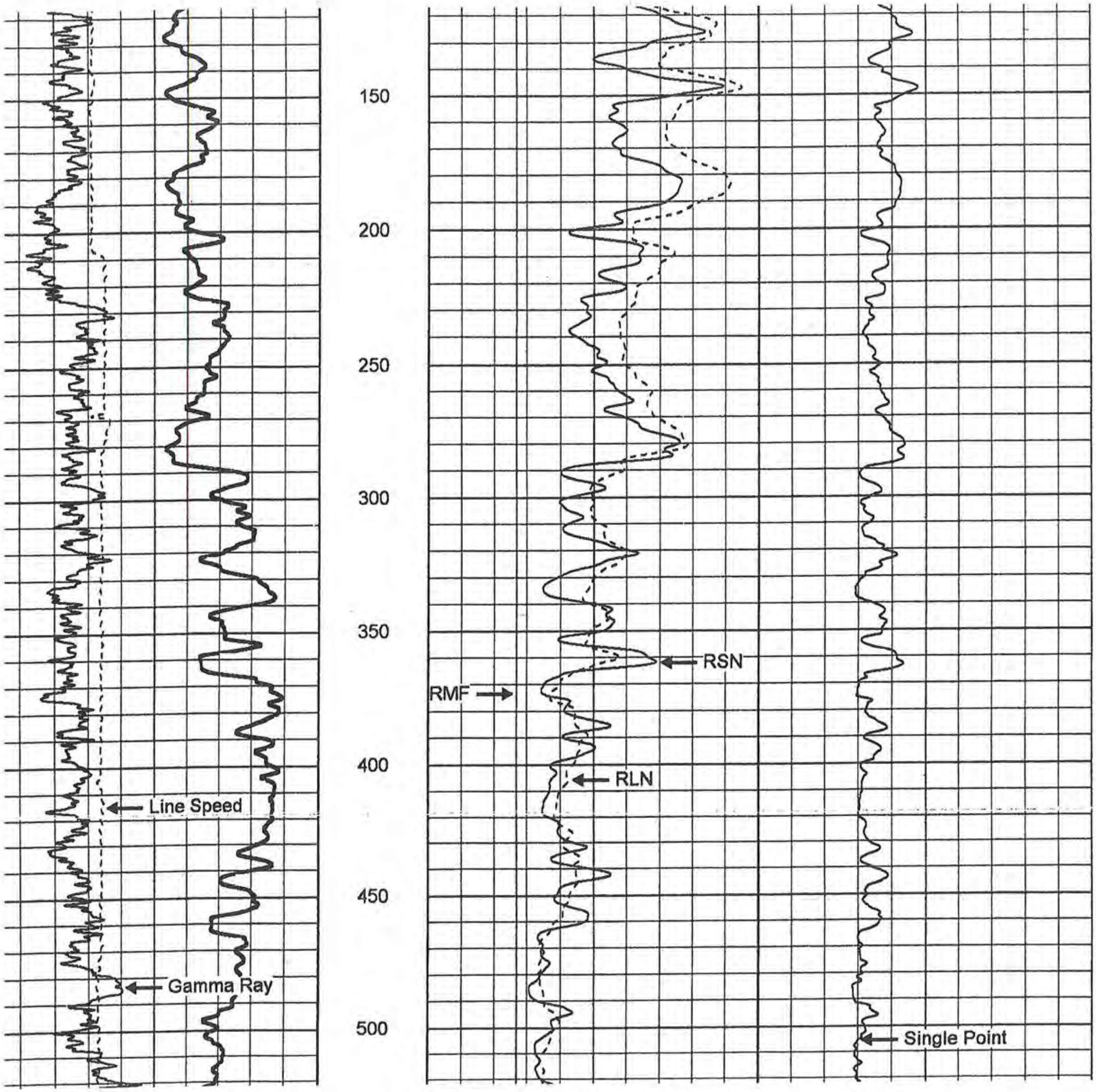
Gamma Ray Calibration Report

Serial Number:	D1	
Tool Model:	ELOG	
Performed:	Tue Aug 01 12:19:10 2006	
Calibrator Value:	162	GAPI
Background Reading:	167.616	cps
Calibrator Reading:	722.887	cps
Sensitivity:	0.291745	GAPI/cps

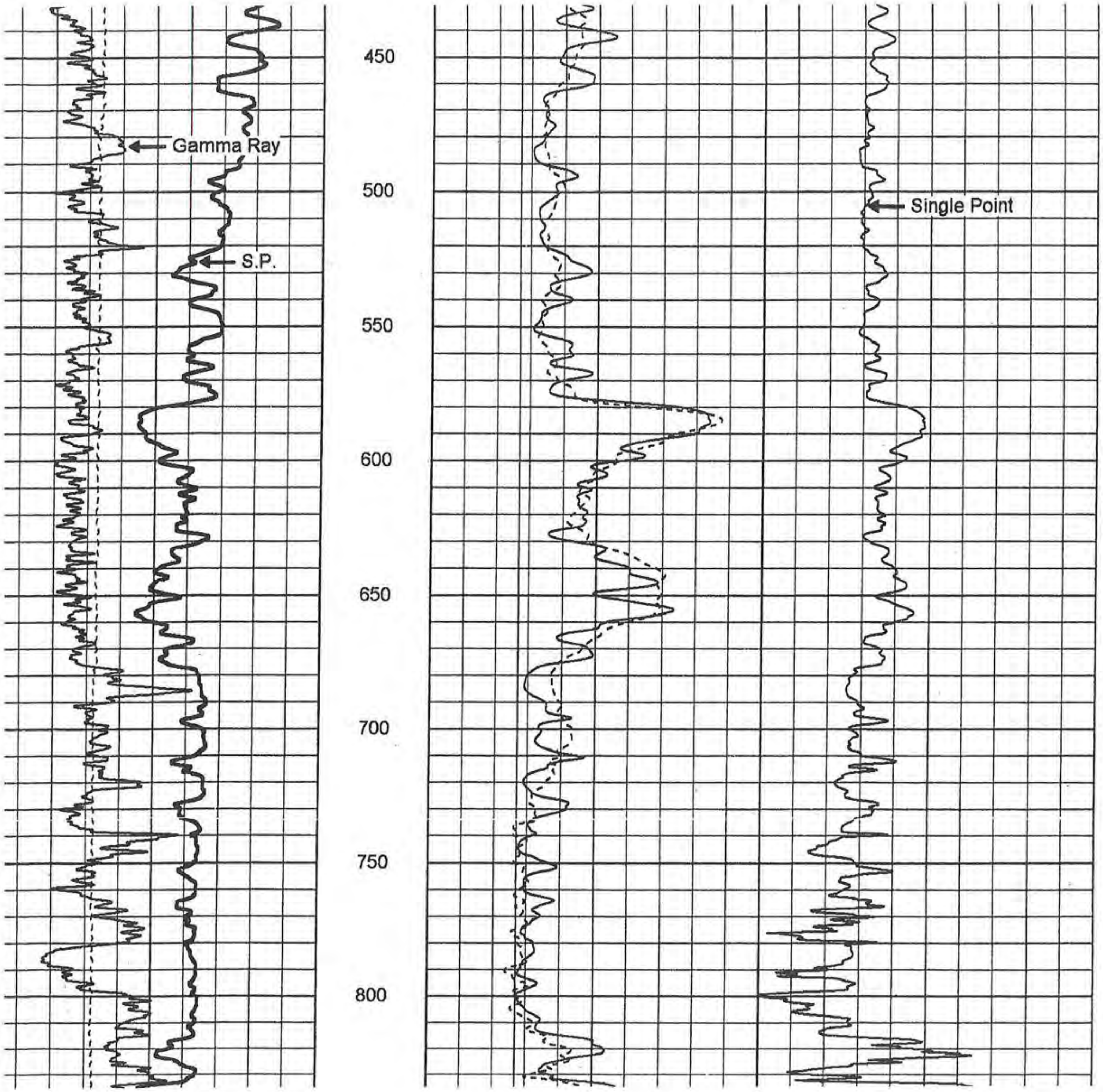
Database File:	12824.db
Dataset Pathname:	Best/LosAlam/run1/Elog
Presentation Format:	elog2
Dataset Creation:	Sat Oct 14 08:43:29 2006 by Log 6.0
Charted by:	Depth in Feet scaled 1:600

35	S.P. (mV)	15
0	Gamma Ray (GAPI)	110
	Line Speed (ft/min)	100
0	RSN (Ohm-m)	50
0	RLN (Ohm-m)	50
0	RMF (Ohm-m)	50
50	RSN X10 (Ohm-m)	500
50	RLN X10 (Ohm-m)	500
0	Single Point (Ohm-m)	100
100	SPR X10 (Ohm-m)	1000





150
200
250
300
350
400
450
500
Line Speed
Gamma Ray
RMF
RSN
RLN
Single Point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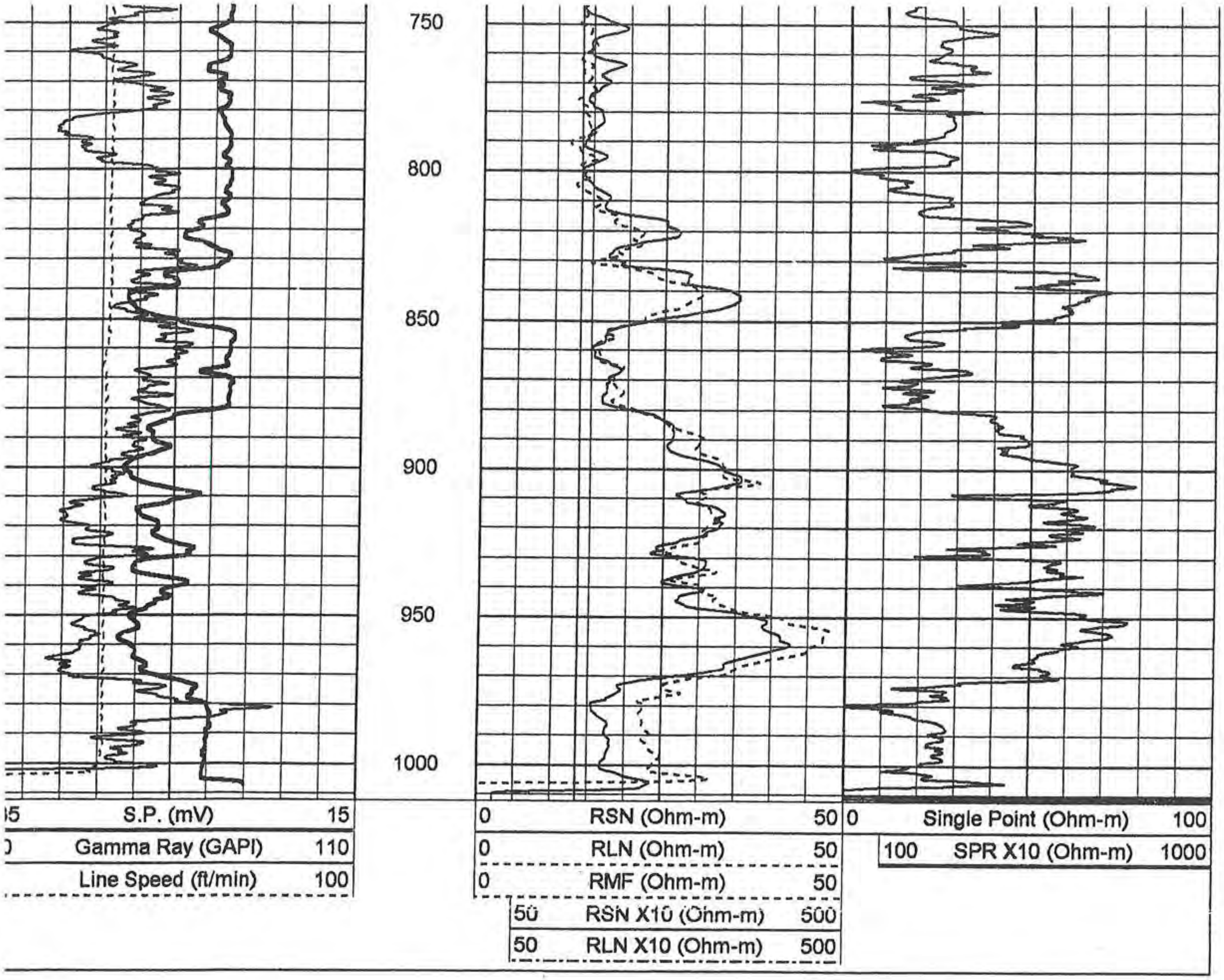
Gamma Ray
S.P.
Single Point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900
950
1000
S.P. (mV) 15
Gamma Ray (GAPI) 110
Line Speed (ft/min) 100
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0 RLN (Ohm-m) 50
0 RMF (Ohm-m) 50
50 RSN X10 (Ohm-m) 500
50 RLN X10 (Ohm-m) 500
0 Single Point (Ohm-m) 100
100 SPR X10 (Ohm-m) 1000

PACIFIC SURVEYS

CALIPER
BOREHOLE VOLUMES

Job No. 12824	Company	BEST DRILLING
	Well	WELL #5
	Field	LOS ALAMOS
File No.	County	SANTA BARBARA State CA

Location: END OF ST. JOSEPH ST.

Sec. Twp. Rge.

Other Services: E-LOG

Permanent Datum	G.L.		Elevation		Elevation
Log Measured From	G.L.	0'	above perm. datum	K.B.	
Drilling Measured From	G.L.			D.F.	
				G.L.	

Date	10-14-06		
Run Number	ONE		
Depth Driller	1011'		
Depth Logger	1010'		
Bottom Logged Interval	1005'		
Top Log Interval	0'		
Type Caliper	3 ARM		
Type Fluid in Hole	WATER		
Density / Viscosity	N/A		
Max. Recorded Temp.	N/A		
pH/Fluid Loss	N/A		
Time Well Ready	8:30 AM		
Time Logger on Bottom	8:45 AM		
Equipment Number	PS-2		
Location	L.A.		
Recorded By	LAPORTE		
Witnessed By	D. BURKE		

Borehole Record				Gravel Feed/Tubing Schedule			
Run Number	Bit	From	To	Size	Type	From	To
ONE	24"	60'	1011'				

Casing Schedule	Size	Wgt/Ft	Top	Bottom
Surface String	28"	COND	0	60'
Production String	12"	CSG	0	935'
Production String				
Production String				
Production String				

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nterpretations are opinions based on inferences from electrical or other measurements and Pacific Surveys cannot and do not guarantee the accuracy or correctness of any nterpretation, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or ained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to Pacific Surveys' general terms and conditions set out in our current Price Schedule.

Comments

Comments

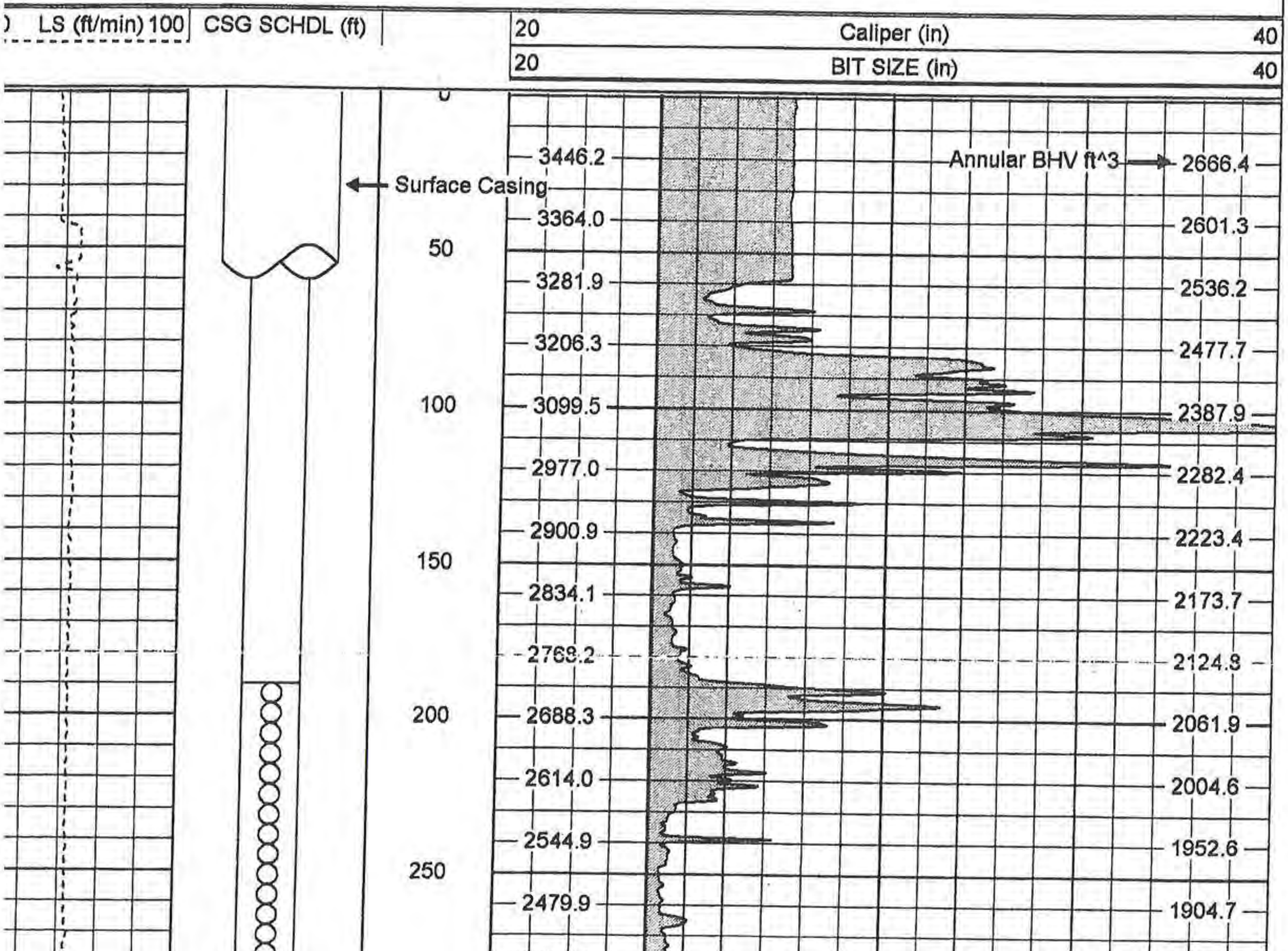
XY Caliper Calibration Report

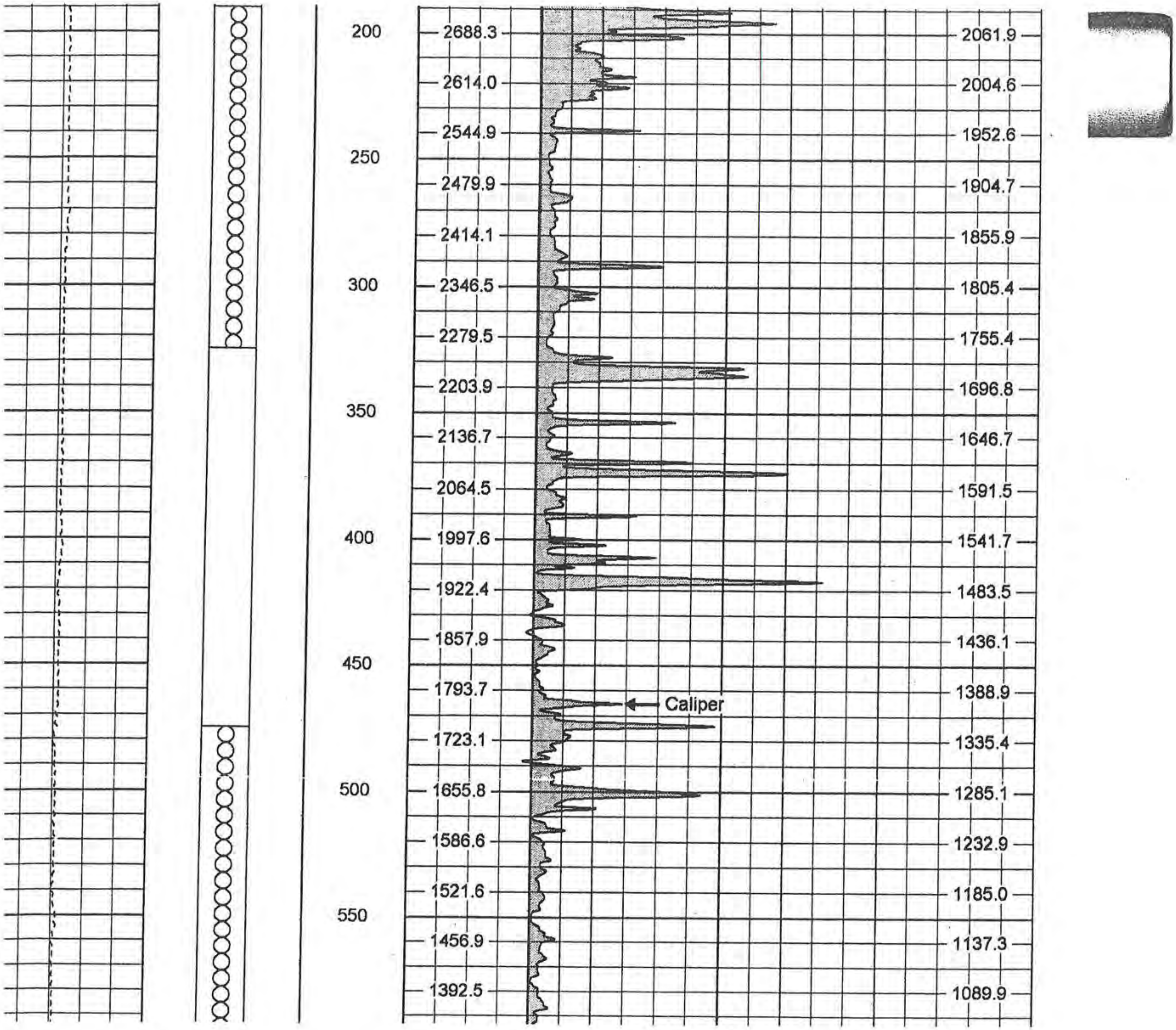
Serial Number:	LONG		
Tool Model:	Comprobe		
Performed:	Sat Oct 14 09:20:52 2006		
Small Ring:	23	in	
Large Ring:	33	in	
	X Caliper	Y Caliper	
Reading with Small Ring:	555.7	555.7	cps
Reading with Large Ring:	873.4	873.4	cps
Gain:	0.0314762	0.0314762	
Offset:	5.50866	5.50866	

Database File:	12824.db
Dataset Pathname:	Best/LosAlam/run1/CAL.1
Presentation Format:	xyc
Dataset Creation:	Sat Oct 14 09:52:04 2006 by Calc 6.0
Charted by:	Depth in Feet scaled 1:600

Gain:	0.0314762	0.0314762
Offset:	5.50866	5.50866

Database File:	12824.db
Dataset Pathname:	Best/LosAlam/run1/CAL.1
Presentation Format:	xyc
Dataset Creation:	Sat Oct 14 09:52:04 2006 by Calc 6.0
Charted by:	Depth in Feet scaled 1:600

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1922.4
1857.9
1793.7
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1655.8
1586.6
1521.6
1456.9
1392.5
Caliper
2061.9
2004.6
1952.6
1904.7
1855.9
1805.4
1755.4
1696.8
1646.7
1591.5
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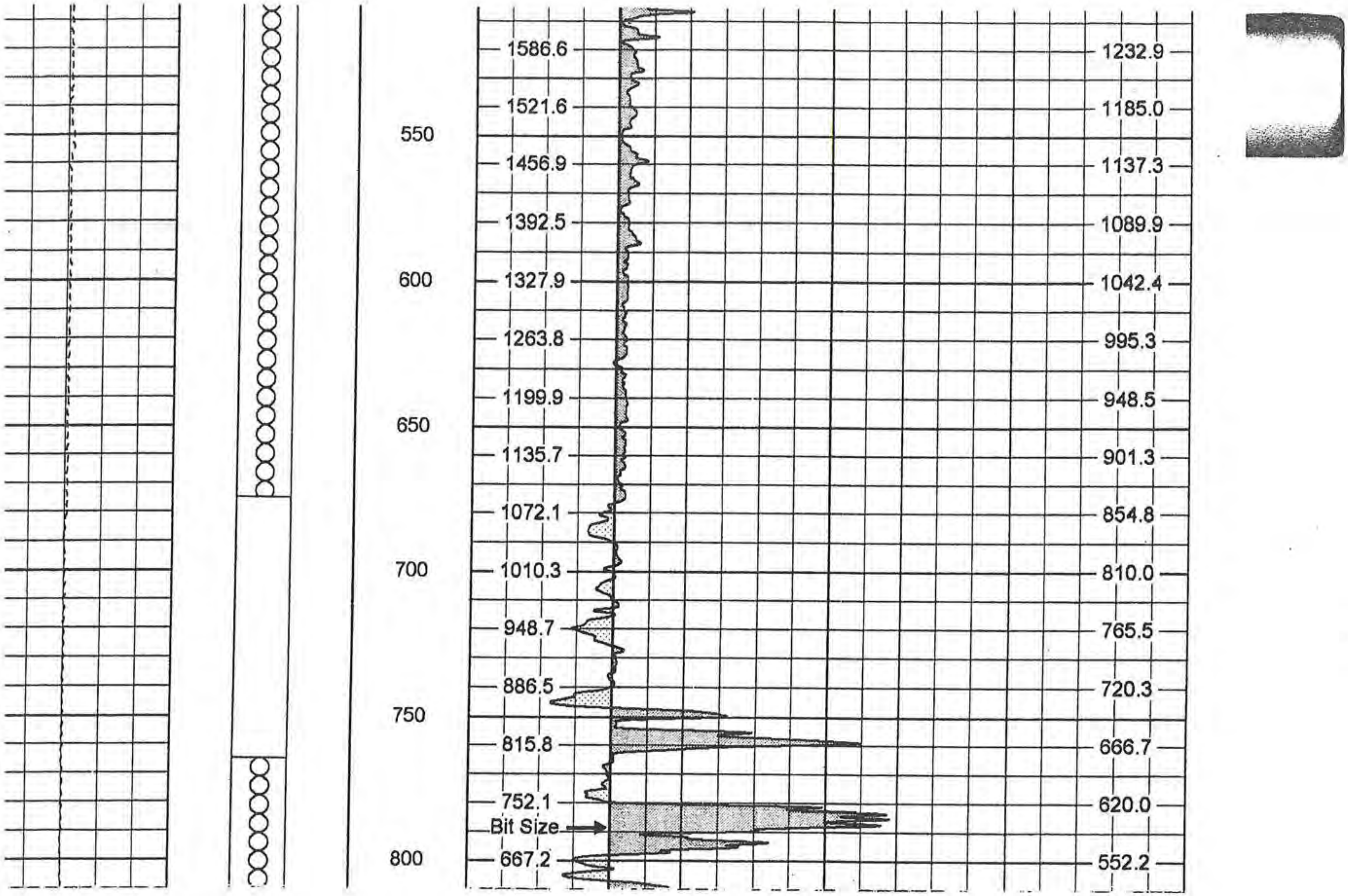
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750
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1521.6
1456.9
1392.5
1327.9
1263.8
1199.9
1135.7
1072.1
1010.3
948.7
886.5
815.8
752.1
Bit Size
667.2
1232.9
1185.0
1137.3
1089.9
1042.4
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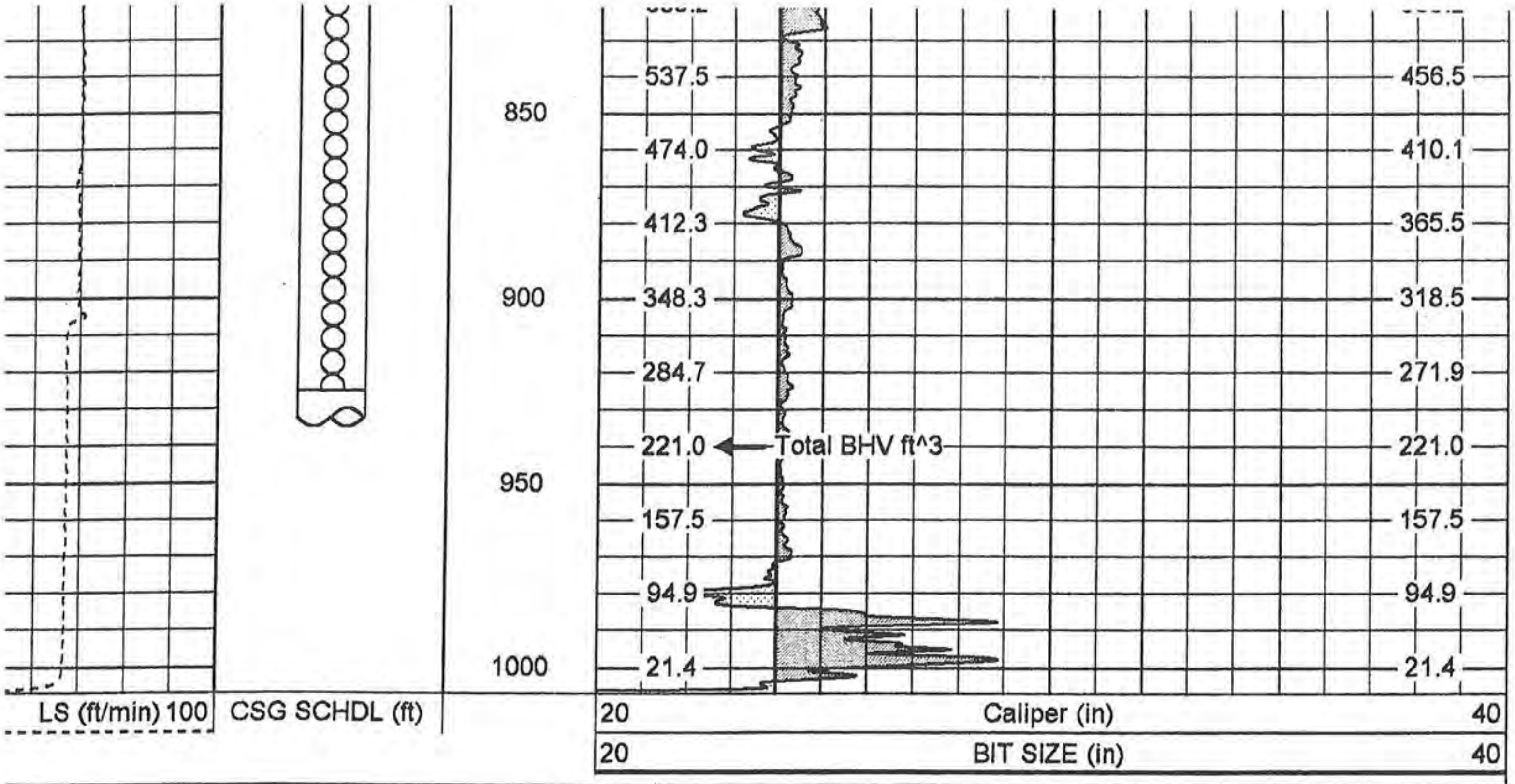
948.5
901.3
854.8
810.0
765.5
720.3
666.7
620.0
552.2



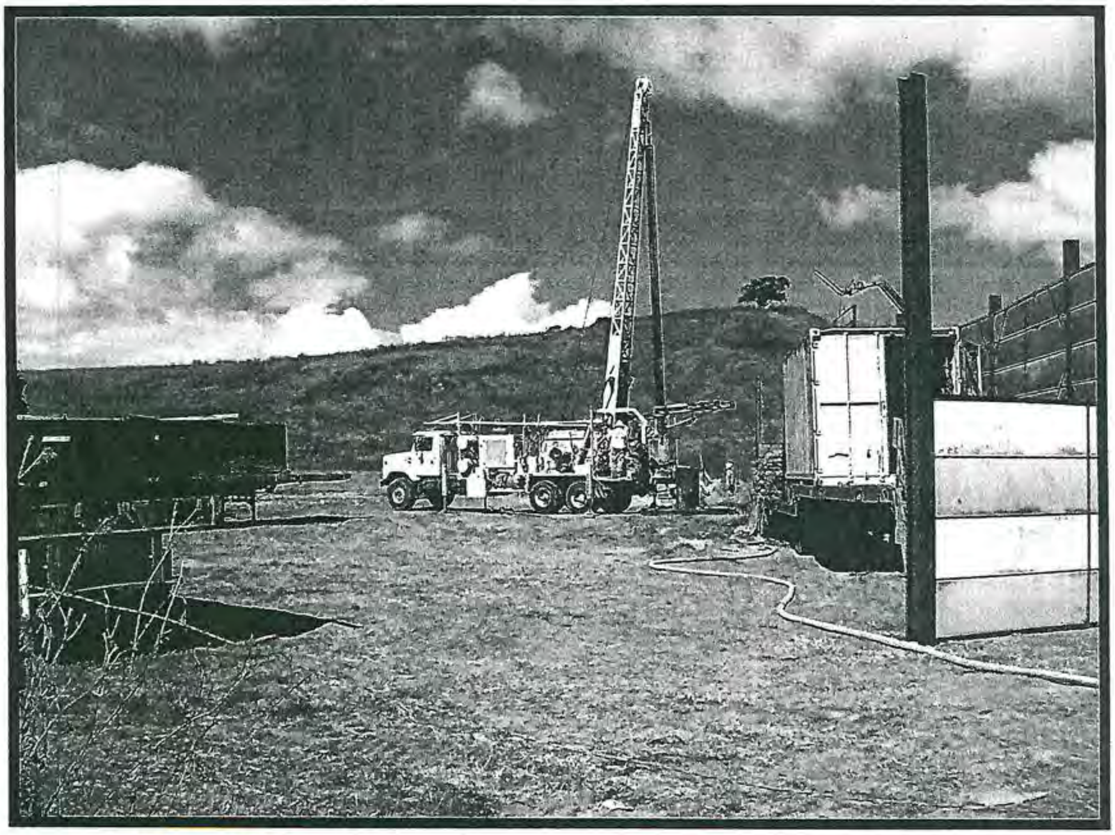
LS (ft/min) 100
CSG SCHDL (ft)
850
900
950
1000
537.5
474.0
412.3
348.3
284.7
221.0
157.5
94.9
21.4
Total BHV ft^3
456.5
410.1
365.5
318.5
271.9
221.0
157.5
94.9
21.4
20
Caliper (in)
40
20
BIT SIZE (in)
40

Appendix B

Photographs

Appendix B

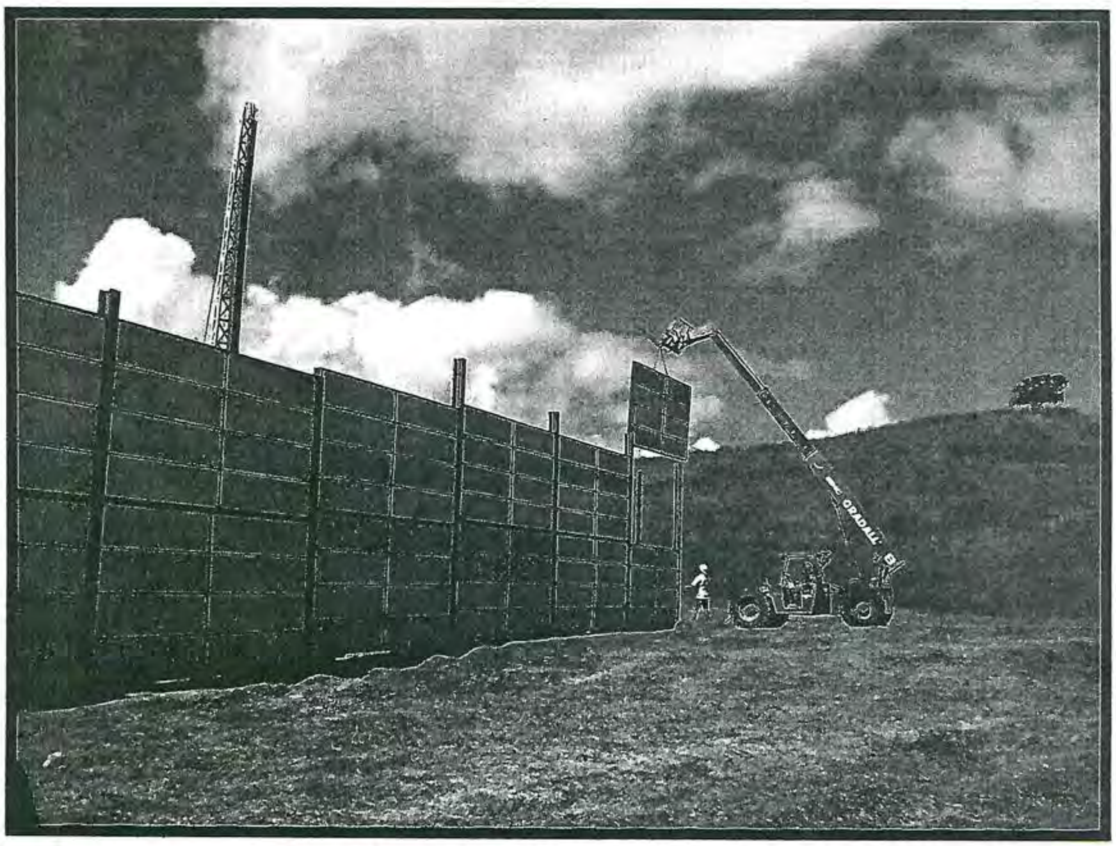
Photographs



Drilling 60-foot hole with bucket auger for conductor pipe

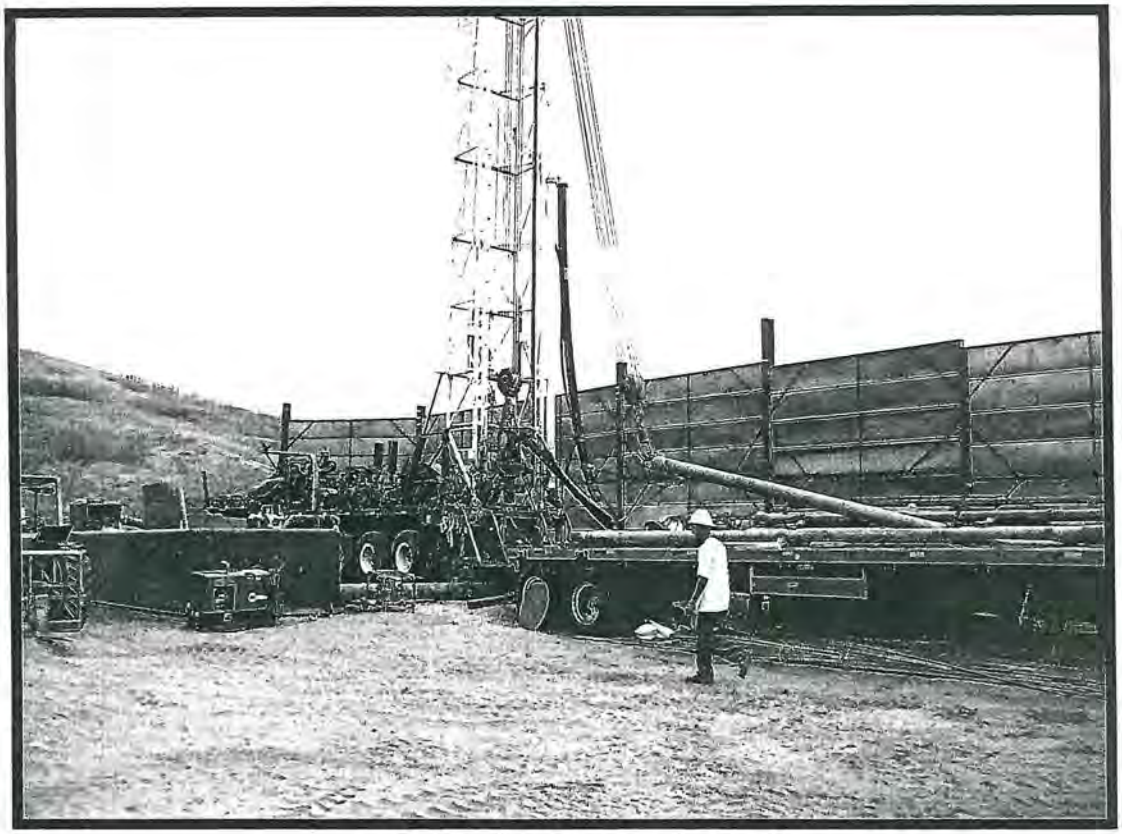
Installing 36-inch conductor pipe

Well Site



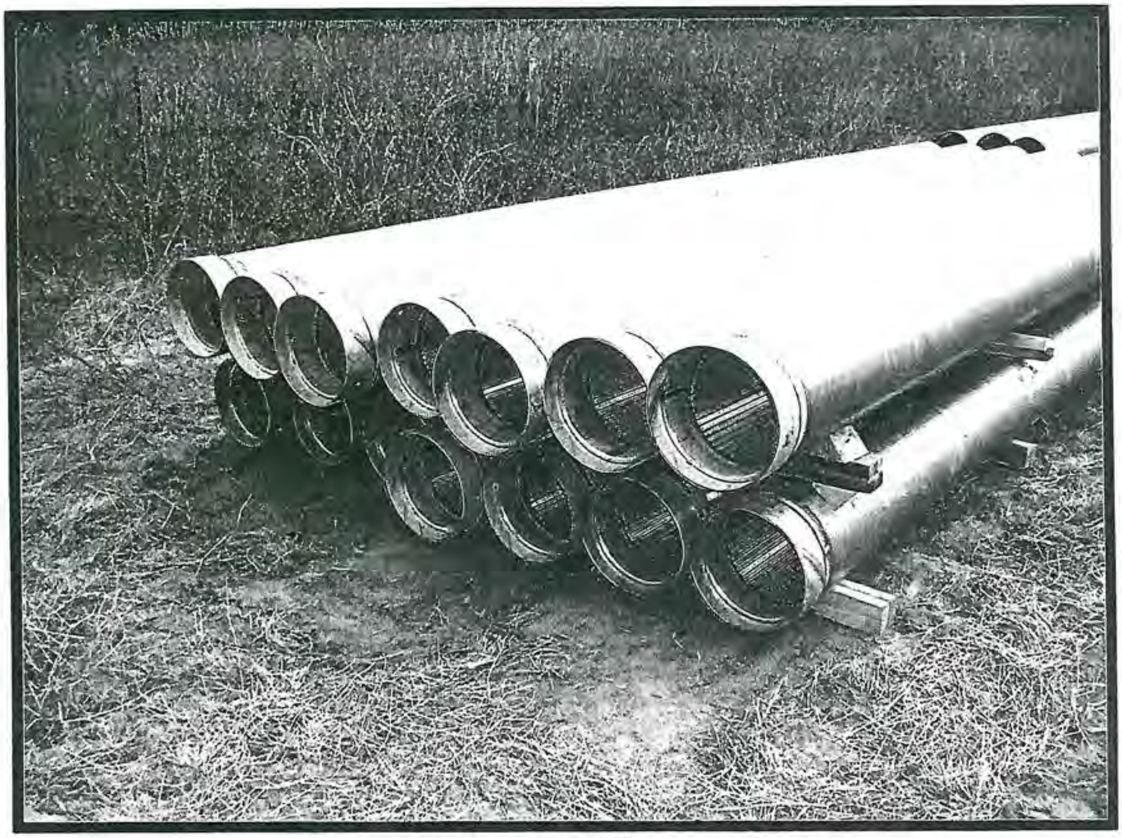
Sound Wall Installation

St. Joseph Street Well #5, LACSD

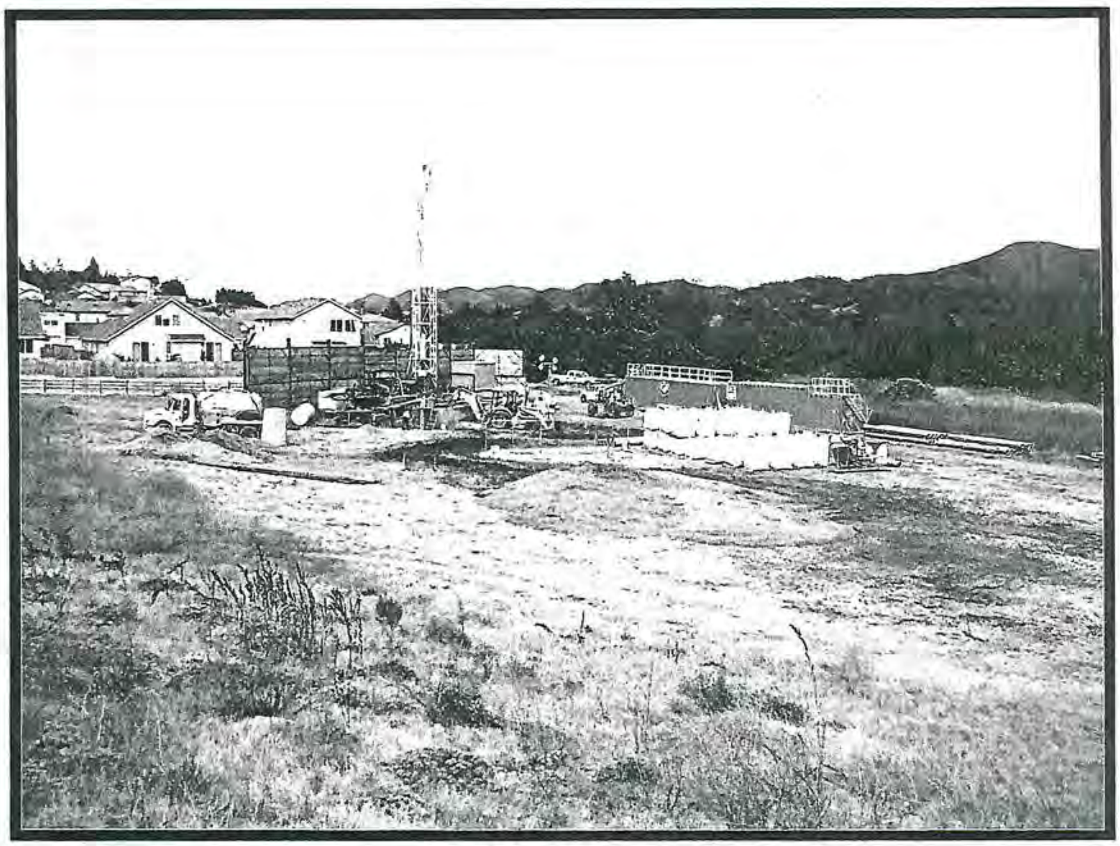


Drilling 24-inch pilot hole

Mechanical Coupling - carbon to stainless steel



Stainless Steel Wire-Wrap Screen



Well Site

St. Joseph Street Well #5, LACSD

Appendix C

Construction materials documentation

CEMEX

TECHNICAL SERVICES LABORATORY
4750 Norris Canyon Road, Suite A
San Ramon, CA 94583

Telephone: (925) 866-2780 Fax: (925) 866-2983

November 17, 2006

Best Drilling
Attn: Mark Best
Fax: (909) 421-9070

Project Reference: Los Alamos

We submit the typical test data information below for your approval and as certification of the following product:

Source: Lapis #310
Product: #3, Lapis Lustre Sand
Nominal Sieve Size: #8 x #20

U.S. Sieve		% Passing
#6	(3.35 mm)	100
#8	(2.36 mm)	99 +/- 1
#12	(1.70 mm)	59 +/- 12
#16	(1.18 mm)	9 +/- 5
#20	(850 µm)	2 +/- 1
#30	(600 µm)	1 +/- 1

Respectfully,

Ron Novak
Quality Control Representative
CEMEX

cc: Dale Kendall
Chris Mathias

CASING SCHEDULE

BEST DRILLING - LOS ALAMOS

WELL NO 5

Includes Additional 30' Piece

TIME OF WELD IN

- 1 PC @ 15' BLANK (#41)
- 5 PCS @ 40' BLANK (#36, 37, 38, 39, 40)
- 12 3/4"OD NC x 304SS MECHINICAL CONNECTOR (#35)
- 1 PC @ 5' BLANK (#34)
- 1 PC @ 15' CWW (#33) ✓
- 6 PCS @ 20' CWW (#27-32) ✓
- 1 PC @ 30' BLANK (#26) ✓
- 3 PCS @ 40' BLANK (#23, 24, 25) ✓
- 10 PCS @ 20' CWW (#13-22) ✓
- 1 PC @ 10' BLANK (#12) ✓
- 2 PCS @ 40' BLANK (#10, 11) ✓
- 8 PCS @ 20' CWW (#2-9)
- 1 PC @ 10' BLANK W/SS BOTTOM PLATE ATTD (#1)

BLUE SECTION - WIREWRAP SCREEN
RED SECTION - BLANK CASING

SPECIFICATIONS

12 3/4"OD 304SS CWW 0.165" x 0.217" (0.040"SLOT) W/W

* 24 PCS @ 20' CWW (#2-9, 13-22, 27-32)
* 1 PC @ 15' CWW (#33)

12 3/4"OD x 1/4" 304SS BLANK W/COLLARS

* 1 PC @ 10' BLANK W/SS BOTTOM PLATE ATTD (#1)
* 2 PCS @ 40' BLANK (#10, 11)
* 1 PC @ 10' BLANK (#12)
* 3 PCS @ 40' BLANK (#23, 24, 25)
* 1 PC @ 30' BLANK (#26)
* 1 PC @ 5' BLANK (#34)

12 3/4"OD x 1/4" NC BLANK W/COLLARS

* 5 PCS @ 40' BLANK (#36, 37, 38, 39, 40)
* 1 PC @ 15' BLANK (#41)

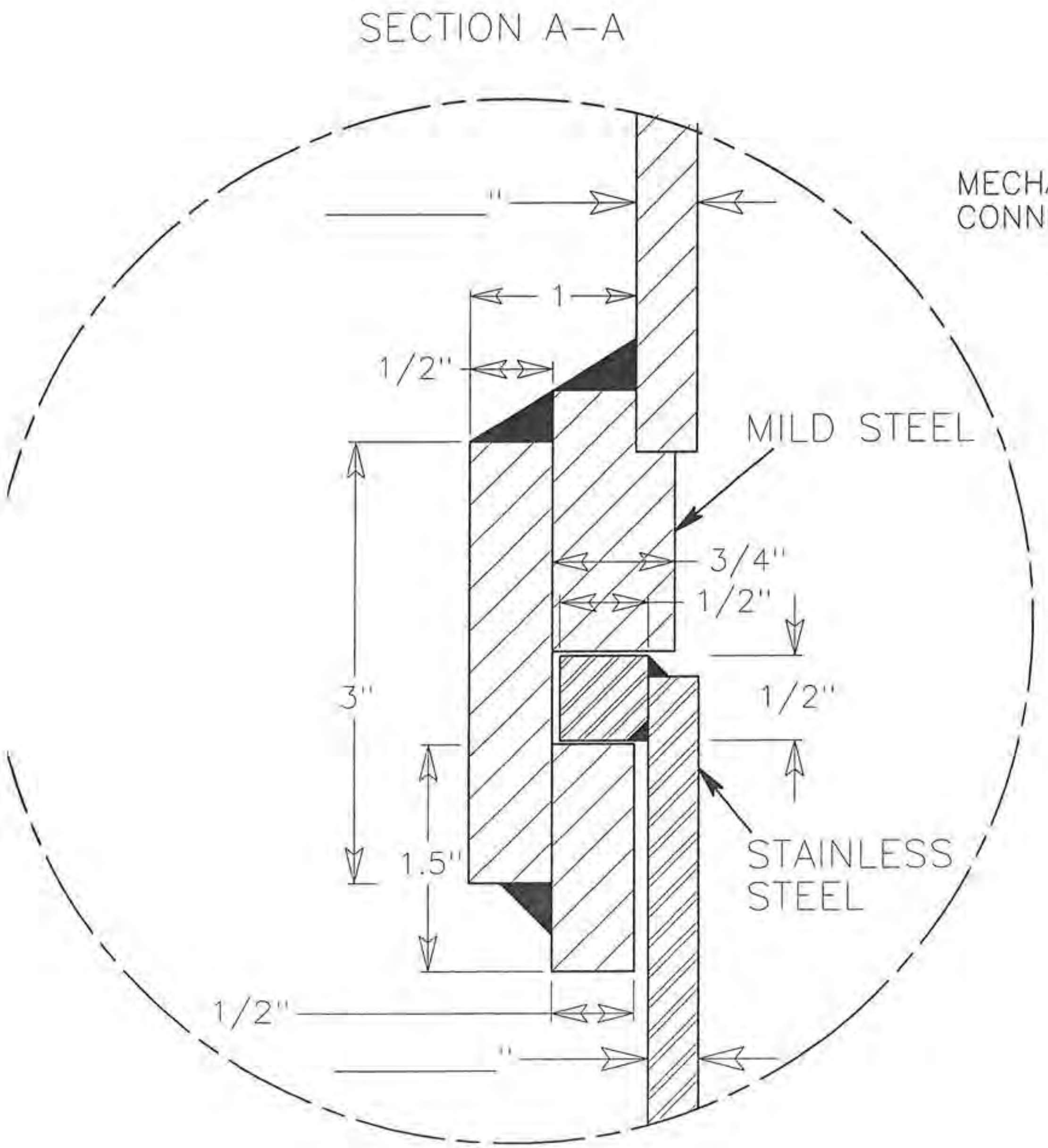
ACCESSORIES

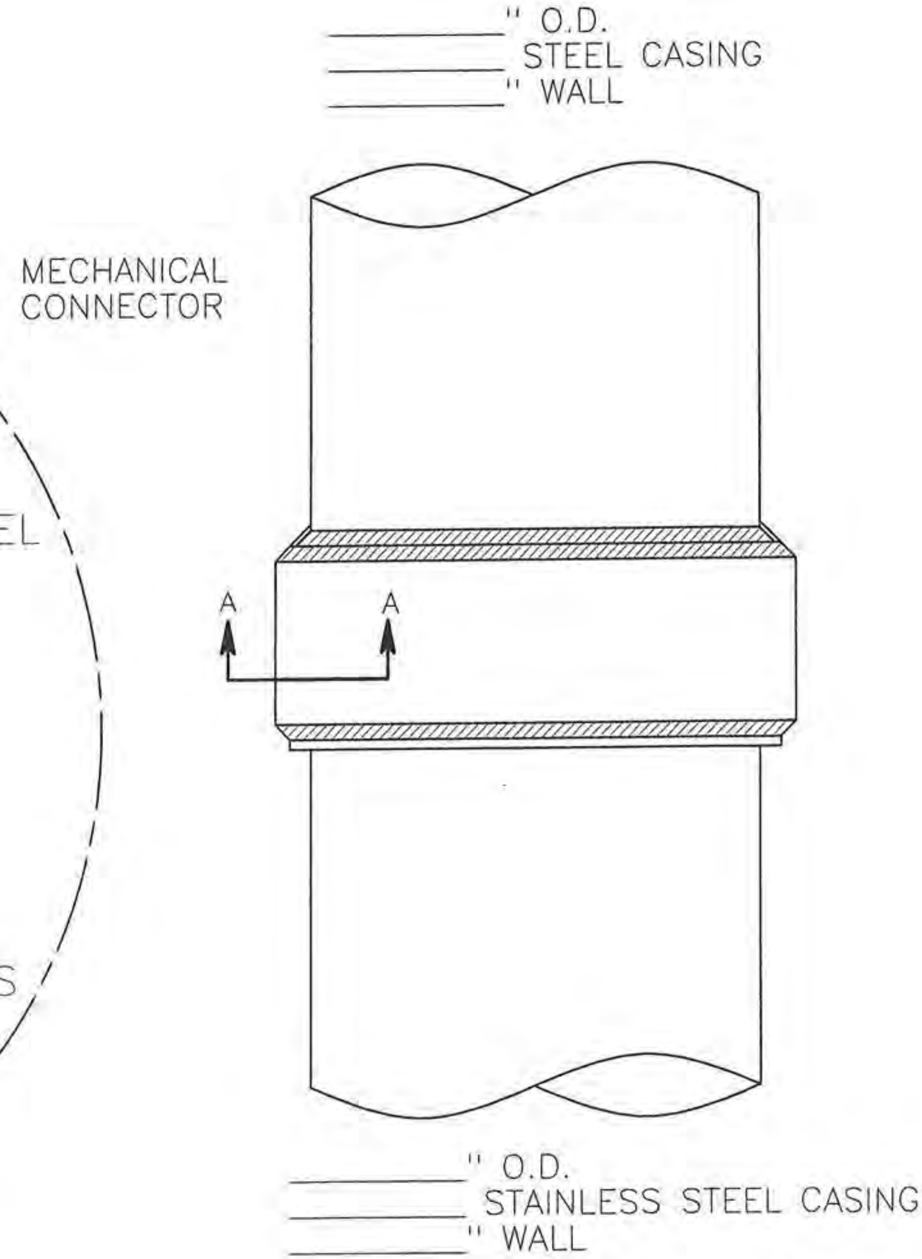
1 ONLY - 12 3/4"OD NC x 30SS MECHINICAL CONNEC

1 ONLY - 12 3/4"OD x 1/4" 304SS BTTOM PLATE ATTD '

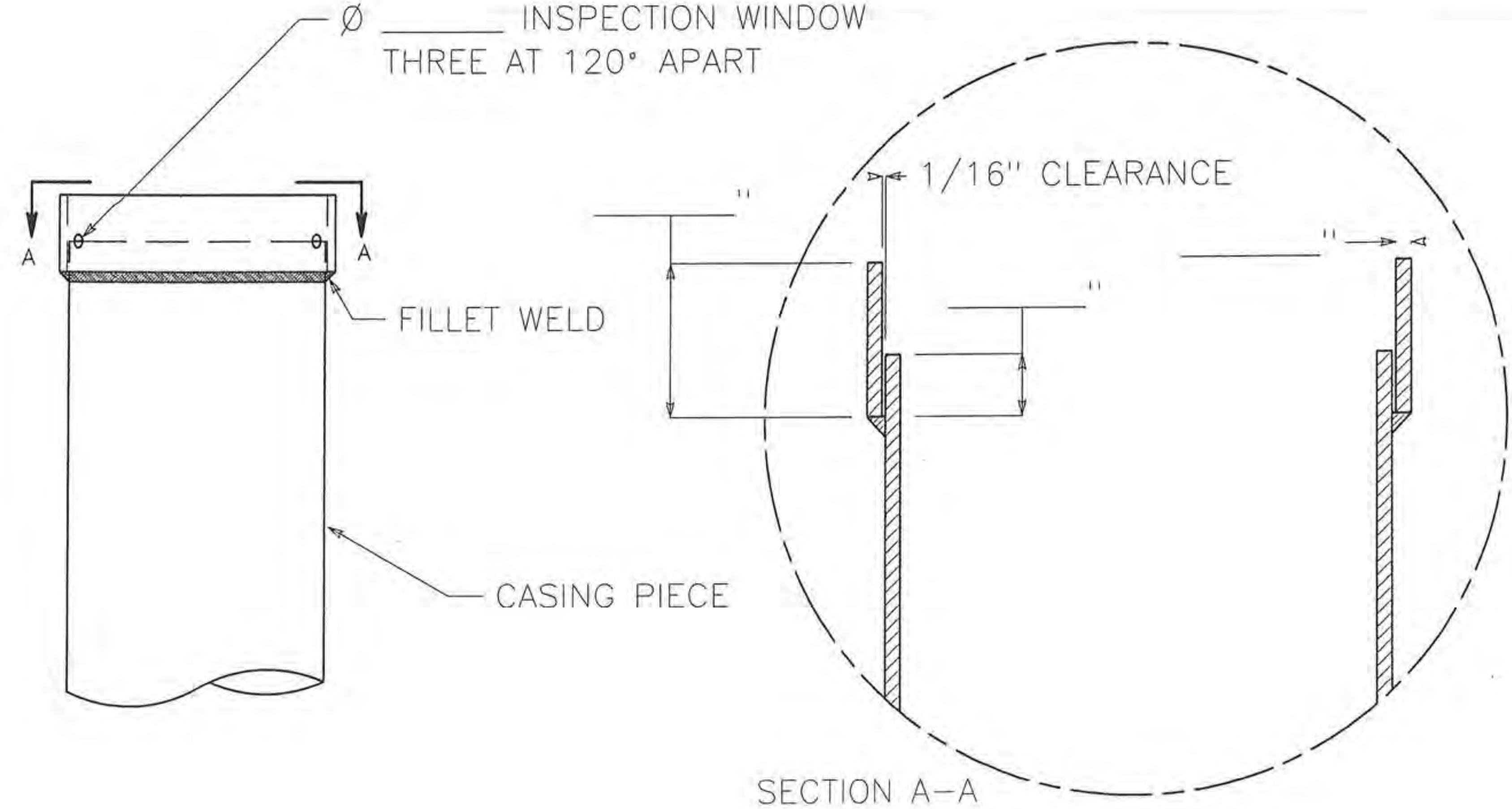
12EA - 1/4" MS CASING GUIDES W/4" BEND

57EA - 1/4" 304SS "C" TYPE CASING GUIDES W/4" BEN





OMJ 3-3-04	MECHANICAL CONNECTOR
NOT TO SCALE	ROSCOE MOSS CO.



TFB 9-04-03	WELDING COLLAR
NOT TO SCALE	ROSCOE MOSS CO.

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Water Well Casing and Screen

Specifications

♦Mild Steel Well Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM A 139 Grade B with the following additions:

Welding shall be by the automatic submerged-arc process using at least one pass on the inside and one pass on the outside.

Casing shall be 12¾ inches outside diameter and 5/16 inch wall thickness.

Casing shall be furnished in 20 foot lengths with welding collars attached.

♦Mild Steel

Well screen shall be manufactured in accordance with the aforementioned casing requirements.

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be ..... inch with ..... openings per lineal foot. The minimum area of opening shall be ..... square inches per lineal foot. N/A

♦Field Assembly of Mild Steel Casing and Screen Sections

For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section. Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section. The inside edge of the collars shall be free of sharp edges and burrs. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

Three 11/16 inch diameter inspection windows must be provided in each collar to assure proper matching of the sections.

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Weights and Strengths of Mild Steel Casing

6	3/16	4.76	6-5/8	168	6-1/4	159	12.89	19.22	718	1656	50.5	505	113.7	103.4
6	1/4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	3/16	4.76	8-5/8	219	8-1/4	210	16.90	25.19	393	908	27.7	277	149.0	135.5
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	3/16	4.76	10-3/4	273	10-3/8	263	21.15	31.53	228	527	16.1	161	186.6	169.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	5/16	7.94	10-3/4	273	10-1/8	257	34.84	51.94	760	1755	53.5	535	307.3	279.3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	1/4	6.35	12-3/4	324	12-1/4	311	33.38	49.76	306	707	21.5	215	294.4	267.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12	3/8	9.53	12-3/4	324	12	305	49.56	73.89	779	1799	54.8	548	437.1	397.4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	1/4	6.35	14	356	13-1/2	343	36.71	54.74	242	560	17.1	171	323.8	294.3
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	3/8	9.53	14	356	13-1/4	337	54.57	81.36	636	1468	44.7	447	481.3	437.5
[illegible]	[illegible]	[illegible]	16	406	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	1/4	6.35	16	406	15-1/2	394	42.05	62.70	172	398	12.1	121	370.9	337.2
16	5/16	7.94	16	406	[illegible]	[illegible]	[illegible]	[illegible]	303	700	21.3	213	[illegible]	[illegible]
16	3/8	9.53	16	406	15-1/4	387	62.58	93.30	470	1084	33.0	330	552.0	501.7
18	3/16	4.76	18	457	17-5/8	[illegible]	[illegible]	53.12	58	[illegible]	4.1	41	314.6	[illegible]
18	1/4	6.35	18	457	17-1/2	445	47.39	70.66	126	292	8.9	89	418.0	380.0
18	5/16	7.94	18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	226	521	15.9	159	520.7	473.3
18	3/8	9.53	18	457	17-1/4	438	70.59	105.24	356	819	25.0	250	622.6	565.9
20	3/16	[illegible]	20	508	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	1/4	6.35	20	508	19-1/2	495	52.73	78.62	95	220	6.7	67	465.1	422.8
20	5/16	7.94	20	508	19-3/8	492	65.70	97.96	172	398	12.1	121	579.5	526.8
20	3/8	9.53	20	508	19-1/4	489	78.60	117.18	274	632	19.3	193	693.3	630.2
22	3/16	4.76	22	559	21-5/8	549	[illegible]	65.12	33	77	2.3	23	385.3	350.2
22	1/4	6.35	22	559	21-1/2	546	58.07	86.58	74	170	5.2	52	512.2	465.6
22	5/16	7.94	22	559	21-3/8	543	72.38	107.92	134	310	9.4	94	638.4	580.3
22	3/8	9.53	22	559	21-1/4	540	86.61	129.13	215	497	15.2	152	763.9	694.4
24	3/16	4.76	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71.09	26	60	1.8	18	420.6	[illegible]
24	1/4	6.35	24	610	23-1/2	597	63.41	94.54	58	134	4.1	41	559.3	508.4
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	3/8	9.53	24	610	23-1/4	591	94.62	141.07	172	398	12.1	121	834.6	758.6

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Water Well Casing and Screen

Specifications

• Stainless Steel Type 304 Well Casing

Well casing shall be manufactured in accordance with applicable parts of ASTM A 778 with the following additions:

Welding shall be by the gas tungsten-arc process using at least one pass on the inside and one pass on the outside.

Lengths shall be furnished as specified, circumferentially welded joints will not be permitted.

Minimum wall thickness shall not be less than 5% of the nominal wall thickness specified.

Ovality of the casing supplied shall not exceed 1%.

Straightness of the casing will be determined by placing a 10-ft straightedge so that both ends are in contact with the length, a maximum gap of 0.125 inch is allowable. In addition, section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

The steel from which the casing is manufactured shall be stainless steel Type .....

Casing shall be 12¾" inches inside diameter and 1/4" inch wall thickness. Casing shall be furnished in [illegible] foot lengths with welding collars attached.

• Stainless Steel Shutter Screen

N/A

Well screen shall be manufactured in accordance with the aforementioned casing requirements.

Screen openings shall be machine made, horizontal to the axis of the casing and of a louver form with the aperture facing downward. The aperture size shall be ..... inch with ..... openings per lineal foot. The minimum area of opening shall be ..... square inches per lineal foot..

• Field Assembly of Stainless Steel Casing and Screen Sections

For field assembly by welding, section ends shall be furnished with collars in accordance with the following standard:

Collars shall be the same thickness and have the same physical and chemical properties as the corresponding casing section. Collars must be 5 inches wide, rolled to fit the outside diameter, and factory welded to one end of each section. The inside edge of the collars shall be free of sharp edges and burrs. Section ends shall be machined flat perpendicular to the axis of the casing and shall not vary more than 0.010 inch at any point from a true plane at right angles to the axis of the casing.

Three 11/16 inch diameter inspection windows must be provided in each collar to assure proper matching of the sections.

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Weights and Strengths of Stainless Steel Casing

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	3/16	4.76	6-5/8	168	6-1/4	159	13.19	19.67	646	1490	45.4	454	142.1	129.2
6	1/4	6.35	6-5/8	168	6-1/8	156	17.42	25.97	1136	2622	79.9	799	[illegible]	[illegible]
8	3/16	4.76	8-5/8	219	8-1/4	210	17.29	25.78	361	833	25.4	254	186.3	169.3
8	1/4	6.35	8-5/8	219	8-1/8	206	22.86	34.12	679	1566	47.7	477	[illegible]	[illegible]
10	3/16	4.76	10-3/4	273	10-3/8	263	21.65	32.27	213	492	15.0	150	233.2	212.0
10	1/4	6.35	10-3/4	273	10-1/4	260	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	5/16	7.94	10-3/4	273	10-1/8	257	35.65	53.15	683	1576	48.0	480	384.1	349.1
12	3/16	4.76	12-3/4	324	12-3/8	314	25.75	38.39	139	320	9.7	97	277.[illegible]	[illegible]
* 12	1/4	6.35	12-3/4	324	12-1/4	311	34.16	50.92	283	654	19.9	199	368.0	334.5
12	5/16	7.94	12-3/4	324	12-1/8	308	[illegible]	[illegible]	[illegible]	1093	[illegible]	[illegible]	[illegible]	[illegible]
12	3/8	9.53	12-3/4	324	12	305	50.72	75.62	699	1614	49.2	492	546.4	496.7
14	3/16	4.76	14-1/2	368	14-1/8	359	[illegible]	[illegible]	99	229	[illegible]	70	[illegible]	[illegible]
14	1/4	6.35	14-1/2	368	14	356	38.94	58.05	207	478	14.6	146	419.5	381.3
14	5/16	[illegible]	[illegible]	368	13-7/8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	3/8	9.53	14-1/2	368	13-3/4	349	57.89	86.32	533	1230	37.5	375	623.7	566.9
16	3/16	[illegible]	[illegible]	422	16-1/4	[illegible]	[illegible]	[illegible]	69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	1/4	6.35	16-5/8	422	16-1/8	410	44.74	66.71	147	339	10.3	103	482.0	438.2
16	5/16	7.94	16-5/8	422	16	406	[illegible]	[illegible]	256	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	3/8	9.53	16-5/8	422	15-7/8	403	66.60	99.30	393	907	27.6	276	717.5	652.2
18	3/16	4.76	18-5/8	473	18-1/4	464	37.79	56.33	51	117	[illegible]	36	[illegible]	[illegible]
18	1/4	6.35	18-5/8	473	18-1/8	460	50.21	74.86	109	253	7.7	77	540.9	491.7
18	5/16	7.94	18-5/8	473	18	457	62.65	93.25	193	447	13.6	136	[illegible]	[illegible]
18	3/8	9.53	18-5/8	473	17-7/8	454	74.80	111.52	302	696	21.2	212	805.9	732.5
20	3/16	4.76	[illegible]	524	[illegible]	[illegible]	[illegible]	[illegible]	35	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	1/4	6.35	20-5/8	524	20-1/8	511	55.67	83.01	84	193	5.9	59	599.8	545.2
20	5/16	7.94	20-5/8	524	20	508	[illegible]	103.42	150	345	10.6	106	[illegible]	[illegible]
20	3/8	9.53	20-5/8	524	19-7/8	505	83.00	123.76	236	544	16.6	166	894.2	812.8
22	3/16	4.76	22-1/2	572	22-1/8	562	45.73	68.17	30	70	2.1	21	[illegible]	[illegible]
22	1/4	6.35	22-1/2	572	22	559	60.80	90.64	66	153	4.7	47	655.0	595.4
22	5/16	7.94	22-1/2	572	21-7/8	556	75.76	112.99	120	276	8.4	84	815.4	742.1
22	3/8	9.53	22-1/2	572	21-3/4	552	90.68	135.20	190	439	13.4	134	977.0	888.1
24	3/16	4.76	24-1/2	622	24-1/8	[illegible]	[illegible]	[illegible]	24	55	1.7	17	[illegible]	[illegible]
24	1/4	6.35	24-1/2	622	24	610	66.26	98.79	53	122	3.7	37	713.9	648.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	3/8	9.53	24-1/2	622	23-3/4	603	98.88	147.42	153	354	10.8	108	1065.3	968.3

Continuous Slot Screen
Information Sheet

Project Best
Date 29-Sep-06

Nominal diameter (in.)	12.75
Screen length	20
Slot size (in.)	0.050
Wire width (in.)	0.215
Wire altitude (in.)	0.320
Wire base (in.)	0.040
Rod diameter (in.)	0.250 √
Rod count (ea)	60
Weight (lb/ft)	31.53
Length of weld ring (in)	4x4,w/clr
Collapse strength (psi)	385
Safe hanging weight (lbs)	30,909 √
Transmitting capacity @0.1 (gpm/ft)	28.27
Transmitting capacity @1.5 (gpm/ft)	424.00
Open area (%)	18.87
Open area (sq. in.)	90.65

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Roscoe Moss Company Continuous Slot Screen

Summary

Continuous slot screens are designed for production wells where there are a limited number of thin, well defined, and highly permeable aquifers. Continuous slot screens are very effective in wells of this type since they can be manufactured with very small slot openings and yet maintain the necessary open area to minimize frictional head loss.

Continuous slot screen is manufactured by wrapping and resistance welding a shaped wire around an internal array of longitudinal rods. This process lends itself to close tolerances required for very fine aperture sizes; the V- shaped slot configuration minimizes clogging by formation or filter pack particles. This type of screen is usually produced from stainless steel Types 304 or 316L in order to avoid problems associated with pumping sand that may result from corrosion of carbon steel screens.

Users of continuous slot screen are cautioned against using this product for purposes other than those for which it was originally designed because of inherent disadvantages associated with its relatively low strength and limited durability. As a result of these restrictions, special handling during installation and development may be required. For example, the use of highly effective well development techniques such as swabbing is precluded since the screen's interior is obstructed by rods. In addition, the extent of future well maintenance and repair efforts may be restricted as repair by swaging is impractical.

A thorough technical discussion of the selection of well casing and screen can be found in the Handbook of Ground Water Development (published by John Wiley and Sons, 1990). Additional information is also available on our web site www.roscoemoss.com.

Design of continuous slot screen

The specifier of continuous slot screen must determine: type of steel, slot size, wire size, rod size, number of rods, screen length, and the type of end fitting required. Slot size and screen length most likely will be determined from information collected from test well samples and logs. The other construction components must be determined prior to bidding.

Steel selection

Stainless steel should always be considered as the material of choice for continuous slot screens. Mild steel material seldom, if ever, provides adequate corrosion resistance for long lived wells. Stainless steel Types 304 or 316L are most commonly used for continuous slot screen.

Selection of wire size

The shape of the wire, slot size, and screen diameter determines the collapse strength of continuous slot screen. As a general rule, the width of the wire should never be less than the slot size.

Collapse strength

With regard to collapse strength, the screen should have collapse resistance at least equal to that determined by Equation 1. In no case should screen with a collapse strength of less than 50 psi be considered.

Equation 1: Minimum collapse strength (psi) = (Maximum depth setting (feet)/10) + 50

Example: Screen will be set to a maximum depth of 500 feet

Minimum collapse strength (psi) = (500/10) + 50

Minimum collapse strength = 100 psi

Note that this is the minimum collapse strength requirement. Site specific requirements and the designer's experience may require significantly higher collapse strength.

Calculating collapse strength of continuous slot screen

The pressure at which a single wire ring will collapse is calculated by Equation 2. This same formula can be used to approximate the collapse strength of continuous slot screen.

Equation 2: $P_{ww} = \frac{24\,EI}{(w + s)D^3}$

where
- Pww = collapse pressure of continuous slot screen (psi)
- E = Young's modulus (3×10^7) for steel
- I = moment of inertia of the external face (in.)^4
- w = width of the wire on the external face (in.)
- S = slot width of the screen (in.)
- D = mean diameter of the screen

The moment of inertia (I) depends on the shape of the wire; but is generally between wt³/12 (a rectangle) and wt³/36 (a triangle), where t is the thickness of the wire. An interactive program to determine collapse strength can be found on our web site www.roscoemoss.com and is also available from your Roscoe [illegible] representative.

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Selection of rod size and number of rods

The amount of static weight that can be safely supported by the uppermost screen is referred to as the safe hanging weight. The cross sectional rod area of the screen determines the load limit of the screen. Safe hanging weight of continuous slot screen can be determined from Equation 3.

Equation 3: $T = 5.25A$

where T = safe hanging weight (tons)

A = cross sectional rod area

Example: If the screen is constructed with 60 rods and each rod is 0.250" in diameter, the total cross sectional area of the screen is 2.94 sq. in. Therefore the safe hanging weight is:

$T = 5.25 \times 2.94$

$T = 15.44$ tons

Users are cautioned that many factors determine the joint efficiency between the screen body and fitting. Also, many dynamic forces are applied during installation, gravel packing, and well development. For these reasons, the actual safe hanging weight of the screen may be less than indicated by this theoretical formula.

End fittings

Continuous slot screens manufactured by Roscoe Moss Company may be fabricated with weld rings, welding collars, flush threaded ends, or threaded and coupled connections. It is the designer's responsibility to select the type of end fitting most suitable for site specific conditions.

Specifications for continuous slot screen

General

Continuous slot screen shall be constructed of shaped wire helically wrapped over a circular array of internal rods. Using electrical resistance welding, each wire and rod juncture will be fusion welded under water. The slot size will be based on sieve analysis of the water-bearing sediments or selected pack materials.

Materials

The screen shall be constructed from stainless steel Type 304

Diameter

The screen shall have a maximum outside diameter of 12¾" inches and a minimum clear inside diameter of 12 inches.

Strength

The screen shall meet the following minimum strength requirements:

Collapse pressure 385 psi at .050 slot size

Safe hanging weight 30,900 lbs.

Field Assembly

For field assembly the screen shall be furnished with COLLARS

If weld rings are used they shall be 4 inches long and 5/16" inches thick. Weld rings shall be fabricated from the same grade of steel used for the screen bodies.

If welding collars are used they shall be 4 inches long and 5/16 inches thick. Welding collars shall be fabricated from the same grade of steel used for the screen bodies.

If flush threaded joints are used they shall be compatible with those described by ASTM F 480 standards. Material used to fabricate these fittings shall be from the same grade of steel used for the screen bodies.

Documentation

If required, the manufacturer will provide documentation that the screen meets contract specifications. Examples of such documentation are: mill test reports, manufacturer's certificate of compliance, and calculations used to determine collapse strength and safe hanging weight.

Appendix D

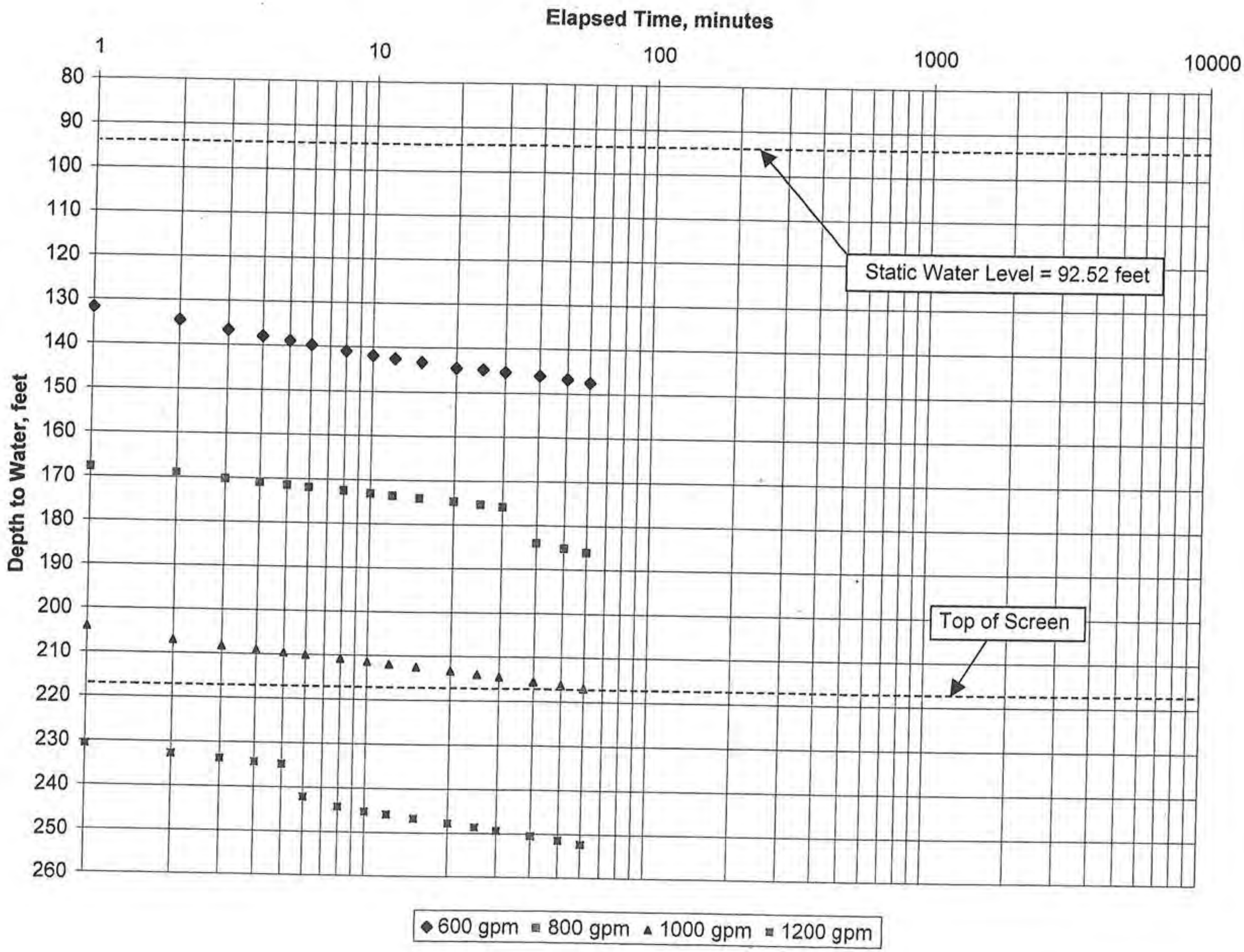
Pumping test data

Pumping Test Step test, St. Joseph Street Well (Well #5) November 2, 2006

Day	Time	Elapsed Time	Depth to Water	Drawdown	Recorded Pumping Rate
Mo./Day/Yr	hr:min	minutes	feet	feet	gallons per minute
11/2/2006	10:00	0	92.52	0	Start
	10:01	1	131.72	39.20	600
	10:02	2	134.45	41.93	600
	10:03	3	136.55	44.03	600
	10:04	4	137.85	45.33	600
	10:05	5	138.78	46.26	600
	10:06	6	139.66	47.14	600
	10:08	8	140.91	48.39	600
	10:10	10	141.80	49.28	600
	10:12	12	142.44	49.92	600
	10:15	15	143.22	50.70	600
	10:20	20	144.45	51.93	600
	10:25	25	144.67	52.15	600
	10:30	30	145.25	52.73	600
	10:40	40	145.98	53.46	600
	10:50	50	146.71	54.19	600
	11:00	60	147.40	54.88	600
	11:01	1	167.80	75.28	800
	11:02	2	168.97	76.45	800
	11:03	3	170.13	77.61	800
	11:04	4	170.89	78.37	800
	11:05	5	171.40	78.88	800
	11:06	6	171.85	79.33	800
	11:08	8	172.5	79.98	800
	11:10	10	173.05	80.53	800
	11:12	12	173.50	80.98	800
	11:15	15	174.07	81.55	800
	11:20	20	174.70	82.18	800
	11:25	25	175.29	82.77	800
	11:30	30	175.80	83.28	800
	11:40	40	183.98	91.46	800
	11:50	50	185.08	92.56	800
	12:00	60	185.90	93.38	800
	12:01	1	204.10	111.58	1000
	12:02	2	206.93	114.41	1000
	12:03	3	208.17	115.65	1000
	12:04	4	208.95	116.43	1000
	12:05	5	209.52	117.00	1000
	12:06	6	210.00	117.48	1000
	12:08	8	210.73	118.21	1000
	12:10	10	211.32	118.80	1000
	12:12	12	211.83	119.31	1000
	12:15	15	212.41	119.89	1000
	12:20	20	213.22	120.70	1000
	12:25	25	213.91	121.39	1000
	12:30	30	214.49	121.97	1000
	12:40	40	215.48	122.96	1000
	12:50	50	216.19	123.67	1000
	13:00	60	216.90	124.38	1000
	13:01	1	230.60	138.08	1200
	13:02	2	232.65	140.13	1200
	13:03	3	233.58	141.06	1200
	13:04	4	234.27	141.75	1200
	13:05	5	234.67	142.15	1200
	13:06	6	242.00	149.48	1200
	13:08	8	244.11	151.59	1200
	13:10	10	245.14	152.62	1200
	13:12	12	245.73	153.21	1200
	13:15	15	246.61	154.09	1200
	13:20	20	247.64	155.12	1200
	13:25	25	248.50	155.98	1200
	13:30	30	249.20	156.68	1200
	13:40	40	250.37	157.85	1200
	13:50	50	251.30	158.78	1200
	14:00	60	252.20	159.68	1200

Step Test - St. Joseph Street Well (Well #5)
Los Alamos Community Services District
November 2, 2006

Depth to Static Water Level: 92.52 feet **600, 800, 1,000, and 1,200 gallons per minute**



Pumping Test 72-Hour, St. Joseph Street Well (Well #5) November 7 to 10, 2006

Day Mo./Day/Yr	Time hr:min	Elapsed Time minutes	Depth to Water feet	Drawdown feet	Recorded Pumping Rate gallons per minute	Meter Reading gallons
11/7/06	6:15	0	89.30	0	Start	9897500
	6:19	4	154.28	64.98		
	6:20	5	155.55	66.25		
	6:21	6	156.62	67.32		
	6:23	8	158.62	69.32		
	6:25	10	160.01	70.71	750	9903500
	6:27	12	161.16	71.86	750	9905000
	6:30	15	162.40	73.10		
	6:35	20	171.66	82.36	700	9908500
	6:40	25	173.25	83.95	800	9912500
	6:45	30	174.35	85.05	800	9916500
	6:55	40	176.03	86.73	800	9920500
	7:05	50	177.34	88.04	800	9928500
	7:15	60	178.40	89.10	800	9936500
	7:30	75	179.55	90.25	800	9944500
	7:45	90	180.52	91.22	800	9956500
	8:00	105	181.36	92.06	800	9968500
	8:15	120	182.10	92.80	767	9980000
	8:45	150	183.40	94.10	800	9992000
	9:15	180	184.16	94.86	800	10016000
	10:15	240	186.55	97.25	767	10039000
	11:15	300	190.85	101.55	783	10086000
	12:15	360	192.19	102.89	783	10133000
	13:15	420	192.81	103.51	783	10180000
	14:15	480	193.47	104.17	800	10228000
	15:15	540	194.12	104.82	800	10276000
	16:15	600	194.58	105.28	783	10323000
	17:15	660	195.32	106.02	783	10370000
	18:15	720	195.73	106.43	792	10417500
	19:15	780	196.15	106.85	792	10465000
	20:15	840	196.67	107.37	783	10512000
	21:15	900	196.93	107.63	783	10559000
	22:15	960	197.33	108.03	792	10606500
	23:15	1020	197.43	108.13	775	10653000
11/8/06	0:15	1080	197.56	108.26	800	10701000
	1:15	1140	197.75	108.45	783	10748000
	2:15	1200	198.20	108.90	783	10795000
	3:15	1260	198.35	109.05	767	10841000
	4:15	1320	198.61	109.31	650	10880000
	5:15	1380	198.69	109.39	917	10935000
	6:15	1440	198.62	109.32	783	10982000
	8:15	1560	199.10	109.80	600	11018000
	10:15	1680	199.27	109.97	875	11123000
	12:15	1800	199.45	110.15	775	11216000
	14:15	1920	199.71	110.41	783	11310000
	15:15	1980	200.07	110.77	775	11403000
	16:15	2040	201.60	112.30	767	11449000
	17:15	2100	201.82	112.52	800	11497000
	18:15	2160	202.07	112.77	783	11544000
	19:15	2220	202.07	112.77	792	11591500
	20:15	2280	202.24	112.94	792	11639000
	21:15	2340	202.30	113.00	783	11686000
	22:15	2400	202.65	113.35	792	11733500
	23:15	2460	202.69	113.39	775	11780000
11/9/06	0:15	2520	202.73	113.43	817	11829000
	1:15	2580	202.85	113.55	817	11878000
	2:15	2640	202.91	113.61	750	11923000
	3:15	2700	203.05	113.75	800	11971000
	4:15	2760	203.11	113.81	767	12017000
	5:15	2820	203.33	114.03	783	12064000
	6:15	2880	203.38	114.08	800	12112000
	7:15	2940	203.64	114.34	783	12159000
	8:15	3000	203.50	114.20	800	12207000
	9:15	3060	203.50	114.20	783	12254000
	10:15	3120	203.48	114.18	783	12301000
	11:15	3180	203.49	114.19	783	12348000
	12:15	3240	203.49	114.19		
	13:15	3300	203.45	114.15	783	12442000
	14:15	3360	203.57	114.27	783	12489000
	15:15	3420	203.44	114.14	800	12537000
	16:15	3480	203.60	114.30	783	12584000
	17:15	3540	203.80	114.50	783	12631000
	18:15	3600	203.86	114.56	783	12678000
					783	12725000

Pumping Test 72-Hour, St. Joseph Street Well (Well #5) November 7 to 10, 2006

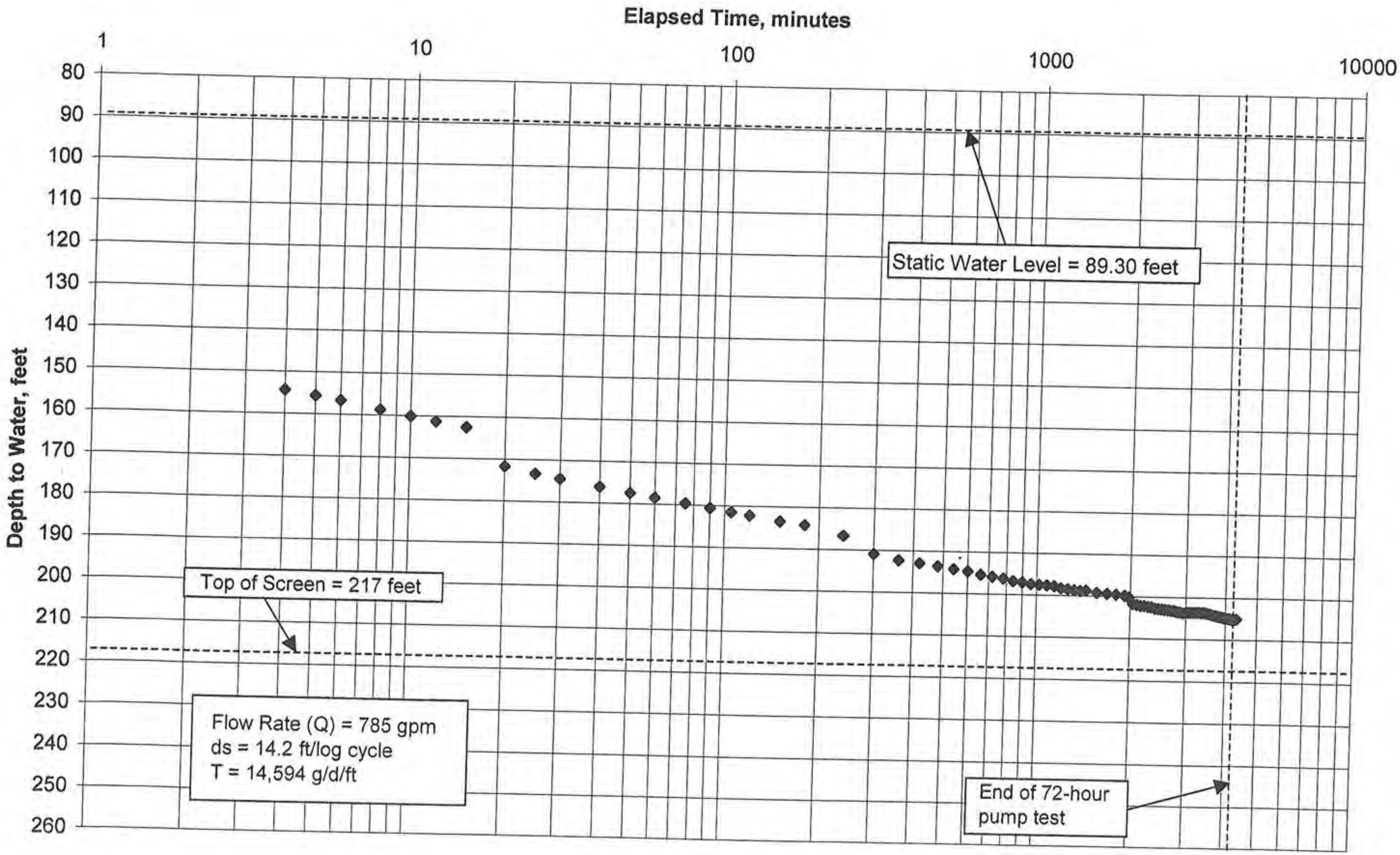
Day Mo./Day/Yr	Time hr:min	Elapsed Time minutes	Depth to Water feet	Drawdown feet	Recorded Pumping Rate gallons per minute	Meter Reading gallons
	19:15	3660	204.08	114.78	783	12772000
	20:15	3720	204.12	114.82	783	12819000
	21:15	3780	204.32	115.02	783	12866000
	22:15	3840	204.44	115.14	783	12913000
	23:15	3900	204.52	115.22	800	12961000
11/10/06	0:15	3960	204.64	115.34	783	13008000
	1:15	4020	204.72	115.42	783	13055000
	2:15	4080	204.80	115.50	783	13102000
	3:15	4140	204.88	115.58	783	13149000
	4:15	4200	205.03	115.73	783	13196000
	5:15	4260	205.05	115.75	783	13243000
	6:15	4320	204.96	115.66	783	13290000
					Average = 785 gpm	

Recovery Test, St. Joseph Street Well (Well #5)

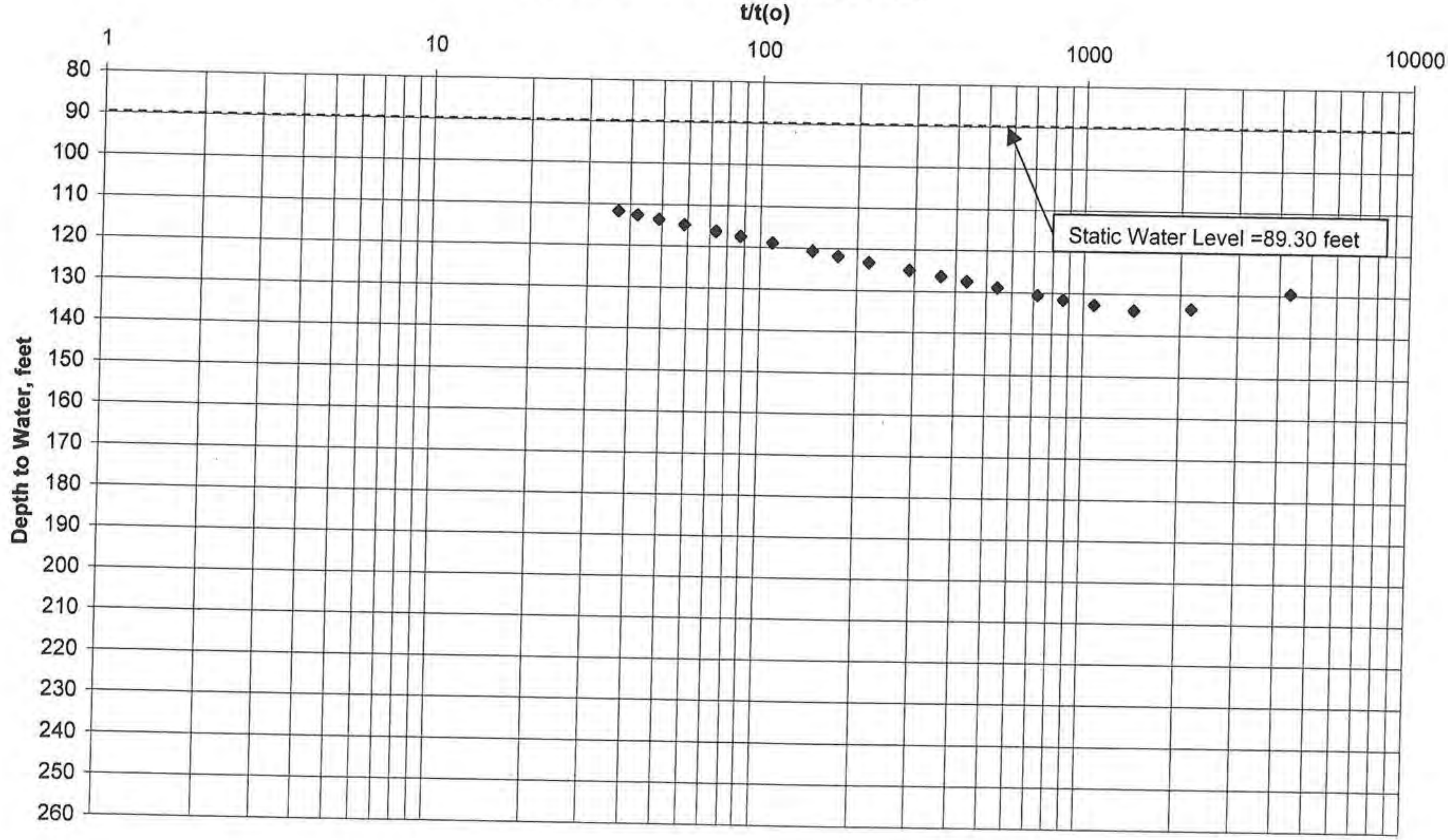
Day Mo./Day/Yr Recovery	Time hr:min	Elapsed Time minutes t	Depth to Water feet s	Elapsed Time minutes t(0)	Recovery Time Ratio t/t(0)
11/10/06	6:16	4321	129.41	1	4321.0
	6:17	4322	133.41	2	2161.0
	6:18	4323	133.89	3	1441.0
	6:19	4324	132.72	4	1081.0
	6:20	4325	131.55	5	865.0
	6:21	4326	130.52	6	721.0
	6:23	4328	128.78	8	541.0
	6:25	4330	127.40	10	433.0
	6:27	4332	126.26	12	361.0
	6:30	4335	124.87	15	289.0
	6:35	4340	123.12	20	217.0
	6:40	4345	121.72	25	173.8
	6:45	4350	120.57	30	145.0
	6:55	4360	118.77	40	109.0
	7:05	4370	117.37	50	87.4
	7:15	4380	116.20	60	73.0
	7:30	4395	114.73	75	58.6
	7:45	4410	113.51	90	49.0
	8:00	4425	112.49	105	42.1
	8:15	4440	111.61	120	37.0

Pump Test (72-Hour) - St. Joseph Street Well (Well #5)
Los Alamos Community Services District
November 7 to 10, 2006

Depth to Static Water Level: 89.30 feet **Average flow rate: 785 gallons per minute**



Recovery Test - St. Joseph Street Well (Well #5)
Los Alamos Community Services District
November 7 to 10, 2006
Depth to Static Water Level: 89.30 feet



St. Joseph Street Well #5
Los Alamos CSD

Operational drop 30 ft

Items	pre-prod static	operat. static	ref drop	design drop	actual drop	10 min static	Top of zone	max draw	cycles	max draw per cycle	ref draw	ref rate	well yield
	89.3	119.3	71	64	64.5	183.3	217	33.7	2.62	12.9	14.2	785	713
	(ft bgs) pump test	(ft bgs) Static + op. drop	(ft) 10 min @785 pump test	(ft) manual input	(ft)	(ft bgs)	(ft bgs)	(ft)	(cycles) log cycles from 10 min to 2.9 d	(ft) 33.7/2.62	(ft/log cycle) @785gpm pump test	(gpm) pump test	(gpm)

Notes: Yield estimate is based on Cooper-Jacob modification of Theis Equation.

Appendix E

Water Quality Results

CLINICAL LAB OF SAN BERNARDINO, INC
21881 BARTON ROAD
GRAND TERRACE, CA 92313
RADIOACTIVITY ANALYSIS (9/99)

EX

1 of 1

Date of Report: 06/11/22
Laboratory
Name: CLINICAL LABORATORIES OF SAN BERNARDINO
Name of Sampler: JEREMY LOGUE
Date/Time Sample
Collected: 06/11/09/1126

Sample ID No. M65114R-1A
Signature Lab
Director:
Employed By: L.A.C.S.D.

Date/Time Sample
Received @ Lab: 06/11/10/1030

Date Analyses
Completed: 06/11/17

System
Name: LOS ALAMOS COMMUNITY SER DIST
Name or Number of Sample Source: WELL 5

System
Number: 4210002

User ID: TAP
Date/Time of Sample: |06|11|09|1126|
YY MM DD TTTT
Submitted by: ______

Station Number:
Laboratory Code: 3761
Date Analysis completed: |06|11|17|
YY MM DD
Phone #: ______

MCL REPORT UNITS	CHEMICAL	STORET CODE	ANALYSES RESULTS	DLR
15	pCi/L Gross Alpha	01501	ND	3.0
	pCi/L Gross Alpha Counting Error	01502	2.0	
	pCi/L Gross Alpha MDA (95% Confidence)	A-072	2.0	
20	pCi/L Uranium	28012	1.5	1.0
	pCi/L Uranium Counting Error	A-028	0.58	
	pCi/L Uranium MDA (95% Confidence)	A-073	0.87	
	pCi/L Radium 226	09501		1.0
	pCi/L Radium 226 Counting Error	09502		
	pCi/L Radium 226 MDA (95% Confidence)	A-074		
	pCi/L Radium 228	11501		1.0
	pCi/L Radium 228 Counting Error	11502		
	pCi/L Radium 228 MDA (95% Confidence)	A-075		
5	pCi/L Ra 226 + Ra 228	11503		2.0
	pCi/L Ra 226 + Ra 228 Counting Error	11504		
50	pCi/L Gross Beta	03501		4.0
	pCi/L Gross Beta Counting Error	03502		
	pCi/L Gross Beta MDA (95% Confidence)	A-077		
8	pCi/L Strontium 90	13501		2.0
	pCi/L Strontium 90 Counting Error	13502		
	pCi/L Strontium 90 MDA (95% Confidence)	A-078		
20000	pCi/L Tritium	07000		1000
	pCi/L Tritium Counting Error	07001		
	pCi/L Tritium MDA (95% Confidence)	A-079		

CLINICAL LAB OF SAN BERNARDINO, INC
21881 BARTON ROAD
GRAND TERRACE, CA 92313

EX

GENERAL MINERAL & PHYSICAL & INORGANIC ANALYSIS (9/99) 1 oF 2

Date of Report: 06/11/27 Sample ID No.M65114-1A

Laboratory
Name: CLINICAL LABORATORIES OF SAN BERNARDINO Signature Lab Director: ____

Name of Sampler: JEREMY LOGUE Employed By: L.A.C.S.D.

Date/Time Sample Collected: 06/11/09/1126 Date/Time Sample Received @ Lab: 06/11/10/1030 Date Analyses Completed: 06/11/21

System Name: LOS ALAMOS COMMUNITY SER DIST System Number: 4210002

Name or Number of Sample Source: WELL 5

User ID: TAP Station Number:

Date/Time of Sample: |06|11|09|1126| (YY MM DD TTTT) Laboratory Code: 3761

Date Analysis completed: |06|11|21| (YY MM DD)

Submitted by: ____ Phone #: ____

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	mg/L	Total Hardness (as CaCO3) (mg/L)	00900	350	5.0
	mg/L	Calcium (Ca) (mg/L)	00916	90	1.0
	mg/L	Magnesium (Mg) (mg/L)	00927	34	1.0
	mg/L	Sodium (Na) (mg/L)	00929	71	1.0
	mg/L	Potassium (K) (mg/L)	00937	3.8	1.0
Total Cations		Meq/L Value: 10.47			
	mg/L	Total Alkalinity (as CaCO3) (mg/L)	00410	210	5.0
	mg/L	Hydroxide (OH) (mg/L)	71830	ND	5.0
	mg/L	Carbonate (CO3) (mg/L)	00445	ND	5.0
	mg/L	Bicarbonate (HCO3) (mg/L)	00440	250	5.0
*	mg/L+	Sulfate (SO4) (mg/L)	00945	190	0.50
*	mg/L+	Chloride (Cl) (mg/L)	00940	73	1.0
45	mg/L	Nitrate (as NO3) (mg/L)	71850	7.4	2.0
2.0	mg/L	Fluoride (F) (Natural-Source)	00951	0.16	0.10
Total Anions		Meq/L Value: 10.24			
	Std.Units+	PH (Laboratory) (Std.Units)	00403	7.2	
***	umho/cm+	Specific Conductance (E.C.) (umhos/cm)	00095	930	2.0
****	mg/L+	Total Filterable Residue@180C(TDS)(mg/L)	70300	620	5.0
15	Units	Apparent Color (Unfiltered) (Units)	00081	ND	3
3	TON	Odor Threshold at 60 C (TON)	00086	1	1
5	NTU	Lab Turbidity (NTU)	82079	0.4	0.1
0.5	mg/L+	MBAS (mg/L)	38260	ND	0.10

* 250-500-600 ** 0.6-1.7 *** 900-1600-2200 **** 500-1000-1500

2 of 2

INORGANIC CHEMICALS M65114-1A

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
1000	ug/L	Aluminum (Al) (ug/L)	01105	ND	50
6	ug/L	Antimony (ug/L)	01097	ND	6.0
10	ug/L	Arsenic (As) (ug/L)	01002	ND	2.0
1000	ug/L	Barium (Ba) (ug/L)	01007	ND	100
4	ug/L	Beryllium (ug/L)	01012	ND	1.0
5	ug/L	Cadmium (Cd) (ug/L)	01027	1.6	1.0
50	ug/L	Chromium (Total Cr) (ug/L)	01034	ND	10
1000	ug/L+	Copper (Cu) (ug/L)	01042	ND	50
300	ug/L+	Iron (Fe) (ug/L)	01045	ND	100
	ug/L	Lead (Pb) (ug/L)	01051	ND	5.0
50	ug/L+	Manganese (Mn) (ug/L)	01055	35	20
2	ug/L	Mercury (Hg) (ug/L)	71900	ND	1.0
100	ug/L	Nickel (ug/L)	01067	ND	10
50	ug/L	Selenium (Se) (ug/L)	01147	ND	5.0
100	ug/L+	Silver (Ag) (ug/L)	01077	ND	10
2	ug/L	Thallium (ug/L)	01059	ND	1.0
5000	ug/L+	Zinc (Zn) (ug/L)	01092	ND	50

ADDITIONAL ANALYSES

MCL	REPORTING UNITS	CHEMICAL	ENTRY #	ANALYSES RESULTS	DLR
	C	Source Temperature C	00010	20	
		Langelier Index Source Temp.	71814	- 0.10	
		Langelier Index at 60 C	71813	0.60	
		Agressiveness Index	82383	11.87	
	ug/L	Boron (ug/L)	01020	130	100
10000	ug/L	Nitrate + Nitrite as Nitrogen(N) (ug/L)	A-029	1700	400
1000	ug/L	Nitrite as Nitrogen(N) (ug/L)	00620	ND	400
150	ug/L	Cyanide (ug/L)	01291	ND	100
	ug/L	Vanadium (ug/L)	01087	6.6	3.0

+ Indicates Secondary Drinking Water Standards

CLINICAL LAB OF SAN BERNARDINO, INC
21881 BARTON ROAD
GRAND TERRACE, CA 92313
ORGANIC CHEMICAL ANALYSIS (9/99)

EX

1 of 2

Date of Report: 06/11/28
Sample ID No.M65114X-1A
Laboratory Name: CLINICAL LABORATORIES OF SAN BERNARDINO
Signature Lab Director:
Name of Sampler:JEREMY LOGUE
Employed By: L.A.C.S.D.
Date/Time Sample Collected:06/11/09/1126
Date/Time Sample Received @ Lab:06/11/10/1030
Date Analyses Completed:06/11/22

System Name:LOS ALAMOS COMMUNITY SER DIST
System Number: 4210002
Name or Number of Sample Source:WELL 5

User ID: TAP
Station Number:
Date/Time of Sample: |06|11|09|1126| YY MM DD TTTT
Laboratory Code: 3761
Date Analysis completed: |06|11|22| YY MM DD
Submitted by:
Phone #:

Page 1 of 2

REGULATED ORGANIC CHEMICALS

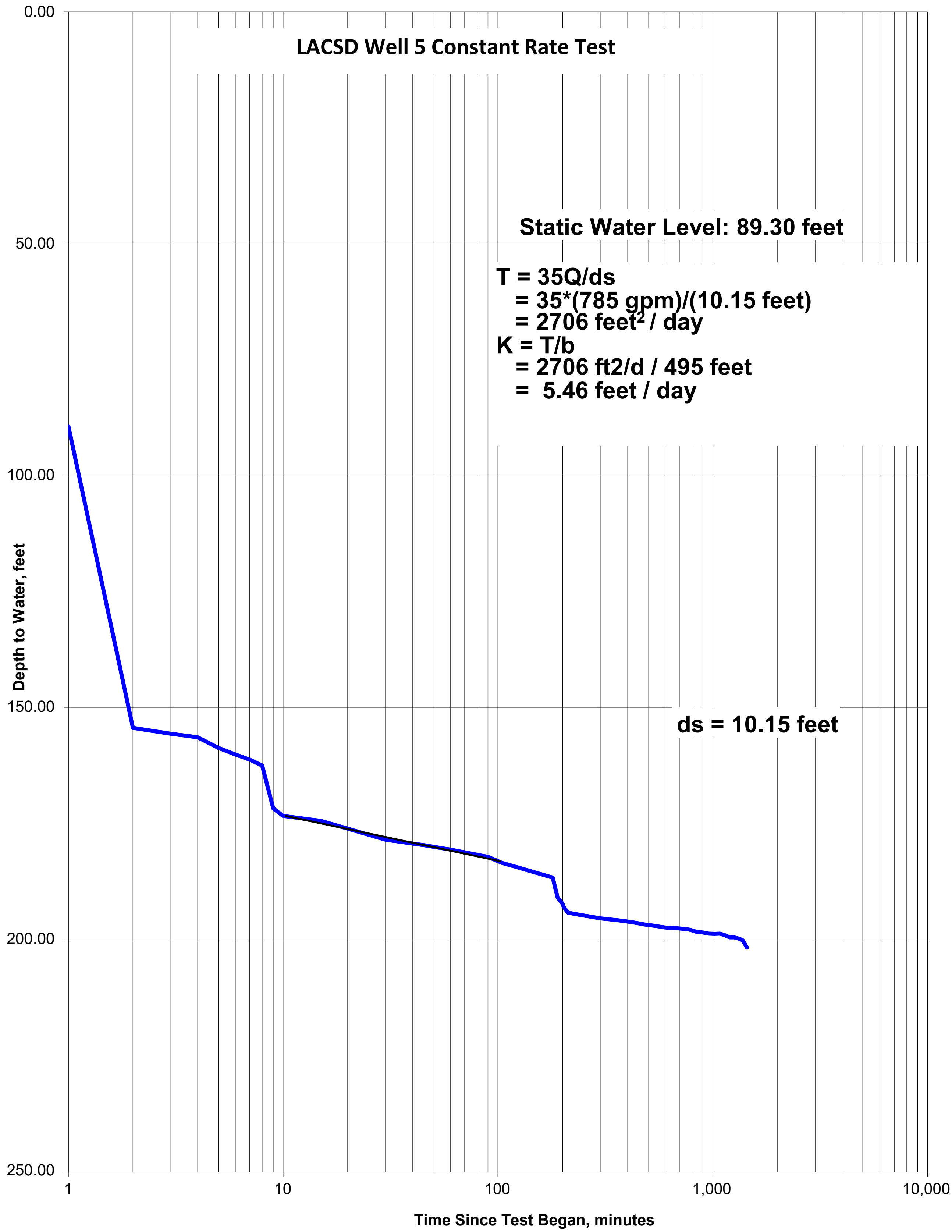
TEST METHOD	CHEMICAL ALL CHEMICALS REPORTED ug/L	ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
524.2	Total Trihalomethanes (TTHMs)	82080	ND	80	
524.2	Bromodichloromethane	32101	ND		1.0
524.2	Bromoform	32104	ND		1.0
524.2	Chloroform (Trichloromethane)	32106	ND		1.0
524.2	Dibromochloromethane	32105	ND		1.0
524.2	Benzene	34030	ND	1	0.50
524.2	Carbon Tetrachloride	32102	ND	.5	0.50
524.2	1,2-Dichlorobenzene (o-DCB)	34536	ND	600	0.50
524.2	1,4-Dichlorobenzene (p-DCB)	34571	ND	5	0.50
524.2	1,1-Dichloroethane (1,1-DCA)	34496	ND	5	0.50
524.2	1,2-Dichloroethane (1,2-DCA)	34531	ND	.5	0.50
524.2	1,1-Dichloroethylene (1,1-DCE)	34501	ND	6	0.50
524.2	cis-1,2-Dichloroethylene (c-1,2-DCE)	77093	ND	6	0.50
524.2	trans-1,2-Dichloroethylene (t-1,2-DCE)	34546	ND	10	0.50
524.2	Dichloromethane (Methylene Chloride)	34423	ND	5	0.50
524.2	1,2-Dichloropropane	34541	ND	5	0.50
524.2	Total 1,3-Dichloropropene	34561	ND	.5	0.50
524.2	Ethyl Benzene	34371	ND	300	0.50
524.2	Methyl tert-Butyl Ether(MTBE)	46491	ND	5	3.0
524.2	Monochlorobenzene (Chlorobenzene)	34301	ND	70	0.50
524.2	Styrene	77128	ND	100	0.50
524.2	1,1,2,2-Tetrachloroethane	34516	ND	1	0.50
524.2	Tetrachloroethylene (PCE)	34475	ND	5	0.50
524.2	Toluene	34010	ND	150	0.50
524.2	1,2,4-Trichlorobenzene	34551	ND	5	0.50
524.2	1,1,1-Trichloroethane (1,1,1-TCA)	34506	ND	200	0.50
524.2	1,1,2-Trichloroethane (1,1,2-TCA)	34511	ND	5	0.50
524.2	Trichloroethylene (TCE)	39180	ND	5	0.50
524.2	Trichlorofluoromethane (FREON 11)	34488	ND	150	5.0

REGULATED ORGANIC CHEMICALS CONTINUED M65114X-1A

TEST METHOD	CHEMICAL ALL CHEMICALS REPORTED ug/L	ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
524.2	Trichlorotrifluoroethane (FREON 113)	81611	ND	1200	10
524.2	Vinyl Chloride (VC)	39175	ND	.5	0.50
524.2	m,p-Xylene	A-014	ND		1.0
524.2	o-Xylene	77135	ND		0.50
524.2	Total Xylenes (m,p, & o)	81551	ND	1750	
504.1	Dibromochloropropane (DBCP)	38761	ND	.2	0.010
504.1	Ethylene Dibromide (EDB)	77651	ND	.05	0.020
507	Atrazine (AATREX)	39033	ND	1	0.50
507	Molinate (ORDRAM)	82199	ND	20	2.0
507	Simazine (PRINCEP)	39055	ND	4	1.0
507	Thiobencarb (BOLERO)	A-001	ND	70	1.0
507	Alachlor (ALANEX)	77825	ND	2	1.0
515.4	Bentazon (BASAGRAN)	38710	ND	18	2.0
515.4	2,4-D	39730	ND	70	10
515.4	2,4,5-TP (SILVEX)	39045	ND	50	1.0
531.1	Carbofuran (FURADAN)	81405	ND	18	5.0
515.4	Dalapon	38432	ND	200	10
515.4	Dinoseb (DNBP)	81287	ND	7	2.0
531.1	Oxamyl (Vydate)	38865	ND	50	20
515.4	Pentachlorophenol (PCP)	39032	ND	1	0.20
515.4	Picloram	39720	ND	500	1.0

UNREGULATED ORGANIC CHEMICALS

TEST METHOD	CHEMICAL	ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
524.2	tert-Amyl Methyl Ether (TAME)	A-034	ND		3.0
524.2	tert-Butyl Alcohol (TBA)	77035	ND		2.0
524.2	Dichlorodifluoromethane (Freon 12)	34668	ND		0.50
524.2	Ethyl tert-Butyl Ether (ETBE)	A-033	ND		3.0



LACSD Well 5 Constant Rate Test
Static Water Level: 89.30 feet
T = 35Q/ds
= 35*(785 gpm)/(10.15 feet)
= 2706 feet² / day
K = T/b
= 2706 ft2/d / 495 feet
= 5.46 feet / day
ds = 10.15 feet
0.00
50.00
100.00
150.00
200.00
250.00
Depth to Water, feet
1
10
100
1,000
10,000
Time Since Test Began, minutes

APPENDIX D-2

Four Deer Ranch Well Field Pumping Tests

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WATER WELL DRILLING PROJECT

HUNTER FOUR DEER RANCH

Los Alamos Area
Santa Barbara County, CA

Managed By

KATHERMAN EXPLORATION CO., LLC

NOVEMBER 2009

WATER WELL DRILLING PROJECT

HUNTER FOUR DEER RANCH

Los Alamos Area
Santa Barbara County, CA

INTRODUCTION

In March of 2009 Katherman Exploration Co., LLC prepared an in-depth ground water review report of the ground water conditions in the Las Flores Canyon Area for the client, Hunter Four Deer Ranch (Figure 1 & 2). Out of this reporting, a well drilling and testing project was proposed in order to develop new water wells to supplement the existing wells on the ranch. Together, these water sources were to meet the long range water needs of the ranch, which would include a domestic water source to supply water to a new proposed domestic water system, and an agricultural water source for a possible vineyard. The Four Deer Ranch consists of approximately 1400 acres of land (Figure 3) west of and adjacent to US Highway 101 at Palmer Road.

PRIOR GROUND WATER REVIEW

The March 2009 report revealed the potential for substantial water reserves under the ranch within the Paso Robles Formation and the Careaga Formation, however there were drilling and extraction concerns uncovered from prior drilling on the ranch, as well as the adjacent property to the south. These concerns centered on observed artesian flow from numerous offsite testholes; several of which were lost due to uncontrollable water flow and sand entry. What was thought to originally be an artesian problem in the Careaga, appeared to now be confined to a sand interval within the Paso Robles Formation from the initial electric log correlations on the existing area water wells and in old oil wells drilled on the property. In addition, the existing water wells on the northern part of the Four Deer Ranch did not exhibit any artesian characteristics and were drilled and completed to a depth of 460 feet without any difficulties. However, a shallow existing domestic well on the subject ranch did have artesian flow both during the drilling and later during the completion. The description of the penetrated sediments during the drilling of this well seemed to indicate a color change at a depth of 130 feet from gray, gray-brown to blue, which is indicative of the Careaga Formation. This appeared to be too shallow to be Careaga based on prior log correlations. Unfortunately, some of the water wells and testholes to the south on the Schaff property failed at even deeper depths due to excessive flow during the drilling and were consequently not completed. Nothing appeared to be consistent as to a single confined water zone within the Paso Robles, so it was assumed to be Careaga related.

The conclusions and recommendations of the initial ground water review report resulted in the identification of four new drilling locations, as well as an analysis of the potential for greater water production from two of the three existing wells. A map showing these new locations and the existing wells is shown in Figure 4.

RE-ANALYSIS OF THE EXISTING WELLS

All three of the existing water wells on the ranch were drilled by Ron Taylor drilling in 1999 and 2000 for the previous property owner, Chevron, and its tenant rancher, Tommy Thompson (Figure 4). The northerly two wells were drilled to similar depths (approx. 460 feet) and were completed with 8 inch PVC casing. Since these wells were being utilized as a primary source wells for livestock watering, low capacity pumps were placed in each of the wells. Following recent pumping testing in 2009, both wells have been shown to have potential flow capabilities of 300-400 gallons per minute (GPM), a similar low percentage of total drawdown (5+%) and a specific capacity of 10-12 gallons per foot of drawdown. These wells formed the basis for the commencement of a 2009 drilling program in order to expand the ground water supplies available for future ranch development.

The third well, located near the ranch house and barns, was again drilled by Ron Taylor but only to 185 feet, as artesian flow was experienced. In order to prevent a hole collapse and potential damage to the rig from surface liquefaction, a 12 inch conductor pipe was run and cemented to a depth of 130 feet. A screened (perforated) interval from 30 to 185 feet within the 8 inch PVC casing was placed in the borehole and gravel packed with Monterey sand. The estimated yield for this well in air jet testing after the completion was 400 GPM, but no specific testing phase was performed and no electric log was run.

Consequently, the well was tested in September of 2009 utilizing the existing downhole submersible pump. With the pump set at an estimated depth of 175-180 feet, the well was tested at a flowrate of 150 GPM for 8 hours. The stabilized pumping level was at a depth of 55 feet for the duration of the test period and the static level was at the surface, since the well still exhibits artesian flow. While the well is capable of producing at a higher rate (>150 gpm), it isn't necessary to change the downhole pump and increase production, as this well will be designated as the domestic water source and will serve the domestic water system for the ranch buildings and residences. A water sample was taken following the test period and analyzed at Creek Environmental Labs. The produced water from this well met all of the standards for potable (drinking) water as determined by the State Health Dept. with the exception of two minor constituents, manganese (Mn) and odor. Both of these items were retested in a second water sample collected on November 4, 2009, however the manganese levels still exceeded the State limits of 0.05 mg/l. Consequently, it is recommended that a green sand filter be installed on the downstream end of the domestic water storage in order to reduce the Mn concentration. It is also suggested that a third sample be taken after the well has been run and the water system is place for a period of time. The results of the testing and the water quality analyses can be located in the Appendix. The recent pump tests on the two existing ag wells are also included in the Appendix along with the drillers logs and the electric logs.

NEW WELL DRILLING & TESTING

NewAg Well #1

The first location, NewAg Well #1, to test for additional ground water supplies was staked north and west of existing ag well #2 (Figure 4). This test site was chosen in order to obtain data on whether the extent of the primary ground water aquifers was this far north on the ranch. Drilled to a total depth of 400 feet on June 2nd of 2009, this testhole penetrated a short Paso Robles section that was only 200 feet thickness and was likely low in water saturation. The underlying Careaga appeared to be clay-rich, with some intervals that were hard and/or cemented, as the drilling rate or rate of penetration was much slower than what would be expected for a permeable, water-bearing sand; i.e. possibly poor reservoir development. Additionally, the water quality was suspect from the appearance of the resisitivity curves on the electric log at the bottom of the hole. Consequently, it was decided to not run casing and complete the wellbore, and to move to the next location. A copy of this e-log is included in the Appendix of this report.

NewAg Well #2

The second new well, NewAg Well #2, was located near the ranch gate entrance, approximately 1000 feet south of existing ag well #1 (Figure 4). Drilled to a total depth of 455 feet on June 5th, new well #2 was completed with 12 inch, high strength PVC casing run to 450 feet. The screened or perforated interval in this well is from 100-450 feet with a 50 foot sanitary seal. An examination of the drill cuttings indicated a color change to typical blue or blue-grey Careaga sands at a depth of 250 feet, which seems to also correlate with a change in log character at a similar depth. It now appears from this new log and the associated cuttings that the Careaga

Sand (Formation) may begin at depths ranging from 130 feet (domestic well) to 310 feet (ex. ag well #1), depending on where one is located on the Four Deer Ranch.

A step-test was conducted on new well #2 after air jetting and clean-up the infiltration of drilling mud into the reservoir. A static level was measured at 40 feet below grade and submersible pump was set at approximately 300 feet. Tested at varying rate of 500 gpm, 750 gpm and 900 gpm, for two hours at each flow rate, the well exhibited strong aquifer characteristics. Drawdowns at the respective flow rates were 14 feet, 23 feet and 32 feet for the highest rate of 900 gpm. With a total potential drawdown of 260 feet, this well drew down during the step test only 12.3% of maximum capacity with the pump set at 300 feet. With Q = flowrate and S = drawdown in feet, the specific capacity (SC=Q/S=900/32) of this well test was 28 gallons per foot of drawdown; significantly better flow characteristics than the two existing ag wells with a SC of 10 gallons per foot.

In addition a water sample was taken at the end of the 6 hour test period and submitted to a certified lab for analysis. The produced water passed for all constituents involved with testing for potability except manganese (0.40 mg/l), which is commonly found in area ground samples at levels slightly above the State limit of 0.05 mg/l. Because this water will be dedicated to ag usage, there is no water quality issue. Overall, the quality of this water is excellent; with a salinity or TDS (total dissolved solids) level of 430 mg/l (ppm), no nitrates or nitrites and a low hardness of 190 mg/l. A copy of the water quality analysis, as well as the drillers report and the e-log, is located in the Appendix.

NewAg Well #3

Following the completion of NewAg Well #2, the rig was moved to the next location, which was on the north end of the ranch approximately halfway between ExAg Well #1 and ExAg Well #2 (Figure 4). Drilled to a total depth of 515 feet and completed with 12 inch PVC casing to 440 feet on June 22, 2009, NewAg Well #3 was plugged back from 515 feet to 440 feet due to the concern over the penetration of very fine grained Careaga sands in the lower 60-70 feet of the well, which in a high flow rate ag well can pass through the Monterey gravel pack into the casing over time and cause damage to the downhole pump. Consequently, the decision was made to leave the bottom of the hole below the cased interval. The screened or perforated interval in this well is from 100-440 feet with a 50 foot cement sanitary seal.

After several days of air jetting and surging this well in order to flush as much of the drilling mud out of the aquifer as possible, a static water level was measured at 63 feet below grade. A step test was performed on this well in July of 2009 utilizing three different flow rates of 400 gpm, 600 gpm and 750 gpm. The corresponding drawdowns and stabilized pumping levels were 12 feet of drawdown with a pumping level of 75 feet at a rate of 400 gpm, 28 feet of drawdown with a pumping level of 91 feet for 600 gpm, and a drawdown of 46 feet with a pumping level of 109 feet for 750 gpm of production.

With a total potential drawdown of 237 feet, this well drew down during the step test only 19.4% of maximum capacity with the pump set at 300 feet. The specific capacity (SC=Q/S=750/46) of this well test was 16 gallons per foot of drawdown, less than NewAg Well #2, but still better flow characteristics than the two existing ag wells with a SC of 10 gallons per foot. No sample of the produced water was taken during the step test, since a water analysis was conducted on NewAg Well #2. A copy of the well drillers report and the e-log is included in the Appendix.

NewAg Well #4

The final testhole to be drilled was located further south on the ranch approximately halfway between NewAg Well #2 and the existing Domestic Well, and nearly 2000 feet south-southeast of NewAg Well #3 (Figure 4). NewAg Well #4 was drilled to a total depth of 622 feet, but was completed with 12 inch PVC casing to 490 feet. Similar to NewAg Well #3, this current well had an abundance of very fine sand in the lower 100+ feet of the hole, based on the examination of drill cutting and the electric log. Consequently, the decision was made to complete the well at 490 feet. The screened or perforated interval was 100-480 feet with Monterey gravel pack and 10 feet of blank pipe placed on bottom along with a 25 foot sanitary seal on top.

Following well clean-up and surging, a step test program was started using flow rate of 600 gpm, 750 gpm and 900 gpm, based on the amount of water recovered during air jetting and a static level only 10 feet from the surface. With the pump set at 300 feet the drawdowns were as follows: 73 feet @ 600 gpm, 100 feet @ 750 gpm, and 124 feet @ 900 gpm. It is interesting that the drawdowns were greater than those observed in the shallower NewAg Well #2, however it's likely that the inclusion of more fine grained Careaga in the completion of NewAg Well #4 may have contributed to the appearance of more water (with a higher static level and more water recovered during air jetting) than in the prior well. This very fine Careaga section added to the completion interval would also likely have lower permeability, thereby reducing the overall flow characteristics of the well as demonstrated in the step test.

With a total potential drawdown of 290 feet, this well drew down during the step test 43% of maximum capacity with the pump set at 300 feet. The specific capacity (SC=Q/S=900/124) of this well test was 7+ gallons per foot of drawdown, a lower SC than was observed in either of the existing wells or the prior two new wells. Again, this is likely attributable to the amount of

Lower Careaga interval included in the completion and that overall the Careaga Sand here is more fine grained than in the prior two wells. Because of this longer interval of finer grained Careaga, it is also possible that the mud infiltration or damage during the drilling will lessen or will clean -up more over time as the reservoir is produced.

A water sample was taken at the end of the 6 hour test period and submitted to a certified lab for analysis. The produced water passed for all constituents involved with testing for potability; i.e. drinking water standards. Overall, the quality of this water is excellent; with a salinity or TDS (total dissolved solids) level of 382 mg/l (ppm), no nitrates or nitrites, a low hardness of 180 mg/l and a Mn level within the allowable limits. A copy of the water quality analysis, as well as the drillers report and e-log, is located in the Appendix.

Estimated Ground Water Supply

An accurate estimate of the amount of ground water in storage is critical to the long term viability of any water supply. In addition the annual recharge to the area reservoirs (aquifers) is also important to proper maintenance and management of the ground water supply. Determining the ground water in storage for the Four Deer Ranch is made difficult, due to the lack of a sufficient amount of long term data concerning the existing water wells and their productivity over time. The recordation and review of crucial data such static levels, producing rates, producing volumes, and pumping levels over years of usage, are critical to a viable understanding of ground water in storage under the subject property.

With the water source originating from the Paso Robles and the Careaga sands and gravels, the term "storage unit" is used here to describe the subsurface extent of water-bearing sediments. These storage units are typically defined by differences in rock types, variations in water quality, changes in static water levels and/or differing responses to pumping. In the case of the Four Deer Ranch there are few differences in these characteristics from one area of the ranch to another and from one well to another. The key parameters required to determine the amount of water in storage are 1) the specific yield or storage coefficient, 2) reservoir thickness, and 3) the vertical and horizontal extent of the reservoir.

The **specific yield** is that part of the total volume of water-saturated reservoir that would drain to a wellbore under the influence of gravity and pressure drawdown, i.e. water extraction or pumping. Typically, the value of the specific yield for normal aquifer is on the order of 10-25%. For the coarse-grained, highly permeable reservoirs in the Paso Robles and Upper Careaga, the specific yield is at the high end of the range; likely 20-25%. It is assumed that the finer-grained sands of the Careaga in the study area may have lower specific yields of perhaps 15%.

The **reservoir thickness** for these water storage units is fairly easy to estimate with detailed description of sediment types in the drillers report, and electric logs in not only the water wells but in numerous oil wells that have been drilled on the property in the past.. The source of first water in all of the water wells typically only varies by 10 or 20 feet occurring within 50 feet of the surface. Most of the wells were drilled to depths greater than 400 feet and some to 600 feet, where full water saturation was observed to total depth. Several of the oil wells show water-bearing sediment to depths of 1000 feet or more. Consequently, a best case estimate for reservoir thickness is 700-900 feet over a majority of the ranch parcel.

The **lateral extent of the storage units (Paso & Careaga)** penetrated by the various water and oil wells is also not difficult to determine. Three factors indicate the existence of a very large storage unit for the local ground water, perhaps in the range of 800-1000 acres in lateral size; basically most of the ranch and likely beyond. One factor is the minimal water level drawdowns at high producing rates observed in three existing and three new well tests (typically less than 100 feet of drawdown at rates of 800-900 gpm). The second factor is the low number of dry testholes and/or low volume wells that have been drilled on the Four Deer Ranch. Based upon the data from the first testhole, NewAg #1, and the thinning of the Paso Robles and the Careaga on the northern 1/3 of the ranch, especially over the Solomon Anticline and the Four Deer Oil Field structural high, the extent of the storage unit changes quite a bit in this area of the ranch. The third indicator of the large size of the storage unit was the rapid recovery of the water level in each test following the cessation of pumping. Even though the duration of testing was relatively short, in each case the water level returned to static level observed at the beginning of the test indicating no effect on the overall area water table.

Therefore, using the estimates mentioned above for specific yield, reservoir thickness and storage unit size, one can calculate the expected range of water in storage around a given well or wells. These conservative results vary from 84,000 acre-feet to 225,000 acre-feet of water in storage under the Four Deer Ranch.

The rate of ground water recharge in the area of Four Deer Ranch is another critical factor for determining the long term viability of the local water supply. Data that is relevant to this issue include the following: 1) soil/sediment permeability for the material overlying the reservoir/storage unit, 2) the duration of time when recharge will occur, and 3) the actual response of the wells and storage unit(s) to rainfall infiltration. In examining the soil types for the properties in the Four Deer Ranch area there is a **range of soil permeabilities** commonly utilized from 0.15 to 0.35 gal/day/sq. ft. depending on the soil thicknesses overlying the storage unit and the type of soil, whether it be sandy, silty or clayey. Therefore, in the case of the Four Deer Ranch storage unit there is a minimal amount of surface soil horizon of 5 to 15 feet overlying the Paso Robles sands and in most areas of the ranch the Paso Robles sands outcrop (no soil cover), so a permeability value ranging from 0.30 - 0.40 gal/day/sq. ft. is used in this analysis.

The **duration of recharge** is based on a yearly average of 12 days of rainfall exceeding 1 inch with the duration of rainfall being 12 hours. Utilizing these parameters, the total average annual period of recharge due to rainfall is 6 days/year. Consequently, based upon the expected percentage (15-20%) of average annual rainfall (18-20 inches/year) the recharge rate is calculated to be 0.30 to 0.35 AFY/acre. However, due to the highly permeable sands present near surface in the Paso Robles outcrop areas, and the observed subsurface communication from the surrounding storage units to the east, south and west, this value for annual recharge is likely to be near the high end, perhaps as high as 0.40 AFY. For the estimated size (1000 - 1200 acres) of storage unit the annual recharge (0.35 AFY/ac) is calculated to range from 350 acre-feet/year (AFY) for a 1000 acre unit and 420 acre-feet/year (AFY) for a 1200 acre unit. If a higher recharge rate of 0.45 AFY/ac is utilized, the annual recharge to the area aquifers varies from 450 to 540 AFY. This total estimate of recharge or "safe yield" is basically a zero sum or balance between potential water infiltration annually versus potential water extraction. This calculation does not include any recharge from local streams, irrigation runoff or subsurface communication which could add significantly to the totals; increasing them by a factor of 40-50%. Obviously, the actual response of the wells over time to seasonal rains has yet to be measured at Four Deer Ranch, and is therefore not applicable to the calculation of annual recharge.

CONCLUSIONS

1. **Paso Robles Fm. vs Careaga Fm.**

   The distinction between the Paso Robles interval and the Careaga Sand became more clear following the drilling of four new wells; with three wells being completed. The examination of the drilling cuttings revealed a change in color (brown to blue and/or gray) from the Paso Robles to the Careaga marking the change from non-marine deposits to marine deposits. In addition a change also occurs in the relative levels of the gamma ray (GR) and SP curves with the Careaga exhibiting a higher GR level and a less well-developed (+) SP curve.

   After drilling four new wells beginning in June of 2009, it became apparent that the Paso Robles section was thinner than first thought and the Careaga Formation was being penetrated in all of the wells as early as 250 feet. This has resulted in a re-interpretation of the thickness map for the Paso Robles interval and the rework of the regional geologic cross section (Appendix).

2. **Water Potential in the Existing Wells**
   After a comparison was made between the limited test results in the existing wells and the test results in the new wells, it became apparent that the existing wells have the potential to produce water at rates approaching 400-500 gallons per minute (gpm). The primary limiting factor besides the size of the existing downhole pumps in these wells was the diameter of the casing. Eight (8") inch PVC casing was run in each of the three existing wells versus a larger diameter twelve (12") inch casing run in the new wells, creating more surface area exposed to the aquifers and therefore more production capacity. However, the capacity of the domestic well is purposely restricted due to the artesian effect present in this well and a failure to run the casing beyond 185 feet.

3. **Water Potential in the New Wells**
   With the exception of the first new well, which was plugged and abandoned due to the lack of a thick permeable sand interval, each of the newly completed wells is capable of producing at rates in excess of 800 gpm with minimal drawdowns. The completions in each of the three new wells included approximately 150-200 feet of water- bearing Paso Robles sands and 250-350 feet of saturated Careaga Sand. In NewAg #2 and #3, the Careaga Sand grain size in the upper 150-200 feet of the sand zone was comprised of coarser sands and some gravel beds. This was an huge improvement over the normal Careaga section in the Los Alamos Area, where the interval is dominated by very fine, almost flower sand. Consequently, the improved reservoir characteristics in the Careaga in these wells resulted specific capacities of 18 to 28 gallons per foot of drawdown and high transmissivities or permeabilities. These high capacities are reflected in the high producing rates over 800 gpm with minimal drawdowns of only 35-45 feet. During the testing of these wells, the following observations were made:

   A. High static water levels

   B. The observed percentage of total possible drawdown is low.

   C. The wells all stabilized (stable pumping depth) within 15 minutes of pumping, regardless of flow rate.

   D. Rapid recovery in the fluid level after the cessation of pumping to the originally observed static level.

All of the above-mentioned factors point to a series of aquifers, which have a significant amount of water in storage and appears to have been minimally affected by the recent three years of low rainfall and drought conditions. However, the only exception to the reservoir conditions listed above is the fourth well, NewAg #4. This well had the longest drilled interval in the Careaga and is characterized by a more normal Careaga section including more very fine grained sand in the bottom of the completed interval than in the other wells. Even with that, the bottom 160 feet of Careaga was excluded from the completion in NewAg #4, due to a concern over very fine sand eventually finding its way past the gravel pack and into the wellbore, thereby shortening the life of the submersible pump or bowels, and the well itself.

4. **Water Quality**

The water quality for the ground water being extracted by all of the wells on the Hunter Four Deer Ranch is excellent. Particularly in comparison to the normal water quality observed in the various ground water basins to the north and south of the Los Alamos or San Antonio Basin. Typically in ground water areas of Santa Barbara and San Luis Obispo Counties the total dissolved solids (TDS) or salinity of the water varies from 750-900 ppm, hardness levels are 300-400 mg/l, and chlorides, calcium, sodium and iron are at high levels. The TDS of the ground water underlying the Four Deer Ranch is 350-450 ppm, the hardness is 180-190 mg/l, chlorides, calcium and sodium are less than 100 mg/l and iron is low. This water is suitable for domestic (drinking water) uses as well as agricultural applications of all kinds; row crops, vineyards, trees, etc.

5. **Artesian Conditions**

As was discussed in the initial ground water study for the Four Deer Ranch, the existence of artesian flow in the southern areas of the ranch, as well as the north ½ of the neighboring parcel (Schaff) to the south, was cause for concern in the drilling of any new wells. While the domestic well (shallow well) near the old barns experienced hole collapse and water and sand flow after drilling to a depth of 345 feet, the well was completed to a shallower depth of 185 feet with 8" PVC casing. Unfortunately, several drilling and completion attempts on the Schaff property to south resulted in the total loss of at least 3 boreholes that we are aware of, but depths approaching 400 feet. Through further correlation work and the successful drilling of new wells on both the Four Deer Ranch and the Schaff parcel, it appears as though the artesian phenomena in this area is confined to the middle of Las Flores Canyon. Unlike the prior interpretation of the artesian flow originating from a sand within the basal interval of the Paso Robles, the new log correlation indicates the pressurized section of aquifer is likely within the

Careaga. In addition the appearance of a minor odor of H2S or rotten egg smell in the water from the domestic wells also points to the older underlying Careaga sands, as the gas normally migrates from the older underlying rocks into the Careaga. Locally there likely exists an internal clay bed confining the water and preventing upward flow and communication with the Upper Careaga and the Lower (basal) Paso Robles reservoir sands. It has also been noted that the first new drilling location penetrated low permeability, clay rich, sediments near the base of the Paso Robles and top of the Careaga. This may possibly be the type of confining bed above the pressurized zone that creates the condition of artesian flow. Consequently, precautions were taken when drilling the new wells on the ranch in order to prevent any drilling stoppage at all from depths from 200 to 400 feet. This interval was drilled continuously without stopping, mud weights were raised slightly and each well's Careaga interval was drilled and completed in the same day, minimizes the chance of uncontrolled water and sand flow.

6. Estimated Ground Water Supply

Underlying the Four Deer Ranch is two primary aquifers, the Paso Robles and the Careaga, both of which are typically highly permeable and nearly fully saturated. The depths to the basal sand interval in the Careaga varies on the ranch from 800 to 1400 feet. With this length of saturation the following is assumed from study of other areas on the calculation of the water supply in place:

➔ The specific yield or storage coefficient ranges between 15 and 25%, average 20%.

➔ The average thickness of the saturated section is 700 to 900 feet, average 800 feet.

➔ The lateral extent of this reservoir thickness is estimated at 1000-1200 acres. Therefore, the estimate of the water supply in storage under the Four Deer Ranch is approximately 150,000 acre-feet (AF).

➔ For the purpose of estimating the amount and rate of annual recharge to the primary aquifers under the subject ranch, assumptions for sediment permeability (0.35 gals/day/sq. ft.), annual rainfall (15-20 inches), and duration of recharge (6 days) are utilized to determine a range in the recharge rate of 0.30 AFY/ac to 0.35AFY/ac, however surface geologic conditions may push this value to as high as 0.45 AFY/acre. This rate is consistent with the rates of recharge utilized for several ground water basins along the Central Coast. Consequently, the annual recharge or "safe yield" available to the Four Deer Ranch is estimated at 350-540 AFY. Or put another way, in a normal rainfall year, 540 AFY of ground water could be extracted from the ranch water wells and would be replenished by rainfall infiltration and subsurface communication without creating an overdraft condition.

This ground water report was prepared by:

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STATE OF CALIFORNIA

Date: NOVEMBER 30, 2009

APPENDIX

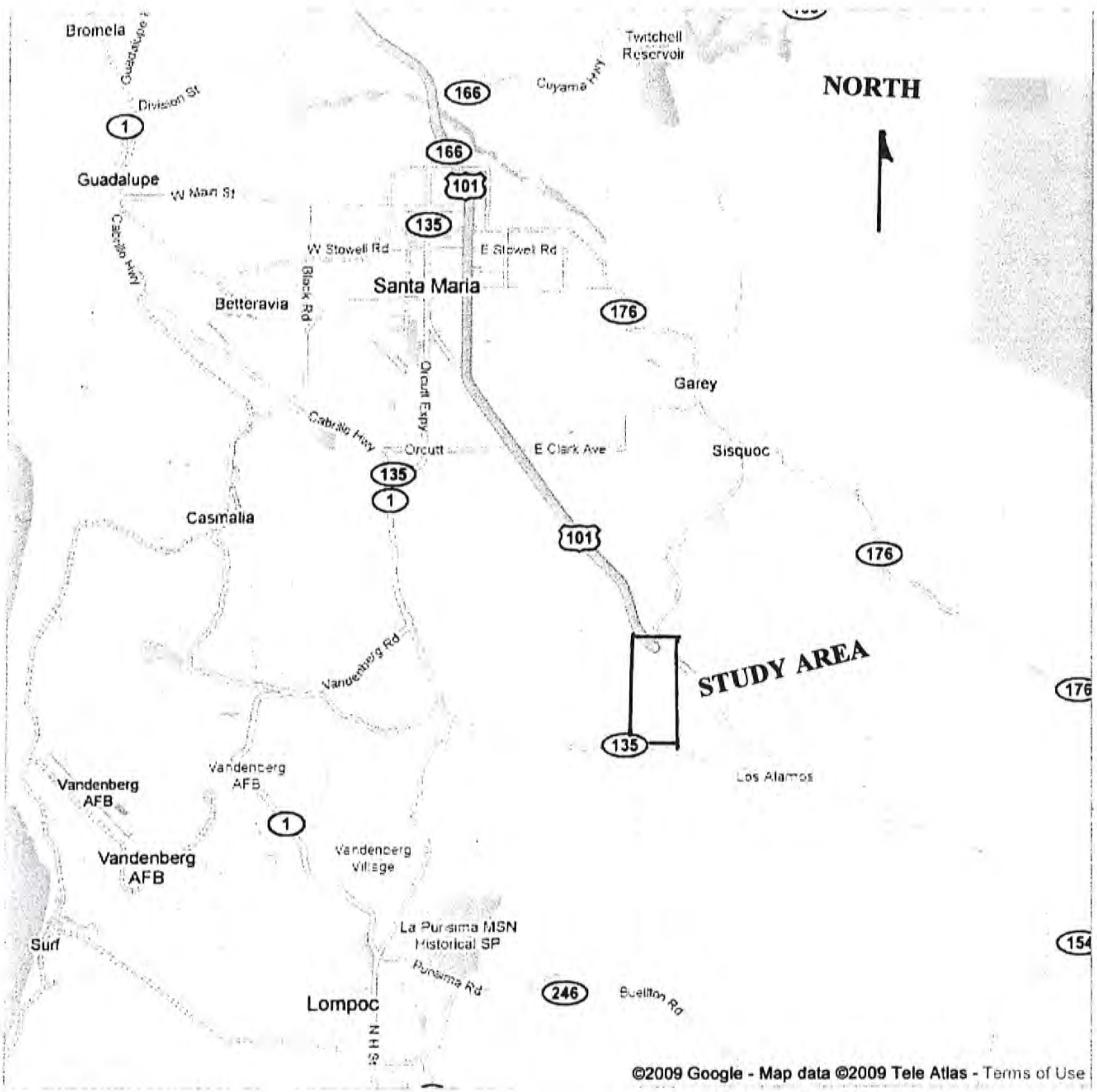


FIGURE 1
LOCATION MAP

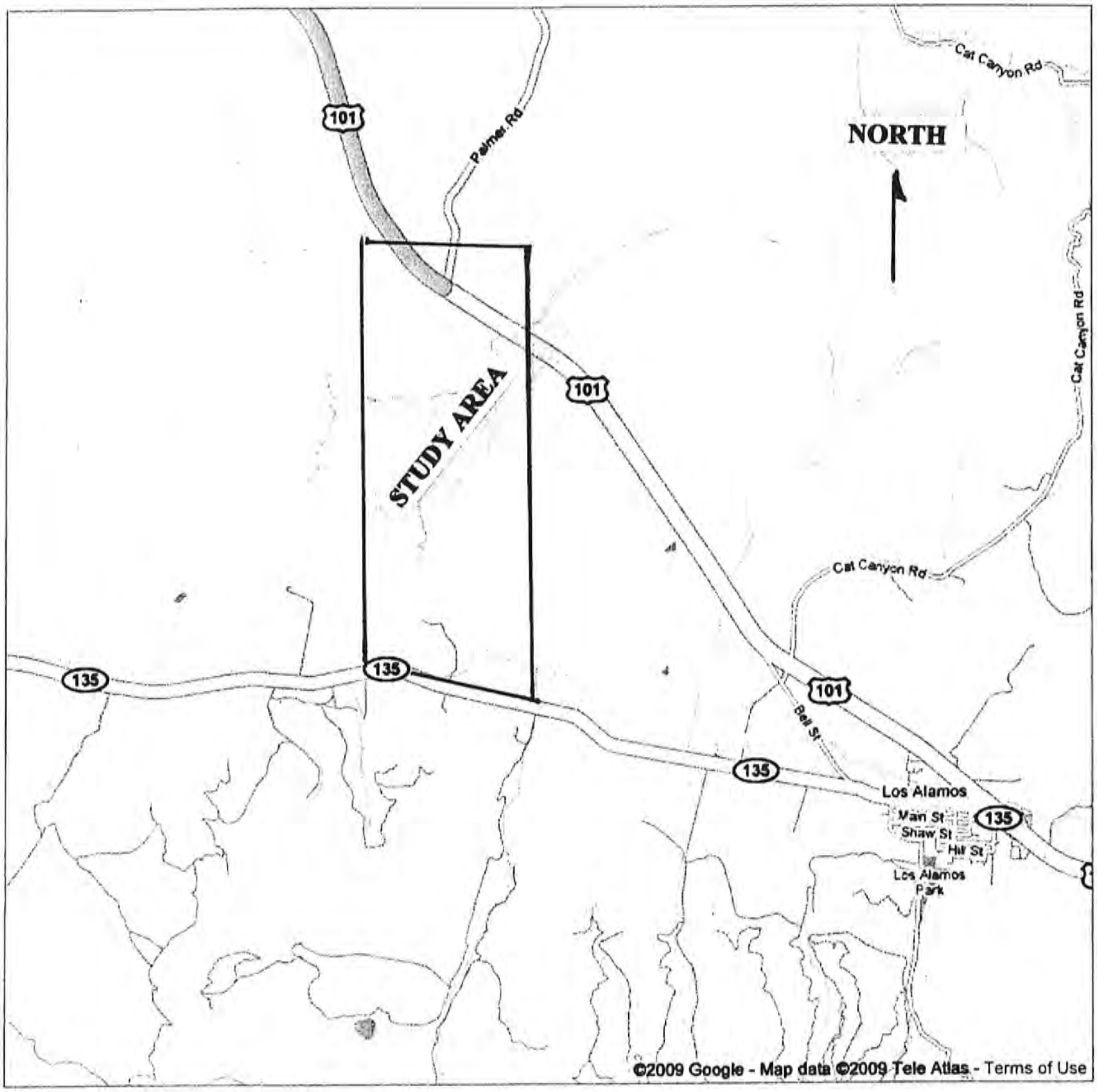


FIGURE 2
LOCATION MAP

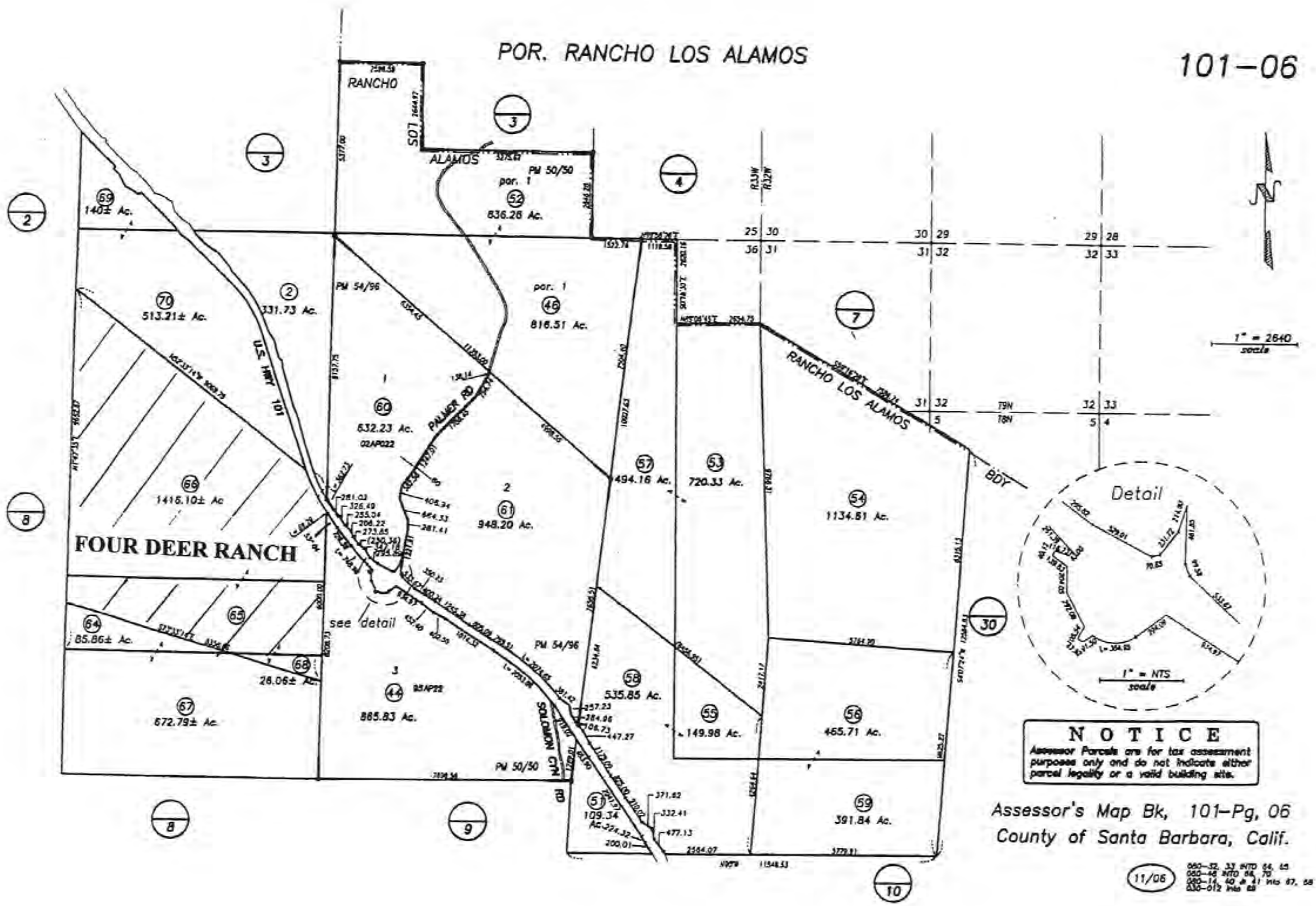


FIGURE 3
PARCEL MAP

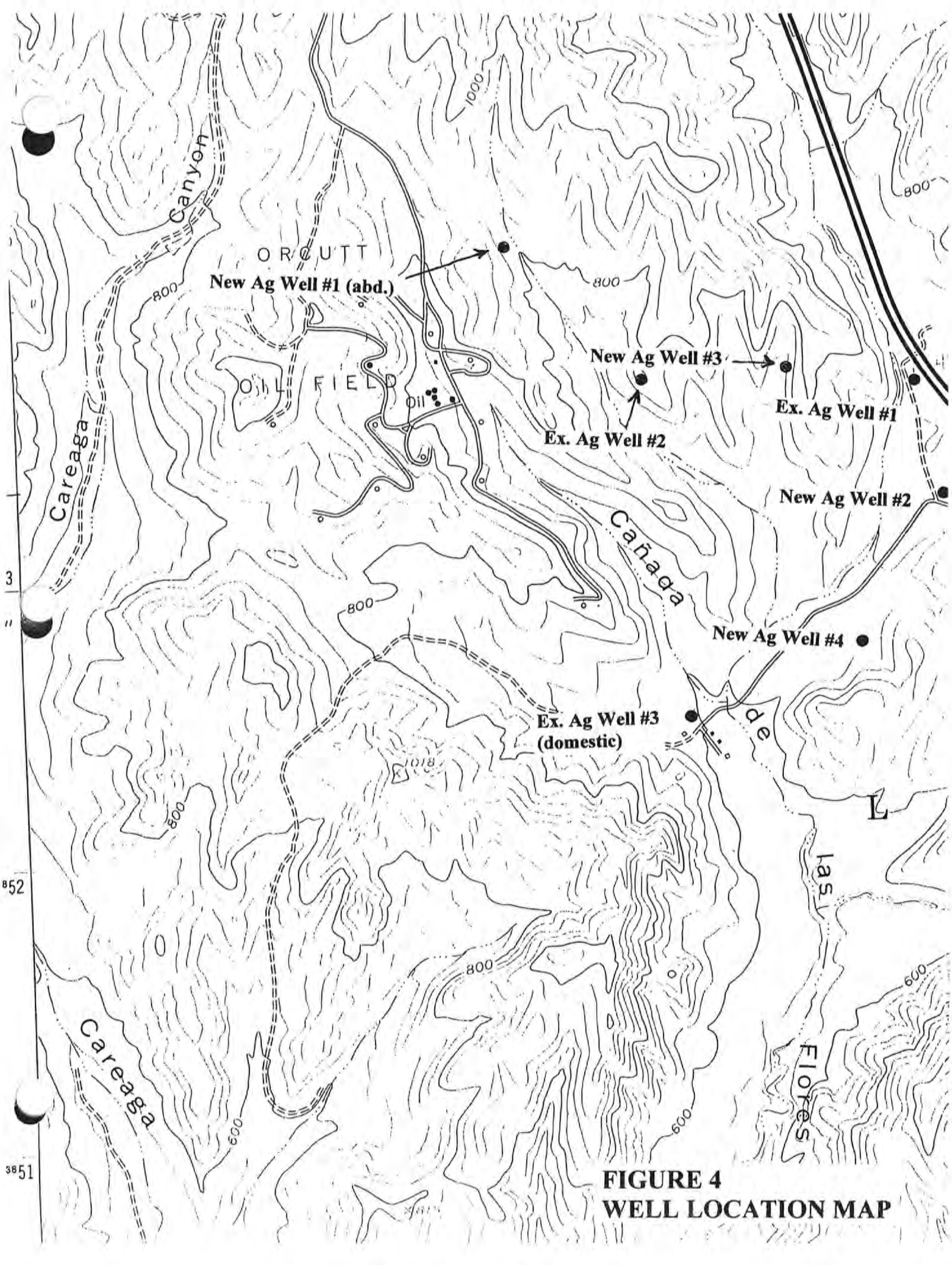


FIGURE 4
WELL LOCATION MAP

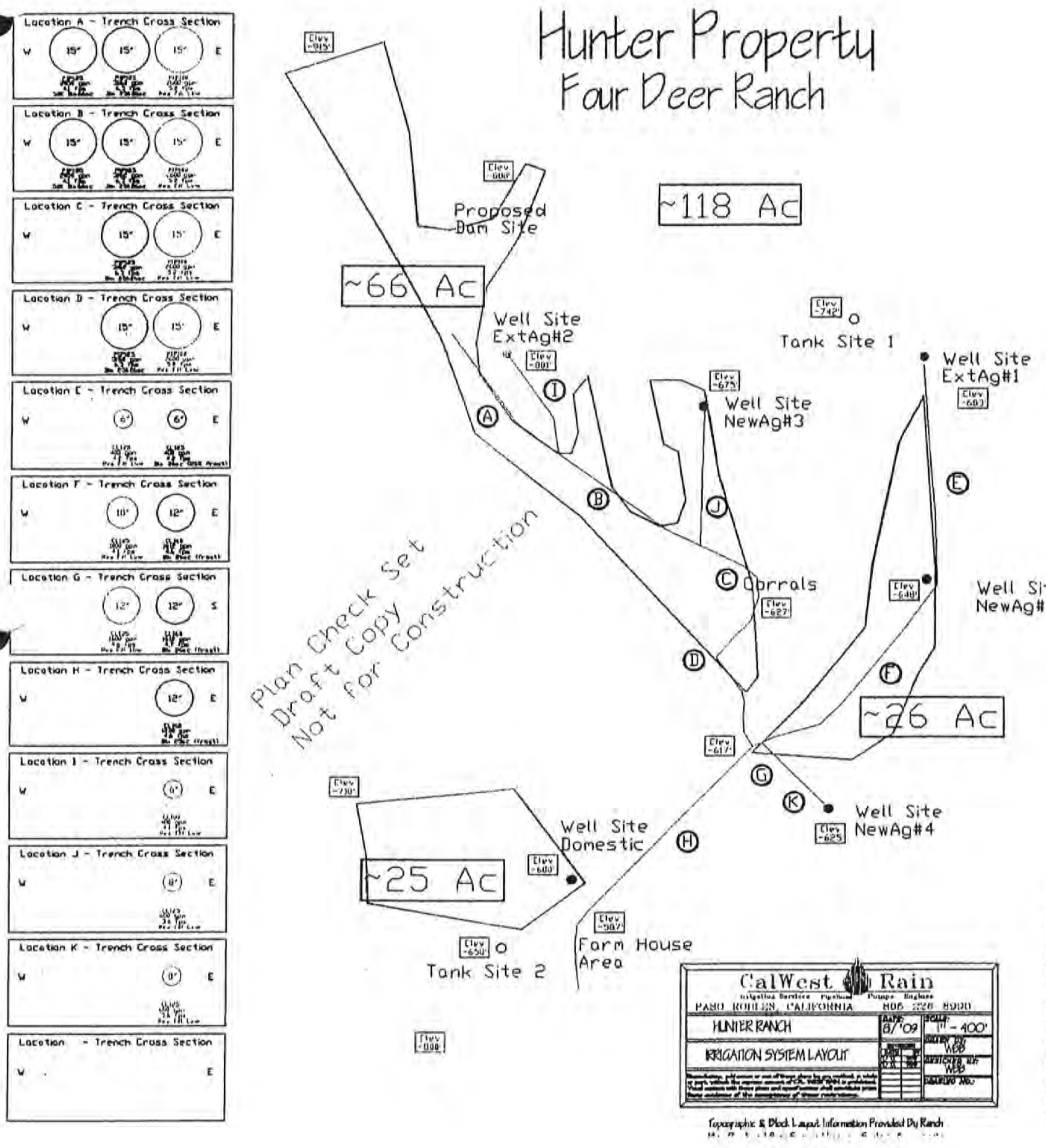


FIGURE 5
WELL/PIPELINE SCHEMATIC

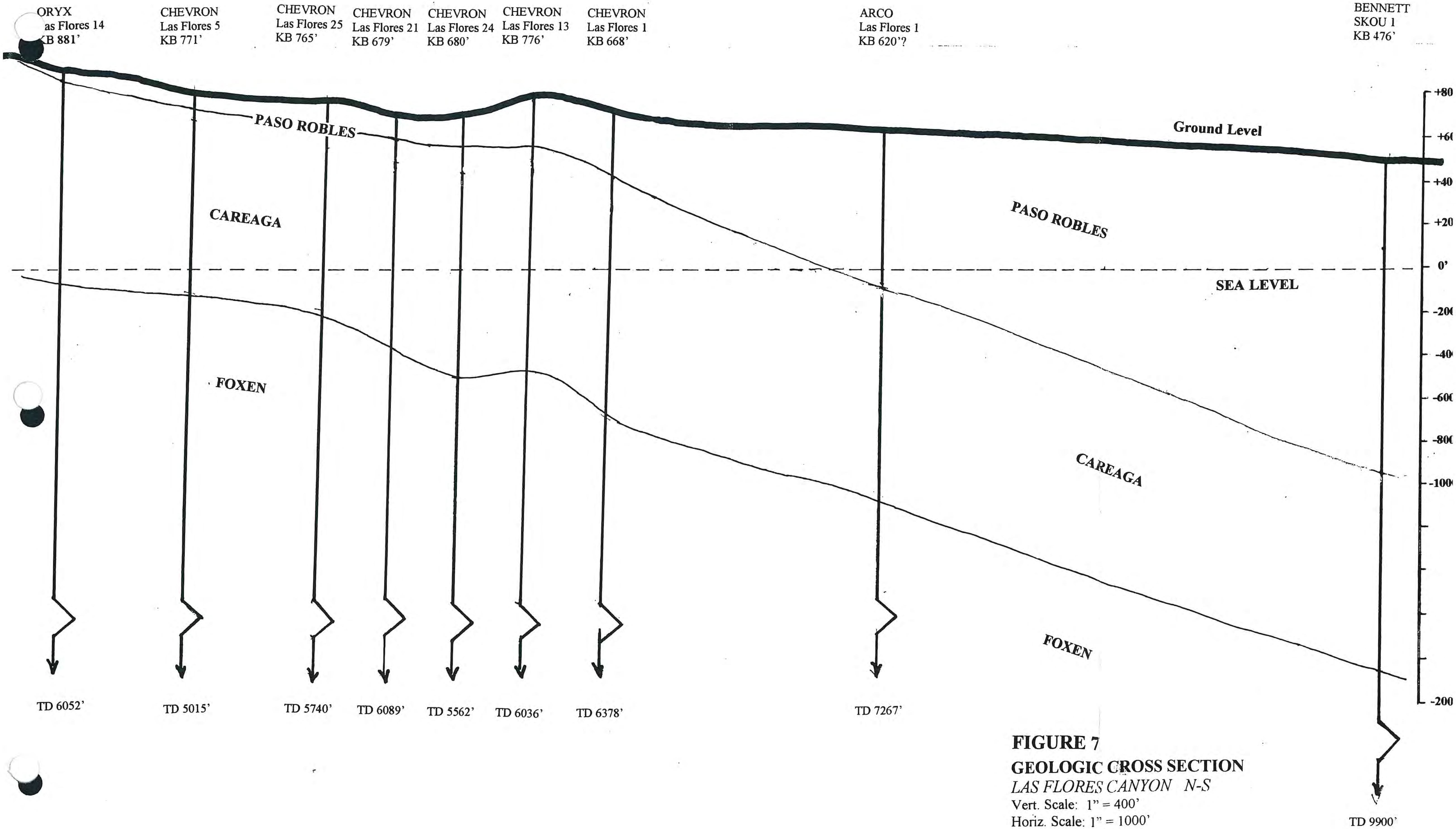


FIGURE 7
GEOLOGIC CROSS SECTION
LAS FLORES CANYON N-S
Vert. Scale: 1" = 400'
Horiz. Scale: 1" = 1000'
3/09 C. Katherman

SISQUOC QUADRANGLE

LEGEND

Qg / Qa

SURFICIAL SEDIMENTS

Qg *gravel and sand of Sisquoc River*
Qa *alluvial gravel, sand and clay of valleys and flood plains, in places dissected by active streams*

Qls

LANDSLIDE DEBRIS

Qoa | Qos | Qo

OLDER DISSECTED SURFICIAL SEDIMENTS

remnants of weakly consolidated older alluvial sediments, much dissected
Qoa *alluvial gravel and sand; undivided in this quadrangle*
Qos *wind-deposited sand (may be part of Qo)*
Qo *Orcutt Sand: tan to rusty brown wind-deposited sand, locally pebbly at base*

—UNCONFORMITY—

QTp / QTps

PASO ROBLES FORMATION

weakly consolidated valley alluvial sediments deposited by streams that drained from rising San Rafael Mountains; Pleistocene and latest Pliocene(?) age
QTps *light gray to tan pebbly sand*
QTp *light gray conglomerate or gravel composed mostly of pebbles of white siliceous shale of Monterey Shale in sandy to clayey matrix, crudely to cross-bedded; includes some greenish gray pebbly claystone;* ⊥⊥⊥⊥⊥ *= marly limestone bed, gray-white, hard, impure, of lacustrine origin*

Tcag | Tcac | Tca

CAREAGA SANDSTONE
(of Woodring and Bramlette 1950)

shallow marine clastic, transgressive and regressive; weakly indurated; late Pliocene age
Tcag *Graciosa Member: massive gray-white to tan sandstone or sand; in part nonmarine and wind-deposited; locally pebbly at base*
Tcac *Cebada Member: massive tan to yellow, soft, fine grained sandstone or sand, locally contains small marine shell fragments*
Tca *undifferentiated Careaga Sandstone*

UNCONFORMITY in subsurface

Tf

FOXEN CLAYSTONE
(of Woodring and Bramlette 1950)

in subsurface only; marine clastic; Pliocene age
Tf *dark gray soft claystone; 900-1200 ft. thick*

Tsqd | Tsq | Tsqs

SISQUOC FORMATION

marine clastic-biogenic; late Miocene - early Pliocene age

on surface:
Tsqd *light gray diatomaceous silty claystone, massive to vaguely bedded, weakly indurated, coherent but closely fractured, crumbly where weathered; at surface, 2500-3800 ft. thick thinning northeastward; includes minor fine grained sandstone*

in subsurface:
Sisquoc formation 2500-3000 ft thick, thinning northeastward, composed of:
Tsq *massive, soft but coherent, impervious diatomaceous claystone throuh gray silty claystone to sandy siltstone*
Tsqs *soft gray sandy siltstone to fine grained massive sandstone*

UNCONFORMITY in subsurface
(in northeastern area)

Tm

MONTEREY SHALE

exposed only near northeast corner, elsewhere only in subsurface; marine biogenic; late and middle Miocene age
Tm *thin bedded hard siliceous shale, dark brown to black (from hydrocarbon impregnation), in part brittle, cherty, oil-bearing where closely fractured, lowest part may be age equivalent of Point Sal Formation (Woodring and Bramlette 1950), 2000-3000 ft. thick in this quadrangle*

Tot?

OBISPO TUFF(?)
(Obispo Formation(?) of Hall and Corbató 1967)

mostly volcanic rocks; (in subsurface only in Continental Oil Company McNee No. 4 well, Olivera Canyon area [see cross-section C-D]); middle Miocene age
Tot *tuff, dark gray massive moderately hard, coherent, impervious, fine grained, contains cycle calcite veinlets, includes tuff breccia ("agglomerate"), one basaltic layer, dark shale, rare thin carbonate layers, undifferentiated*

-UNCONFORMITY-

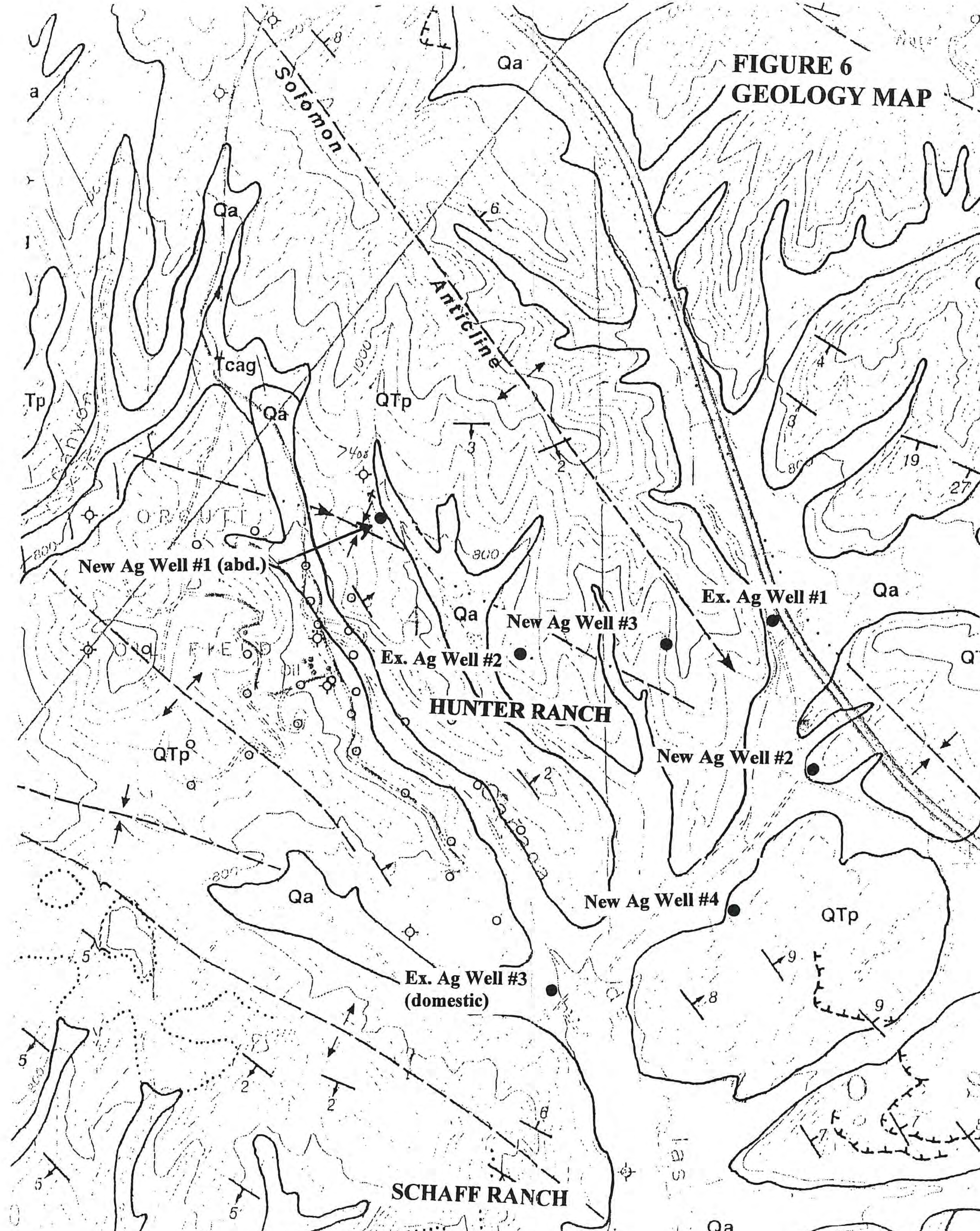
f

"BASEMENT COMPLEX"

in subsurface only, below Miocene formations; mainly Franciscan Assemblage rocks, ultramafic igneous rocks, and remnants of late Mesozoic sedimentary rocks; structure unknown

Holocene — Pleistocene — Pliocene — Miocene

FIGURE 6
GEOLOGY MAP



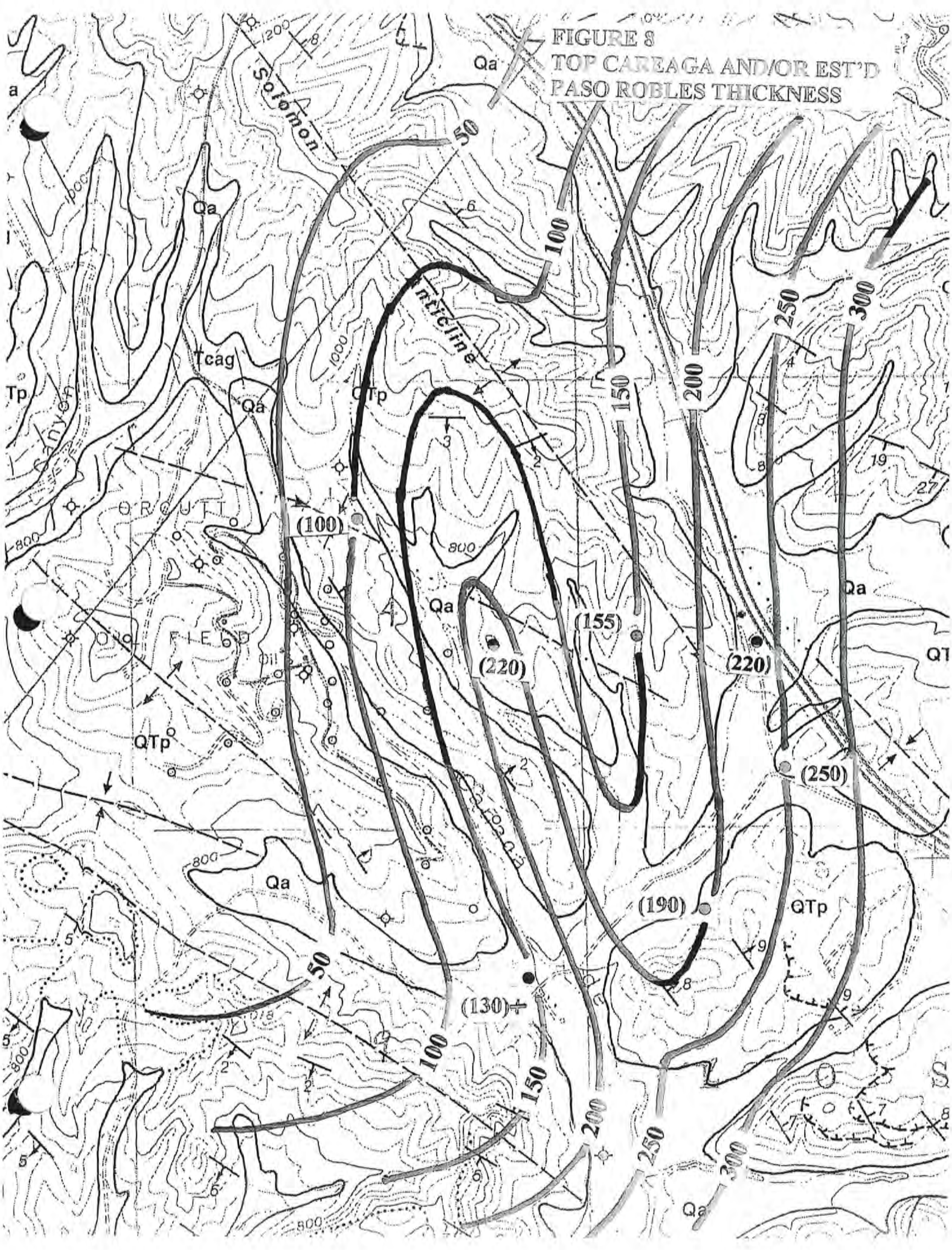


FIGURE 8
TOP CAREAGA AND/OR EST'D
PASO ROBLES THICKNESS
Solomon Anticline
ORCUTT OIL FIELD
Qa
QTp
Tcag
Tp
Canyon
50
100
150
200
250
300
(100)
(155)
(220)
(220)
(250)
(190)
(130)
1200
1000
800

New Ag Well #2

LOG SCALE
1" = 40'

PASO ROBLES

CAREAGA

welenco

5201 Woodmere Drive, Bakersfield, CA 93313– www.welenco.com–(800) 445-9914
California Contractor's License No. 722373

ELECTRIC - GAMMA RAY - TEMPERATURE LOG

FILING NO.

COMPANY: Taylor Drilling & Pump
WELL: Hunter #2
FIELD: Santa Maria
STATE: California COUNTY: Santa Barbara

LOCATION: Approx. .5 Mi. W. of Palmer Rd. and Hwy. 101

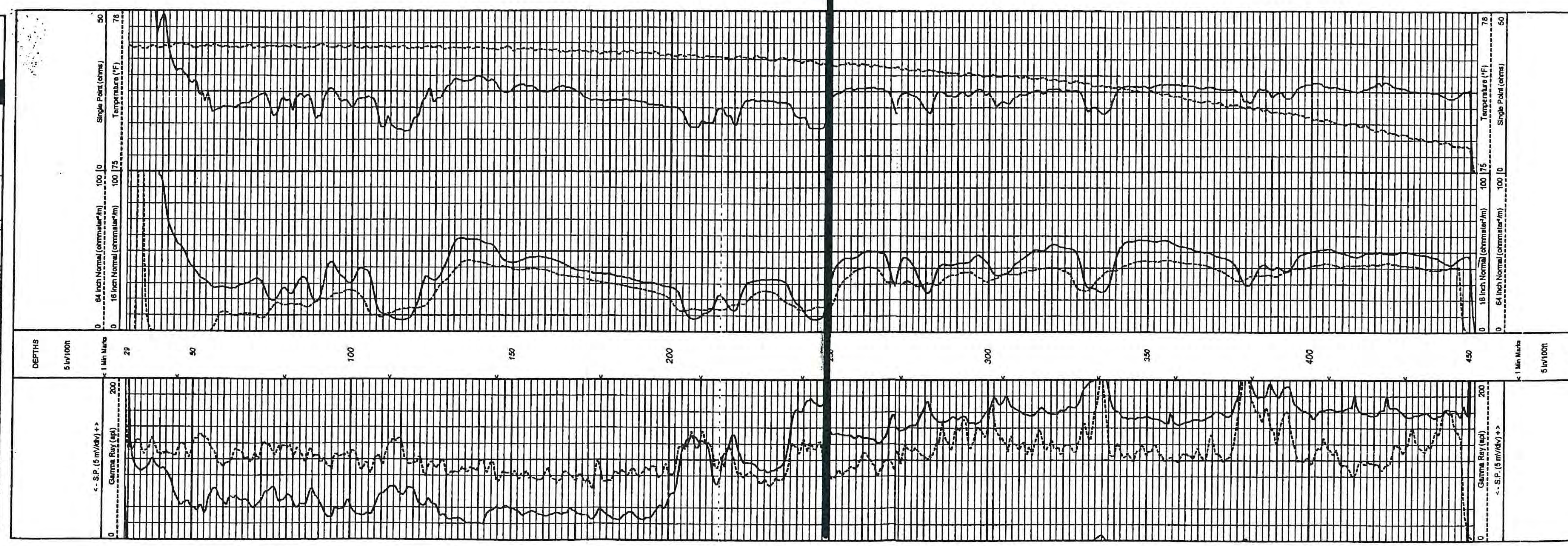
OTHER SERVICES:

JOB NO. 10311

SEC: 4 TWP: 8N RGE: 33W LAT.: 34° 47' 40.8" LONG.: 120° 28' 22.2" MERIDIAN: San Bernardino

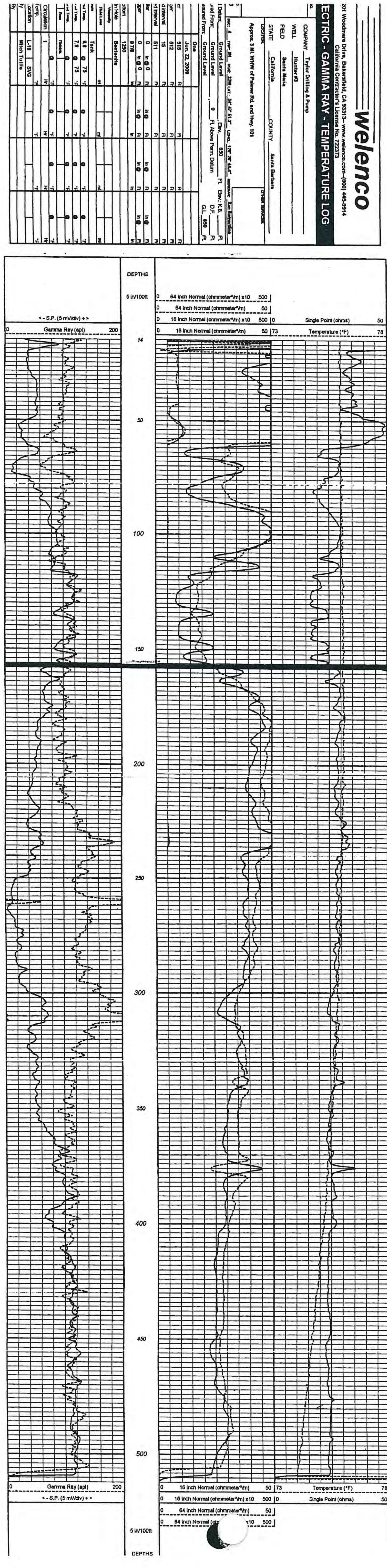
Permanent Datum: Ground Level, Elev. ____ Ft. Elev.: K.B. ____ Ft.
Log Measured From: Ground Level, 0 Ft. Above Perm. Datum D.F. ____ Ft.
Drilling Measured From: Ground Level G.L. ____ Ft.

Run	One			
Date	Jun. 05, 2009			
Depth-Driller	455 Ft	Ft	Ft	Ft
Depth-Logger	452 Ft	Ft	Ft	Ft
Top Logged Interval	30 Ft	Ft	Ft	Ft
Btm. Logged Interval	452 Ft	Ft	Ft	Ft
Casing-Driller	0 In @ 0 Ft	In @ Ft	In @ Ft	In @ Ft
Casing-Logger	0 In @ 0 Ft	In @ Ft	In @ Ft	In @ Ft
Bit Size	9 7/8 In	In	In	In
Time On Bottom	1650			
Type Fluid In Hole	Bentonite			
Density / Viscosity				
pH / Fluid Loss	ml	ml	ml	ml
Source of Sample	Tank			
Rm @ Measured Temp.	8.1 @ 75 °F	@ °F	@ °F	@ °F
Rmf @ Measured Temp.	4.9 @ 75 °F	@ °F	@ °F	@ °F
Rmc @ Measured Temp.	@ °F	@ °F	@ °F	@ °F
Source Rmf / Rmc	meas.			
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circulation	1 Hr	Hr	Hr	Hr
Max. Rec. Temp.	77.3 °F	°F	°F	°F
Van No. / Location	L-18 / SVG			
Recorded By	Mitch Tullie			
Witnessed By				



New Ag Well #3

LOG SCALE
1" = 40'



PASO ROBLES

CAREAGA

MISSING NEW AG WELL #1

WELL DRILLERS REPORTS

Page ___ of ___

Owner's Well No. Ex. Ag Well #1

Date Work Began 12/16/99, Ended 12/23/99

Local Permit Agency ______

Permit No. ______ Permit Date ______

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 715604

STATE WELL NO./STATION NO. ______

LATITUDE ______ LONGITUDE ______

APN/TRS/OTHER ______

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD ______ FLUID ______

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	9	Sand and gravel
9	65	Brown clay
65	123	Fine brown sand
123	214	Brown clay
214	243	Brown sand
243	254	Blue sand and gravel
254	310	Brown sand and gravel
310	461	Blue sand

TOTAL DEPTH OF BORING 462 (Feet)

TOTAL DEPTH OF COMPLETED WELL 460 (Feet)

WELL OWNER

Name Thompson and Chevron

Mailing Address Prell Road

CITY ______ STATE ______ ZIP ______

WELL LOCATION

Address Palmer Rd.

City Santa Maria Ca. 93455

County Santa Barbara

APN Book ______ Page ______ Parcel ______

Township ______ Range ______ Section ______

Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WEST

LOCATION SKETCH

NORTH

WEST / EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

___ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___

TEST WELL ___

CATHODIC PROTECTION ___

HEAT EXCHANGE ___

DIRECT PUSH ___

INJECTION ___

VAPOR EXTRACTION ___

SPARGING ___

REMEDIATION ___

OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 57 (Ft.) & DATE MEASURED 12/27/99

ESTIMATED YIELD * 300 (GPM) & TEST TYPE pump

TEST LENGTH 20 (Hrs.) TOTAL DRAWDOWN 60 (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	240	15	X				PVC	8		
240	460			X			PVC	8		40

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	X			
					none

ATTACHMENTS (✓)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2801 Mallory Santa Maria Calif. 93455
ADDRESS CITY STATE ZIP

Signed Ron Taylor
WELL DRILLER/AUTHORIZED REPRESENTATIVE

5-30 00
DATE SIGNED

523858
C-57 LICENSE NUMBER

DWR 188 REV. 11/97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

File with DWR

Page ___ of ___

Owner's Well No. Ex Ag Well #2

Date Work Began 7/15/00, Ended ______

Local Permit Agency ______

Permit No. ______ Permit Date ______

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 812775

STATE WELL NO./STATION NO. ______

LATITUDE ______ LONGITUDE ______

APN/TRS/OTHER ______

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	52	Gray Clay
52	197	Fine Brown Sand
197	255	Coarse Gray Sand
255	290	Brown Sand
290	351	Dark Gray Sand
351	460	Gray Sand with Seashells

TOTAL DEPTH OF BORING 463 (Feet)

TOTAL DEPTH OF COMPLETED WELL 455 (Feet)

WELL OWNER

Name Thompson & Chevron

Mailing Address ______

Santa Maria, CA 93455

CITY STATE ZIP

WELL LOCATION

Address 7000 Palmer Rd.

City Los Alamos, CA

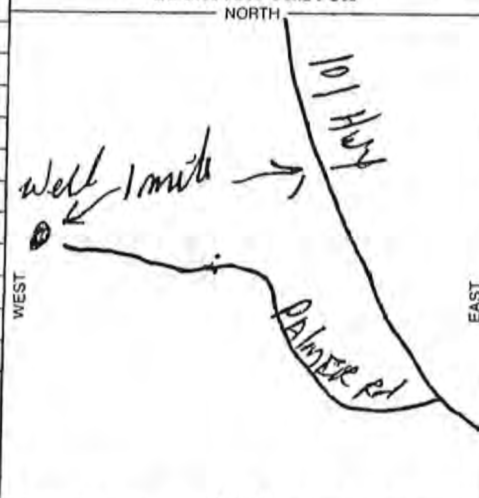
County ______

APN Book ______ Page ______ Parcel ______

Township ______ Range ______ Section ______

Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WEST

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ______ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ______ (Ft.) & DATE MEASURED ______

ESTIMATED YIELD * 300 (GPM) & TEST TYPE pump

TEST LENGTH ______ (Hrs.) TOTAL DRAWDOWN ______ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	220	15	X				PVC	8		
220	460			X			PVC	8		040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	35	X			
					monterey

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ______

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Val Taylor Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2801 Mahoney Rd Santa Maria Calif
CITY STATE ZIP

Signed ______ 7-26-05
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

File with DWR

Page ___ of ___

Owner's Well No. Ex Ag Well 3 (Domestic)

Date Work Began 7/24/00, Ended ___

Local Permit Agency ___

Permit No. ___ Permit Date ___

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 812774

DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE / LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain size, color, etc.
0	2	Brown Dirt
2	9	Brown Clay
9	20	Sand & Gravel
20	31	Brown Clay
31	45	Sand & Gravel
45	67	Fine Gray Sand
67	85	Green Fine Sand
85	102	Green Clay
102	130	Fine Green Sand
130	155	Blue Sand
155	159	Blue Clay
159	217	Blue Sand
217	220	Blue Clay
220	340	Blue Sand

TOTAL DEPTH OF BORING 345 (Feet)

TOTAL DEPTH OF COMPLETED WELL 175 (Feet)

WELL OWNER

Name Chevron & WZ9

Mailing Address ___

CITY ___ STATE ___ ZIP ___

WELL LOCATION

Address 7000 Palmer Rd.

City Los Alamos, CA

County ___

APN Book ___ Page ___ Parcel ___

Township ___ Range ___ Section ___

Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

___ NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
___ Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL ___ (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * 400 (GPM) & TEST TYPE pump

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	30		x				PVC	8		
30	185			x			PVC	8		032
0	130				x					

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
					mont. rey
		x			

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2801 Mahoney Rd CITY Santa Maria STATE CA ZIP ___

Signed Ron Taylor WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED ___ C-57 LICENSE NUMBER ___

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Owner's Copy

Page ___ of ___

Owner's Well No. New Ag Well # 2

Date Work Began 6-04-09, Ended 7-20-09

Local Permit Agency Santa Barbara Co

Permit No. SR-0106424 Permit Date 5-28-09

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1082560

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	10	Brown Clay
10	20	Brown Sand
20	50	Brown Sandy Clay
50	120	Brown Course Sand
120	125	White Course Sand
125	130	Gray Clay
130	150	Brown Sandy Clay
150	160	White Clay & Course Sand
160	175	Small Gravel & White Sand
175	208	Brown Course Sand
208	250	Small Gravel & Brown Sand
250	270	Blue Small Gravel
270	340	Blue Course Sand & Some Gravel
340	345	Blue Clay
345	455	Blue Sand

TOTAL DEPTH OF BORING 455 (Feet)

TOTAL DEPTH OF COMPLETED WELL 450 (Feet)

WELL OWNER

Name Four Deer Ranch L.L.C.

Mailing Address 1641 Mission Dr Suite 302

CITY Solvange Calif 93463 STATE ZIP

WELL LOCATION

Address 7770 Hwy 101

City Santa Maria Calif

County Santa Barbara Co

APN Book ___ Page ___ Parcel 101-060-066

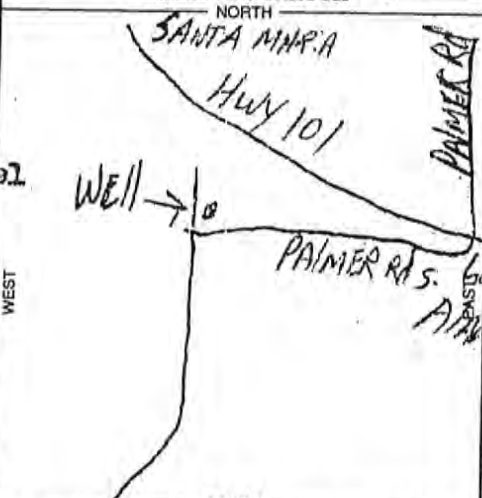
Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W DEG. MIN. SEC.

LOCATION SKETCH

NORTH

WEST



EAST

SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. ***PLEASE BE ACCURATE & COMPLETE.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
- ___ Deepen
- ___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

USES (✓)

WATER SUPPLY
- ___ Domestic ___ Public
- X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 40 (Ft.) & DATE MEASURED 6-14-09

ESTIMATED YIELD * 800 (GPM) & TEST TYPE ___

TEST LENGTH 12 (Hrs.) TOTAL DRAWDOWN 38 (Ft.)

* *May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	100	22	X				Pvc	12	SDR-21	
100	450	22		X			Pvc	12	SDR-21	040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	X			
					Montery

ATTACHMENTS (✓)

- ___ Geologic Log
- ___ Well Construction Diagram
- ___ Geophysical Log(s)
- ___ Soil/Water Chemical Analyses
- ___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2901 Mahoney Rd Santa Maria Calif 93455 CITY STATE ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR DATE SIGNED 09 C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

TRIPLICATE
Owner's Copy

Page ___ of ___

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 1082597

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Owner's Well No. New Ag Well #3

Date Work Began 6-18-09, Ended 7-6-09

Local Permit Agency Santa Barbara Co

Permit No. SR# 0106480 Permit Date 6-16-09

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION (Describe material, grain size, color, etc.)
0	15	Brown Sand
15	30	Course Sand
30	45	Course Sand & Gravel
45	60	Course Sand
60	80	Brown Clay
80	100	Course Sand & Some Gravel
100	135	Brown Clay
135	208	Course Sand
208	215	Clay
215	230	Course Sand
230	250	Clay
250	265	Course Sand
265	280	Blue Clay & Course Sand
280	345	Blue Sand Fine
345	350	Sandy Clay
350	515	SandyBlue Sand

TOTAL DEPTH OF BORING 515 (Feet)

TOTAL DEPTH OF COMPLETED WELL 440 (Feet)

WELL OWNER

Name Four Deer Ranch L.L.C.

Mailing Address 1641 Mission Dr Suite 302

Solvang Calif 93463 CITY STATE ZIP

WELL LOCATION

Address 7770Hway 101

City Santa Maria Calif 93454

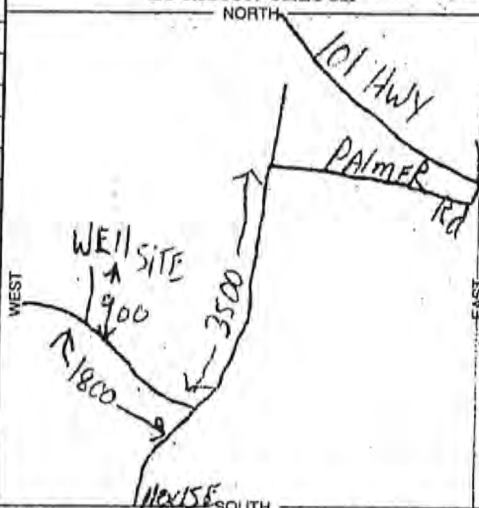
County Santa Barbara

APN Book ___ Page ___ Parcel 101-060-066

Township ___ Range ___ Section ___

Lat ___ ___ ___ N DEG. MIN. SEC. Long ___ ___ ___ W DEG. MIN. SEC.

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 63 (Ft.) & DATE MEASURED 8-24-09

ESTIMATED YIELD * 800 (GPM) & TEST TYPE Pump

TEST LENGTH 8 (Hrs.) TOTAL DRAWDOWN 47 (Ft.)

* May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	100	22	X				PVC	12	SDR-21	
100	440	22		X			PVC	12	SDR-21	040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	X			
					Montery

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 2801 Mahoney Rd Santa Maria Calif 93455 CITY STATE ZIP

Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR

DATE SIGNED 9-9-09

C-57 LICENSE NUMBER 523-858

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DUPLICATE
Owner's Copy

Page ___ of ___ New Aghpec #4

Owner's Well No. ~~3~~ #4

Date Work Began 8-3-09, Ended 8-23-09

Local Permit Agency Santa Barbara Co

Permit No. SB# 0106635 Permit Date 8-03-09

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 1082599

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Rotary FLUID Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	10	Brown Clay
10	30	Brown Sand & Small Gravel
30	60	Gray Coures Sand
60	70	Gray Rock & Coures Sand
70	120	Coures Sand Gray
120	135	Clay
135	145	Courso Sand
145	150	Sandy Clay
150	190	Sand
190	200	Clay
200	310	Gray Sand
310	480	Course Sand & Small Gravel
480	500	Sandy Clay With Sea Shells
500	622	Gray Fine Sandy Clay

TOTAL DEPTH OF BORING 600 (Feet)

TOTAL DEPTH OF COMPLETED WELL 490 (Feet)

WELL OWNER

Name Four Deer Ranch L.L.C.

Mailing Address 1641 Mission Dr. Suite 302

Solvang Calif 93463

CITY STATE ZIP

WELL LOCATION

Address 7700 South Hwy 101

City Santa Maria Calif 93455

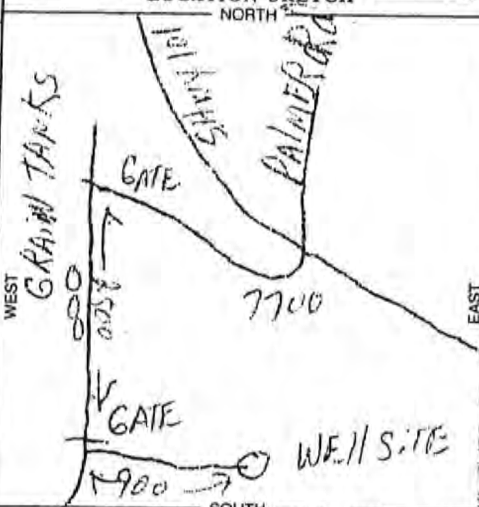
County Santa Barbara Co

APN Book ___ Page ___ Parcel 101-060-066

Township ___ Range ___ Section ___

Lat ___ DEG. MIN. SEC. N Long ___ DEG. MIN. SEC. W

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 11 (Ft.) & DATE MEASURED 8-18-09

ESTIMATED YIELD * 900 (GPM) & TEST TYPE Pump

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN 123 (Ft.)

** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE: BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	100	22	X				PVC	12	SDR-21	
100	480	22		X			PVC	12	SDR-21	040
480	490	22	X				PVC	12	SDR-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	25	X			
					[illegible]

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Ron Taylor Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2801 Mahoney Santa Maria Calif 93455
ADDRESS CITY STATE ZIP

Signed [signature] 9-26-09
C-57 LICENSED WATER WELL CONTRACTOR DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Hunter Four Deer Ranch
Water Well Data
Oct-09

Well #	Status	Total Depth (feet)	Static Level (feet)	Comp Interval (feet)	Test Rate (gpm)	Drawdown (feet)	Comments
Domestic	Existing	340	0 (sfc)	130-185	150	55	Well will serve as potable water source
ExAg - 1	Existing	460	82	240-460	38	3	Est. optimum producing rate = 400-500 gpm
ExAg - 2	Existing	460	189	220-460	100	10	Est. optimum producing rate = 400-500 gpm
NewAg - 1	New	400	NA	Not Comp'd	NA	NA	Well not completed
NewAg - 2	New	455	40	100-450	900	32	Est. optimum producing rate = 800-900 gpm
NewAg - 3	New	515	63	100-480	750	46	Est. optimum producing rate = 700-800 gpm
NewAg - 4	New	600	10	100-440	900	124	Est. optimum producing rate = 600-700 gpm

WELL TEST RESULTS

HUNTER - LOS FLORES RANCH
WATER WELL TESTING
Jan-09

EAST WELL ExtAg #1
NEAR FREEWAY
Air line/pump set @ 140 ft.

PUMPING PHASE

Time (min's)	**Fluid Level** (feet below sfc)	**Fluid Level** (feet above pump)	**Drawdown** (feet)	**Flowrate** (gal/min	**Remarks**
0	82	58	0	0	Static level
5	84.5	55.5	2.5	37.5	
10	84.5	55.5	2.5	37.5	
15	84.5	55.5	2.5	37.5	
20	84.5	55.5	2.5	37.5	
25	84.5	55.5	2.5	37.5	
30	84.5	55.5	2.5	37.5	
45	84.5	55.5	2.5	37.5	
60	84.5	55.5	2.5	37.5	
120	84.5	55.5	2.5	37.5	
180	84.5	55.5	2.5	37.5	
240	84.5	55.5	2.5	37.5	
300	84.5	55.5	2.5	37.5	
360	84.5	55.5	2.5	37.5	
420	84.5	55.5	2.5	37.5	
480	84.5	55.5	2.5	37.5	
540	84.5	55.5	2.5	37.5	
600	84.5	55.5	2.5	37.5	
660	84.5	55.5	2.5	37.5	
720	84.5	55.5	2.5	37.5	
Recovery Phase					
0	84.5	55.5	2.5	0	
5	82	58	0	0	Return to static level

APPENDIX D-3

Vandenberg Space Force Base Well Field Pumping Tests

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Vandenberg Space Force Base
Well Field Pumping Tests

Well Field Pumping Test Data

Well Name	Test Duration (hours)	Flow (gpm)	Static Water Level	Pumping Water Level	Well Depth (ft bgs)	Screened Interval (ft bgs)
Well#4	2.3	956	67’	121’	334’	111’
Well#7	2.5	1,200	69.15’	107’	410’	190’
Well#6	3.7	684	56.5’	90’	Unconfirmed	180’
Well#5	3.1	768	58’	104.5’	400’	110’

Screen Interval Data

Well#4

Screened Interval Beginning Depth/Ending Depth (ft below surface); 2nd Screened Interval Beg. Depth/Ending Depth; 3rd Screened Interval, etc.	162-219/234-273/319-334

Well#5

Screened Interval Beginning Depth/Ending Depth (ft below surface); 2nd Screened Interval Beg. Depth/Ending Depth; 3rd Screened Interval, etc.	200-210 220-230 270-290 300-320 330-340 350-360 370-390

Well#6

Screened Interval Beginning Depth/Ending Depth (ft below surface); 2nd Screened Interval Beg. Depth/Ending Depth; 3rd Screened Interval, etc.	210-390

Well#7A

Screened Interval Beginning Depth/Ending Depth (ft below surface); 2nd Screened Interval Beg. Depth/Ending Depth; 3rd Screened Interval, etc.	200'-390'

APPENDIX D-4

Los Alamos Fire Department Weather Station Precipitation Data

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County of Santa Barbara
Daily Rainfall Record - through 05-01-2020

#204 - Los Alamos Fire Station
Lat 34-44-43, Long 120-16-48, Elev 580 ft

Daily Rainfall (in inches) recorded as of 8am for the previous 24 hours (PST)
Codes: PR = Preliminary data, E = Estimated from nearby gauge

station id	water year	year	month	day	daily rain
204	1910	1909	10	3	0.90
204	1910	1909	10	29	0.05
204	1910	1909	11	9	0.96
204	1910	1909	11	11	0.13
204	1910	1909	11	26	0.17
204	1910	1909	11	27	0.43
204	1910	1909	12	5	1.20
204	1910	1909	12	7	0.37
204	1910	1909	12	8	0.71
204	1910	1909	12	9	2.35
204	1910	1909	12	20	0.66
204	1910	1909	12	21	0.31
204	1910	1909	12	22	0.20
204	1910	1910	1	1	1.47
204	1910	1910	1	2	0.33
204	1910	1910	1	12	0.06
204	1910	1910	1	15	0.19
204	1910	1910	1	16	1.05
204	1910	1910	1	23	0.18
204	1910	1910	1	24	0.30
204	1910	1910	2	6	0.10
204	1910	1910	2	19	0.08
204	1910	1910	2	23	0.05
204	1910	1910	3	14	0.70
204	1910	1910	3	17	0.15
204	1910	1910	3	21	1.03
204	1910	1910	3	22	0.43
204	1910	1910	3	23	0.10
204	1910	1910	3	25	0.22
204	1910	1910	3	27	1.45
204	1910	1910	3	28	0.10
204	1911	1910	9	14	0.14
204	1911	1910	9	15	0.70
204	1911	1910	10	11	0.12
204	1911	1910	11	4	0.18
204	1911	1910	11	25	0.40

station id	water year	year	month	day	daily rain
204	1911	1910	12	3	0.03
204	1911	1910	12	10	0.10
204	1911	1910	12	18	0.20
204	1911	1910	12	19	0.13
204	1911	1911	1	9	1.00
204	1911	1911	1	10	0.45
204	1911	1911	1	11	0.03
204	1911	1911	1	12	0.11
204	1911	1911	1	13	0.15
204	1911	1911	1	14	0.47
204	1911	1911	1	15	0.18
204	1911	1911	1	19	0.15
204	1911	1911	1	24	0.84
204	1911	1911	1	25	0.63
204	1911	1911	1	28	0.60
204	1911	1911	1	29	2.95
204	1911	1911	1	30	1.10
204	1911	1911	1	31	0.87
204	1911	1911	2	3	0.72
204	1911	1911	2	4	0.48
204	1911	1911	2	11	0.84
204	1911	1911	2	12	0.15
204	1911	1911	2	14	0.38
204	1911	1911	2	26	0.06
204	1911	1911	2	27	0.26
204	1911	1911	2	28	0.75
204	1911	1911	3	1	2.66
204	1911	1911	3	2	0.22
204	1911	1911	3	3	0.61
204	1911	1911	3	4	0.95
204	1911	1911	3	5	0.92
204	1911	1911	3	6	1.06
204	1911	1911	3	7	3.10
204	1911	1911	3	8	0.98
204	1911	1911	3	9	1.16
204	1911	1911	3	10	0.55
204	1911	1911	3	21	0.20
204	1911	1911	4	1	0.92
204	1911	1911	4	5	0.23
204	1911	1911	4	6	0.07
204	1911	1911	4	26	0.25
204	1912	1911	12	4	0.42
204	1912	1911	12	6	0.70
204	1912	1911	12	7	0.06
204	1912	1911	12	17	0.15

station id	water year	year	month	day	daily rain
204	1912	1911	12	28	0.17
204	1912	1911	12	29	0.35
204	1912	1912	1	2	0.55
204	1912	1912	1	10	0.41
204	1912	1912	1	11	0.11
204	1912	1912	1	16	0.22
204	1912	1912	1	26	0.30
204	1912	1912	3	1	0.09
204	1912	1912	3	2	0.11
204	1912	1912	3	3	0.15
204	1912	1912	3	4	0.71
204	1912	1912	3	5	1.11
204	1912	1912	3	6	0.27
204	1912	1912	3	9	0.60
204	1912	1912	3	10	1.00
204	1912	1912	3	12	1.85
204	1912	1912	3	13	0.25
204	1912	1912	3	16	0.05
204	1912	1912	3	21	0.42
204	1912	1912	3	26	0.16
204	1912	1912	4	8	0.12
204	1912	1912	4	9	0.08
204	1912	1912	4	10	0.11
204	1912	1912	4	11	0.42
204	1912	1912	4	29	0.12
204	1912	1912	5	6	0.10
204	1912	1912	5	7	0.17
204	1912	1912	5	8	0.17
204	1912	1912	5	25	0.68
204	1913	1912	11	10	0.30
204	1913	1912	12	15	0.16
204	1913	1913	1	9	0.62
204	1913	1913	1	10	0.30
204	1913	1913	1	14	0.03
204	1913	1913	1	15	1.44
204	1913	1913	1	16	0.37
204	1913	1913	1	17	0.10
204	1913	1913	1	18	0.02
204	1913	1913	2	8	0.53
204	1913	1913	2	21	0.37
204	1913	1913	2	22	0.27
204	1913	1913	2	23	0.31
204	1913	1913	2	24	1.32
204	1913	1913	2	25	0.42
204	1913	1913	3	18	0.25

station id	water year	year	month	day	daily rain
204	1913	1913	3	21	0.20
204	1913	1913	3	22	0.05
204	1913	1913	3	23	0.25
204	1913	1913	4	14	0.14
204	1913	1913	4	17	0.19
204	1913	1913	4	18	0.09
204	1913	1913	4	22	0.08
204	1913	1913	5	28	0.15
204	1913	1913	6	26	0.30
204	1913	1913	6	27	0.05
204	1913	1913	8	28	1.20
204	1914	1913	11	1	0.10
204	1914	1913	11	12	0.30
204	1914	1913	11	13	0.95
204	1914	1913	11	14	0.05
204	1914	1913	11	18	0.75
204	1914	1913	11	19	0.20
204	1914	1913	11	29	0.10
204	1914	1913	12	14	0.40
204	1914	1913	12	19	0.07
204	1914	1913	12	23	0.60
204	1914	1913	12	25	1.02
204	1914	1913	12	30	0.85
204	1914	1913	12	31	0.11
204	1914	1914	1	1	0.10
204	1914	1914	1	2	0.10
204	1914	1914	1	15	1.20
204	1914	1914	1	16	0.15
204	1914	1914	1	18	1.25
204	1914	1914	1	19	2.10
204	1914	1914	1	22	0.23
204	1914	1914	1	23	0.04
204	1914	1914	1	24	1.93
204	1914	1914	1	25	2.75
204	1914	1914	1	26	0.35
204	1914	1914	1	27	1.10
204	1914	1914	2	18	2.36
204	1914	1914	2	20	3.50
204	1914	1914	2	21	0.40
204	1914	1914	3	27	0.07
204	1914	1914	3	29	0.90
204	1914	1914	4	4	0.07
204	1914	1914	4	5	0.03
204	1914	1914	4	22	0.35
204	1915	1914	12	1	1.20

station id	water year	year	month	day	daily rain
204	1915	1914	12	3	0.10
204	1915	1914	12	4	0.13
204	1915	1914	12	5	0.18
204	1915	1914	12	6	0.15
204	1915	1914	12	10	0.74
204	1915	1914	12	11	0.58
204	1915	1914	12	12	0.15
204	1915	1914	12	17	1.27
204	1915	1914	12	18	0.20
204	1915	1914	12	20	0.19
204	1915	1914	12	27	0.23
204	1915	1915	1	4	0.25
204	1915	1915	1	5	0.20
204	1915	1915	1	8	0.38
204	1915	1915	1	14	0.25
204	1915	1915	1	20	0.06
204	1915	1915	1	24	0.22
204	1915	1915	1	27	0.07
204	1915	1915	1	28	0.86
204	1915	1915	1	29	2.15
204	1915	1915	1	30	0.90
204	1915	1915	2	2	1.36
204	1915	1915	2	3	0.46
204	1915	1915	2	8	0.95
204	1915	1915	2	9	2.08
204	1915	1915	2	10	0.84
204	1915	1915	2	11	0.12
204	1915	1915	2	16	0.25
204	1915	1915	2	17	0.48
204	1915	1915	2	19	0.06
204	1915	1915	2	20	0.69
204	1915	1915	2	24	0.51
204	1915	1915	2	28	0.36
204	1915	1915	3	1	0.05
204	1915	1915	3	7	0.16
204	1915	1915	3	28	0.40
204	1915	1915	4	7	0.05
204	1915	1915	4	21	1.25
204	1915	1915	4	22	0.05
204	1915	1915	4	23	0.10
204	1915	1915	4	26	0.25
204	1915	1915	4	28	0.35
204	1915	1915	4	29	0.09
204	1915	1915	5	1	0.14
204	1915	1915	5	2	0.46

station id	water year	year	month	day	daily rain
204	1915	1915	5	4	0.70
204	1915	1915	5	5	0.03
204	1915	1915	5	12	0.12
204	1915	1915	5	17	0.20
204	1918	1917	12	26	0.04
204	1918	1918	1	13	0.30
204	1918	1918	1	14	0.04
204	1918	1918	1	26	0.07
204	1918	1918	2	6	0.04
204	1918	1918	2	7	0.30
204	1918	1918	2	17	0.83
204	1918	1918	2	18	0.12
204	1918	1918	2	19	0.14
204	1918	1918	2	20	5.81
204	1918	1918	2	21	2.32
204	1918	1918	2	22	1.12
204	1918	1918	2	24	1.10
204	1918	1918	2	26	0.10
204	1918	1918	3	5	0.55
204	1918	1918	3	6	0.39
204	1918	1918	3	7	1.25
204	1918	1918	3	8	0.10
204	1918	1918	3	10	0.26
204	1918	1918	3	11	0.76
204	1918	1918	3	18	0.81
204	1918	1918	3	19	3.01
204	1918	1918	3	27	0.05
204	1918	1918	8	13	0.03
204	1918	1918	8	14	0.05
204	1918	1918	8	27	0.12
204	1919	1918	9	13	0.03
204	1919	1918	9	14	0.05
204	1919	1918	9	27	0.12
204	1919	1918	10	1	0.30
204	1919	1918	11	4	0.17
204	1919	1918	11	5	0.15
204	1919	1918	11	14	0.31
204	1919	1918	11	15	0.18
204	1919	1918	11	18	0.98
204	1919	1918	11	19	0.38
204	1919	1918	11	23	0.77
204	1919	1918	12	7	1.69
204	1919	1918	12	8	0.28
204	1919	1918	12	9	0.30
204	1919	1918	12	20	0.06

station id	water year	year	month	day	daily rain
204	1919	1918	12	21	0.30
204	1919	1919	1	19	0.46
204	1919	1919	2	1	0.40
204	1919	1919	2	2	0.04
204	1919	1919	2	9	0.10
204	1919	1919	2	10	0.43
204	1919	1919	2	11	1.05
204	1919	1919	2	15	0.04
204	1919	1919	2	22	0.04
204	1919	1919	2	23	0.19
204	1919	1919	2	24	0.04
204	1919	1919	2	26	0.36
204	1919	1919	2	27	0.04
204	1919	1919	2	28	0.02
204	1919	1919	3	1	0.03
204	1919	1919	3	2	0.13
204	1919	1919	3	13	0.97
204	1919	1919	3	14	0.52
204	1919	1919	4	26	0.06
204	1919	1919	5	28	1.11
204	1919	1919	5	29	0.24
204	1920	1919	9	1	0.02
204	1920	1919	9	2	0.56
204	1920	1919	10	24	0.16
204	1920	1919	10	25	0.02
204	1920	1919	11	26	0.03
204	1920	1919	11	27	0.11
204	1920	1919	11	30	0.03
204	1920	1919	12	1	0.04
204	1920	1919	12	2	0.17
204	1920	1919	12	4	0.62
204	1920	1919	12	5	0.97
204	1920	1919	12	6	0.32
204	1920	1919	12	8	0.05
204	1920	1919	12	11	0.50
204	1920	1920	1	4	0.14
204	1920	1920	1	22	0.07
204	1920	1920	1	23	0.18
204	1920	1920	2	1	0.40
204	1920	1920	2	2	0.54
204	1920	1920	2	9	0.02
204	1920	1920	2	19	0.66
204	1920	1920	2	22	0.84
204	1920	1920	2	23	0.18
204	1920	1920	2	27	0.18

station id	water year	year	month	day	daily rain
204	1920	1920	2	29	0.15
204	1920	1920	3	1	0.46
204	1920	1920	3	2	0.11
204	1920	1920	3	9	0.06
204	1920	1920	3	10	0.22
204	1920	1920	3	16	0.44
204	1920	1920	3	21	0.93
204	1920	1920	3	22	0.94
204	1920	1920	3	23	0.16
204	1920	1920	3	25	0.06
204	1920	1920	3	26	0.37
204	1920	1920	4	9	0.26
204	1920	1920	4	10	0.03
204	1920	1920	4	15	0.36
204	1920	1920	4	16	0.06
204	1921	1920	9	24	0.03
204	1921	1920	10	6	0.04
204	1921	1920	10	9	0.29
204	1921	1920	10	18	0.15
204	1921	1920	10	19	0.10
204	1921	1920	11	7	1.15
204	1921	1920	11	15	0.18
204	1921	1920	12	7	0.45
204	1921	1920	12	8	0.02
204	1921	1920	12	10	0.25
204	1921	1920	12	11	0.06
204	1921	1920	12	19	0.41
204	1921	1920	12	24	0.10
204	1921	1921	1	17	0.07
204	1921	1921	1	18	1.39
204	1921	1921	1	19	0.12
204	1921	1921	1	20	0.71
204	1921	1921	1	21	0.06
204	1921	1921	1	22	0.14
204	1921	1921	1	26	0.12
204	1921	1921	1	27	0.58
204	1921	1921	1	30	0.58
204	1921	1921	2	5	0.07
204	1921	1921	2	14	0.94
204	1921	1921	2	15	0.02
204	1921	1921	2	17	0.70
204	1921	1921	2	21	0.07
204	1921	1921	3	6	0.04
204	1921	1921	3	11	0.07
204	1921	1921	3	12	0.28

station id	water year	year	month	day	daily rain
204	1921	1921	3	13	0.43
204	1921	1921	3	14	0.17
204	1921	1921	3	22	0.07
204	1921	1921	4	11	0.32
204	1921	1921	4	13	0.02
204	1921	1921	5	5	0.43
204	1921	1921	5	6	0.28
204	1921	1921	5	20	0.31
204	1921	1921	5	21	0.31
204	1921	1921	5	22	0.14
204	1922	1921	9	1	0.16
204	1922	1921	9	17	0.34
204	1922	1921	9	18	0.34
204	1922	1921	10	23	0.32
204	1922	1921	12	18	0.34
204	1922	1921	12	19	0.84
204	1922	1921	12	20	1.40
204	1922	1921	12	21	0.45
204	1922	1921	12	22	1.15
204	1922	1921	12	23	0.17
204	1922	1921	12	24	0.20
204	1922	1921	12	25	0.59
204	1922	1921	12	26	0.21
204	1922	1921	12	27	0.22
204	1922	1921	12	28	0.16
204	1922	1921	12	29	0.04
204	1922	1922	1	1	0.45
204	1922	1922	1	2	0.29
204	1922	1922	1	3	0.06
204	1922	1922	1	4	0.08
204	1922	1922	1	6	0.32
204	1922	1922	1	7	0.13
204	1922	1922	1	29	1.38
204	1922	1922	1	30	1.28
204	1922	1922	1	31	0.36
204	1922	1922	2	8	0.22
204	1922	1922	2	9	0.74
204	1922	1922	2	10	0.21
204	1922	1922	2	11	0.26
204	1922	1922	2	20	1.79
204	1922	1922	2	21	0.04
204	1922	1922	2	22	0.06
204	1922	1922	2	24	0.05
204	1922	1922	2	27	0.23
204	1922	1922	3	11	0.98

station id	water year	year	month	day	daily rain
204	1922	1922	3	16	1.36
204	1922	1922	3	17	0.04
204	1922	1922	3	23	0.11
204	1922	1922	3	27	0.06
204	1922	1922	3	31	0.03
204	1922	1922	4	5	0.13
204	1922	1922	4	12	0.13
204	1922	1922	5	9	0.39
204	1923	1922	10	27	0.52
204	1923	1922	10	28	0.03
204	1923	1922	11	6	0.02
204	1923	1922	11	7	0.06
204	1923	1922	11	8	0.10
204	1923	1922	11	9	1.08
204	1923	1922	12	1	0.33
204	1923	1922	12	2	0.31
204	1923	1922	12	3	0.12
204	1923	1922	12	6	0.25
204	1923	1922	12	7	0.09
204	1923	1922	12	10	0.25
204	1923	1922	12	12	0.99
204	1923	1922	12	13	0.95
204	1923	1922	12	14	0.24
204	1923	1922	12	15	0.09
204	1923	1922	12	17	0.11
204	1923	1922	12	27	0.42
204	1923	1923	2	1	0.13
204	1923	1923	2	8	0.05
204	1923	1923	2	9	0.13
204	1923	1923	2	11	0.82
204	1923	1923	2	12	0.13
204	1923	1923	3	3	0.35
204	1923	1923	4	1	0.35
204	1923	1923	4	2	0.19
204	1923	1923	4	3	0.07
204	1923	1923	4	4	0.01
204	1923	1923	4	5	0.72
204	1923	1923	4	6	0.92
204	1923	1923	4	10	0.58
204	1923	1923	4	18	0.76
204	1923	1923	6	15	0.05
204	1924	1923	9	25	0.12
204	1924	1923	9	26	0.03
204	1924	1923	10	7	0.05
204	1924	1923	11	8	0.13

station id	water year	year	month	day	daily rain
204	1924	1923	11	9	0.03
204	1924	1923	11	30	0.02
204	1924	1923	12	14	0.22
204	1924	1923	12	19	0.03
204	1924	1923	12	30	0.02
204	1924	1923	12	31	0.09
204	1924	1924	1	1	0.03
204	1924	1924	1	27	0.47
204	1924	1924	1	28	0.07
204	1924	1924	1	29	0.02
204	1924	1924	2	8	0.03
204	1924	1924	2	9	0.16
204	1924	1924	3	2	0.68
204	1924	1924	3	3	0.27
204	1924	1924	3	4	0.05
204	1924	1924	3	17	0.43
204	1924	1924	3	19	0.01
204	1924	1924	3	20	0.01
204	1924	1924	3	23	0.35
204	1924	1924	3	24	0.02
204	1924	1924	3	26	1.28
204	1924	1924	3	28	0.05
204	1924	1924	4	1	0.30
204	1924	1924	4	3	0.03
204	1924	1924	4	4	0.02
204	1924	1924	4	23	0.36
204	1925	1924	10	6	0.38
204	1925	1924	10	10	0.10
204	1925	1924	10	16	0.04
204	1925	1924	10	28	0.06
204	1925	1924	10	29	0.24
204	1925	1924	11	8	0.07
204	1925	1924	11	9	0.56
204	1925	1924	11	10	0.22
204	1925	1924	12	6	0.62
204	1925	1924	12	7	0.07
204	1925	1924	12	8	0.30
204	1925	1924	12	16	0.24
204	1925	1924	12	17	0.10
204	1925	1924	12	22	0.09
204	1925	1924	12	30	0.01
204	1925	1925	1	14	0.15
204	1925	1925	1	25	0.48
204	1925	1925	1	26	0.21
204	1925	1925	2	6	0.22

station id	water year	year	month	day	daily rain
204	1925	1925	2	8	0.44
204	1925	1925	2	12	0.54
204	1925	1925	2	13	0.04
204	1925	1925	2	19	0.05
204	1925	1925	2	20	0.05
204	1925	1925	2	23	0.41
204	1925	1925	3	6	0.40
204	1925	1925	3	7	0.41
204	1925	1925	3	8	0.04
204	1925	1925	3	9	0.03
204	1925	1925	3	10	0.06
204	1925	1925	3	26	0.06
204	1925	1925	3	27	0.10
204	1925	1925	3	29	1.34
204	1925	1925	3	31	1.08
204	1925	1925	4	1	0.03
204	1925	1925	4	3	0.56
204	1925	1925	4	4	1.62
204	1925	1925	4	5	0.26
204	1925	1925	4	20	0.06
204	1925	1925	4	22	0.10
204	1925	1925	5	10	0.04
204	1925	1925	5	13	0.41
204	1925	1925	5	16	0.03
204	1925	1925	5	20	0.73
204	1925	1925	6	3	0.08
204	1926	1925	10	12	0.81
204	1926	1925	10	13	0.01
204	1926	1925	11	3	0.10
204	1926	1925	11	5	0.10
204	1926	1925	11	24	0.05
204	1926	1925	12	1	0.25
204	1926	1925	12	3	0.51
204	1926	1925	12	19	0.86
204	1926	1925	12	29	0.03
204	1926	1926	1	17	0.05
204	1926	1926	1	29	0.86
204	1926	1926	1	31	0.96
204	1926	1926	2	1	0.20
204	1926	1926	2	2	0.90
204	1926	1926	2	3	0.02
204	1926	1926	2	4	0.01
204	1926	1926	2	11	0.06
204	1926	1926	2	12	0.86
204	1926	1926	2	13	0.73

station id	water year	year	month	day	daily rain
204	1926	1926	2	14	0.19
204	1926	1926	2	15	0.10
204	1926	1926	2	16	0.05
204	1926	1926	3	3	0.04
204	1926	1926	3	4	0.16
204	1926	1926	3	5	0.08
204	1926	1926	3	6	0.02
204	1926	1926	3	18	0.02
204	1926	1926	4	2	0.04
204	1926	1926	4	4	0.07
204	1926	1926	4	5	1.57
204	1926	1926	4	6	0.38
204	1926	1926	4	7	0.98
204	1926	1926	4	8	0.84
204	1926	1926	4	9	0.04
204	1926	1926	4	19	0.05
204	1926	1926	4	29	0.12
204	1926	1926	5	3	0.03
204	1927	1926	10	2	0.49
204	1927	1926	11	12	0.06
204	1927	1926	11	24	2.12
204	1927	1926	11	25	0.16
204	1927	1926	11	26	2.05
204	1927	1926	11	27	0.29
204	1927	1926	12	3	0.40
204	1927	1926	12	6	0.05
204	1927	1926	12	18	0.02
204	1927	1926	12	21	0.20
204	1927	1926	12	22	0.02
204	1927	1926	12	23	0.12
204	1927	1927	1	6	0.38
204	1927	1927	1	10	0.33
204	1927	1927	1	11	0.53
204	1927	1927	1	12	0.27
204	1927	1927	1	19	0.05
204	1927	1927	1	20	0.27
204	1927	1927	1	26	0.08
204	1927	1927	2	4	1.06
204	1927	1927	2	13	0.47
204	1927	1927	2	14	1.55
204	1927	1927	2	15	0.86
204	1927	1927	2	16	1.42
204	1927	1927	2	17	0.02
204	1927	1927	2	18	0.40
204	1927	1927	2	21	0.02

station id	water year	year	month	day	daily rain
204	1927	1927	2	22	0.06
204	1927	1927	2	24	0.16
204	1927	1927	3	3	1.41
204	1927	1927	3	4	0.20
204	1927	1927	3	8	0.03
204	1927	1927	3	9	0.16
204	1927	1927	3	28	0.20
204	1927	1927	3	29	0.07
204	1927	1927	3	30	0.09
204	1927	1927	4	3	0.27
204	1927	1927	4	10	1.08
204	1927	1927	4	16	0.08
204	1927	1927	5	7	0.08
204	1928	1927	10	25	0.08
204	1928	1927	10	26	0.34
204	1928	1927	10	27	1.70
204	1928	1927	10	31	1.29
204	1928	1927	11	5	0.04
204	1928	1927	11	13	0.20
204	1928	1927	11	21	0.03
204	1928	1927	12	9	0.15
204	1928	1927	12	10	0.41
204	1928	1927	12	14	0.25
204	1928	1927	12	21	0.32
204	1928	1927	12	25	2.92
204	1928	1927	12	26	0.11
204	1928	1927	12	29	0.20
204	1928	1927	12	30	0.14
204	1928	1928	1	22	0.06
204	1928	1928	1	23	0.06
204	1928	1928	2	1	0.12
204	1928	1928	2	2	0.06
204	1928	1928	2	3	1.29
204	1928	1928	2	4	1.26
204	1928	1928	2	5	0.26
204	1928	1928	3	3	0.89
204	1928	1928	3	5	0.01
204	1928	1928	3	6	0.02
204	1928	1928	3	23	0.20
204	1928	1928	3	24	1.11
204	1928	1928	3	25	0.09
204	1928	1928	3	27	0.22
204	1928	1928	4	3	0.19
204	1928	1928	4	4	0.04
204	1928	1928	5	7	0.01

station id	water year	year	month	day	daily rain
204	1928	1928	5	8	0.89
204	1928	1928	5	9	0.02
204	1929	1928	10	12	0.23
204	1929	1928	11	3	0.14
204	1929	1928	11	13	1.16
204	1929	1928	11	14	1.37
204	1929	1928	11	15	0.12
204	1929	1928	12	2	0.14
204	1929	1928	12	3	0.92
204	1929	1928	12	10	0.37
204	1929	1928	12	11	0.12
204	1929	1928	12	12	0.26
204	1929	1928	12	13	0.37
204	1929	1929	1	16	0.57
204	1929	1929	1	19	0.34
204	1929	1929	1	20	0.79
204	1929	1929	2	3	0.50
204	1929	1929	2	4	0.13
204	1929	1929	2	6	0.03
204	1929	1929	2	7	0.01
204	1929	1929	2	18	0.35
204	1929	1929	3	9	0.04
204	1929	1929	3	10	0.55
204	1929	1929	3	11	0.07
204	1929	1929	3	13	0.10
204	1929	1929	3	18	0.03
204	1929	1929	3	24	0.36
204	1929	1929	3	25	0.01
204	1929	1929	4	4	0.85
204	1929	1929	4	5	0.12
204	1929	1929	4	6	0.12
204	1929	1929	4	9	0.04
204	1929	1929	4	19	0.08
204	1929	1929	6	8	0.03
204	1929	1929	6	16	0.07
204	1930	1929	12	12	0.06
204	1930	1929	12	13	0.03
204	1930	1929	12	14	0.02
204	1930	1930	1	5	0.60
204	1930	1930	1	6	0.56
204	1930	1930	1	9	0.95
204	1930	1930	1	10	0.19
204	1930	1930	1	11	0.68
204	1930	1930	1	12	0.66
204	1930	1930	1	13	0.16

station id	water year	year	month	day	daily rain
204	1930	1930	1	14	0.28
204	1930	1930	1	15	0.04
204	1930	1930	1	18	0.08
204	1930	1930	1	19	0.02
204	1930	1930	2	20	0.22
204	1930	1930	2	22	0.80
204	1930	1930	2	23	0.12
204	1930	1930	2	26	0.17
204	1930	1930	2	27	0.14
204	1930	1930	3	3	0.03
204	1930	1930	3	4	0.37
204	1930	1930	3	5	0.09
204	1930	1930	3	6	0.22
204	1930	1930	3	14	1.49
204	1930	1930	3	15	0.65
204	1930	1930	3	16	0.11
204	1930	1930	3	17	0.22
204	1930	1930	3	18	0.11
204	1930	1930	3	19	0.02
204	1930	1930	4	13	0.27
204	1930	1930	4	14	0.18
204	1930	1930	4	30	0.14
204	1930	1930	5	1	0.17
204	1930	1930	5	3	0.45
204	1930	1930	5	4	0.13
204	1930	1930	5	5	0.03
204	1930	1930	5	8	0.01
204	1930	1930	5	16	0.10
204	1931	1930	9	30	0.29
204	1931	1930	11	13	0.14
204	1931	1930	11	15	0.09
204	1931	1930	11	16	0.17
204	1931	1930	11	17	0.30
204	1931	1930	11	26	0.75
204	1931	1930	11	27	0.19
204	1931	1931	1	1	0.38
204	1931	1931	1	2	0.73
204	1931	1931	1	5	0.75
204	1931	1931	1	6	0.04
204	1931	1931	1	7	0.72
204	1931	1931	1	8	0.31
204	1931	1931	1	13	0.45
204	1931	1931	1	31	0.54
204	1931	1931	2	3	0.71
204	1931	1931	2	4	0.46

station id	water year	year	month	day	daily rain
204	1931	1931	2	8	0.10
204	1931	1931	2	10	0.12
204	1931	1931	2	12	0.36
204	1931	1931	2	13	0.11
204	1931	1931	2	14	0.04
204	1931	1931	2	18	0.02
204	1931	1931	3	11	0.12
204	1931	1931	4	23	0.12
204	1931	1931	4	26	0.39
204	1931	1931	4	27	0.12
204	1931	1931	4	28	0.02
204	1931	1931	5	24	0.98
204	1931	1931	5	25	0.12
204	1931	1931	8	13	0.14
204	1932	1931	11	15	0.78
204	1932	1931	11	17	0.02
204	1932	1931	11	27	1.92
204	1932	1931	12	8	0.90
204	1932	1931	12	11	0.35
204	1932	1931	12	12	0.06
204	1932	1931	12	14	1.02
204	1932	1931	12	21	0.43
204	1932	1931	12	22	0.03
204	1932	1931	12	23	0.02
204	1932	1931	12	24	0.44
204	1932	1931	12	25	1.37
204	1932	1931	12	27	0.41
204	1932	1931	12	28	1.98
204	1932	1931	12	31	0.29
204	1932	1932	1	2	0.31
204	1932	1932	1	12	0.14
204	1932	1932	1	13	0.28
204	1932	1932	1	15	1.45
204	1932	1932	1	16	0.02
204	1932	1932	1	26	0.07
204	1932	1932	1	31	0.83
204	1932	1932	2	1	0.33
204	1932	1932	2	2	0.35
204	1932	1932	2	6	0.15
204	1932	1932	2	8	1.41
204	1932	1932	2	9	0.72
204	1932	1932	2	13	0.13
204	1932	1932	2	14	0.06
204	1932	1932	2	16	0.29
204	1932	1932	2	17	0.07

station id	water year	year	month	day	daily rain
204	1932	1932	3	14	0.06
204	1932	1932	3	15	0.12
204	1932	1932	4	26	0.59
204	1932	1932	4	27	0.17
204	1932	1932	5	5	0.12
204	1933	1932	9	30	0.17
204	1933	1932	10	1	0.04
204	1933	1932	11	1	0.01
204	1933	1932	12	9	0.08
204	1933	1932	12	10	0.22
204	1933	1932	12	11	0.34
204	1933	1932	12	12	0.12
204	1933	1932	12	19	0.22
204	1933	1932	12	20	0.02
204	1933	1932	12	22	0.03
204	1933	1932	12	23	0.35
204	1933	1933	1	16	0.61
204	1933	1933	1	17	0.18
204	1933	1933	1	19	2.12
204	1933	1933	1	20	0.69
204	1933	1933	1	22	0.59
204	1933	1933	1	23	0.54
204	1933	1933	1	24	0.02
204	1933	1933	1	25	0.66
204	1933	1933	1	26	0.10
204	1933	1933	1	28	0.33
204	1933	1933	1	29	0.42
204	1933	1933	1	30	0.69
204	1933	1933	2	12	0.15
204	1933	1933	2	13	0.15
204	1933	1933	3	13	0.07
204	1933	1933	3	17	0.25
204	1933	1933	3	24	0.23
204	1933	1933	4	28	0.66
204	1933	1933	5	2	0.13
204	1933	1933	5	21	0.15
204	1933	1933	6	5	1.26
204	1934	1933	10	31	0.27
204	1934	1933	11	29	0.02
204	1934	1933	12	3	0.13
204	1934	1933	12	4	0.03
204	1934	1933	12	12	0.17
204	1934	1933	12	13	1.45
204	1934	1933	12	14	0.25
204	1934	1933	12	15	0.27

station id	water year	year	month	day	daily rain
204	1934	1933	12	16	0.07
204	1934	1933	12	30	0.48
204	1934	1933	12	31	0.18
204	1934	1934	1	1	1.53
204	1934	1934	1	2	0.10
204	1934	1934	2	5	0.02
204	1934	1934	2	6	0.03
204	1934	1934	2	15	0.49
204	1934	1934	2	16	0.25
204	1934	1934	2	20	0.36
204	1934	1934	2	23	0.43
204	1934	1934	2	24	1.23
204	1934	1934	2	26	0.13
204	1934	1934	2	27	0.10
204	1934	1934	5	26	0.34
204	1934	1934	6	5	0.40
204	1934	1934	6	6	0.13
204	1935	1934	10	17	0.66
204	1935	1934	10	18	0.76
204	1935	1934	11	1	0.21
204	1935	1934	11	15	0.37
204	1935	1934	11	16	0.38
204	1935	1934	11	17	0.40
204	1935	1934	11	18	1.64
204	1935	1934	12	8	0.05
204	1935	1934	12	9	0.07
204	1935	1934	12	12	0.09
204	1935	1934	12	13	1.03
204	1935	1934	12	28	0.41
204	1935	1934	12	31	0.05
204	1935	1935	1	4	0.27
204	1935	1935	1	5	0.99
204	1935	1935	1	6	0.05
204	1935	1935	1	9	1.03
204	1935	1935	1	10	0.28
204	1935	1935	1	11	0.15
204	1935	1935	1	15	0.98
204	1935	1935	1	16	0.03
204	1935	1935	1	17	0.04
204	1935	1935	1	18	0.06
204	1935	1935	1	19	0.30
204	1935	1935	2	4	0.69
204	1935	1935	2	5	0.45
204	1935	1935	2	6	0.31
204	1935	1935	2	7	0.05

station id	water year	year	month	day	daily rain
204	1935	1935	2	8	0.05
204	1935	1935	2	14	0.11
204	1935	1935	3	2	0.41
204	1935	1935	3	3	0.56
204	1935	1935	3	4	0.09
204	1935	1935	3	7	0.89
204	1935	1935	3	8	0.32
204	1935	1935	3	9	0.05
204	1935	1935	3	19	0.06
204	1935	1935	3	23	0.05
204	1935	1935	3	24	0.94
204	1935	1935	4	3	0.10
204	1935	1935	4	4	0.57
204	1935	1935	4	7	0.29
204	1935	1935	4	8	0.93
204	1935	1935	4	9	0.17
204	1935	1935	4	14	0.06
204	1935	1935	4	15	0.07
204	1935	1935	4	16	0.13
204	1935	1935	4	29	0.22
204	1935	1935	4	30	0.04
204	1935	1935	5	1	0.17
204	1935	1935	8	26	0.15
204	1936	1935	10	1	0.04
204	1936	1935	10	11	0.07
204	1936	1935	10	15	0.45
204	1936	1935	11	2	0.29
204	1936	1935	11	17	0.88
204	1936	1935	11	18	0.04
204	1936	1935	12	3	0.74
204	1936	1935	12	12	0.14
204	1936	1935	12	27	0.02
204	1936	1935	12	29	0.69
204	1936	1935	12	30	0.07
204	1936	1936	1	10	0.11
204	1936	1936	1	11	0.25
204	1936	1936	1	12	0.15
204	1936	1936	1	28	0.04
204	1936	1936	2	1	0.44
204	1936	1936	2	2	1.47
204	1936	1936	2	11	0.29
204	1936	1936	2	12	0.25
204	1936	1936	2	13	0.90
204	1936	1936	2	14	0.26
204	1936	1936	2	15	0.99

station id	water year	year	month	day	daily rain
204	1936	1936	2	16	0.76
204	1936	1936	2	18	0.48
204	1936	1936	2	19	0.05
204	1936	1936	2	20	0.04
204	1936	1936	2	23	0.97
204	1936	1936	2	24	0.30
204	1936	1936	3	21	0.09
204	1936	1936	3	24	0.57
204	1936	1936	3	31	0.70
204	1936	1936	4	3	0.22
204	1936	1936	4	4	0.39
204	1936	1936	5	29	0.08
204	1936	1936	6	2	0.05
204	1936	1936	8	9	0.02
204	1936	1936	8	10	0.17
204	1937	1936	9	3	0.03
204	1937	1936	9	4	0.04
204	1937	1936	10	17	0.86
204	1937	1936	10	18	0.94
204	1937	1936	10	19	0.38
204	1937	1936	10	31	0.55
204	1937	1936	12	15	0.43
204	1937	1936	12	16	0.08
204	1937	1936	12	17	0.03
204	1937	1936	12	24	0.34
204	1937	1936	12	27	1.58
204	1937	1936	12	28	0.44
204	1937	1936	12	29	0.25
204	1937	1936	12	30	0.13
204	1937	1936	12	31	1.15
204	1937	1937	1	1	0.19
204	1937	1937	1	6	0.63
204	1937	1937	1	7	0.04
204	1937	1937	1	12	0.80
204	1937	1937	1	13	0.39
204	1937	1937	1	16	0.14
204	1937	1937	1	19	0.04
204	1937	1937	1	28	0.05
204	1937	1937	1	29	0.29
204	1937	1937	1	30	0.35
204	1937	1937	1	31	0.74
204	1937	1937	2	2	0.14
204	1937	1937	2	5	0.54
204	1937	1937	2	6	1.12
204	1937	1937	2	7	0.92

station id	water year	year	month	day	daily rain
204	1937	1937	2	12	0.28
204	1937	1937	2	13	0.02
204	1937	1937	2	14	1.46
204	1937	1937	2	15	0.07
204	1937	1937	2	25	0.69
204	1937	1937	2	26	0.10
204	1937	1937	3	12	0.65
204	1937	1937	3	13	0.93
204	1937	1937	3	15	0.34
204	1937	1937	3	18	0.28
204	1937	1937	3	22	1.37
204	1937	1937	3	23	0.24
204	1937	1937	3	24	0.14
204	1937	1937	3	25	0.73
204	1937	1937	3	28	0.14
204	1937	1937	4	6	0.07
204	1937	1937	4	27	0.16
204	1937	1937	4	28	0.02
204	1938	1937	10	13	0.06
204	1938	1937	12	10	0.35
204	1938	1937	12	11	0.21
204	1938	1937	12	12	1.39
204	1938	1937	12	23	0.07
204	1938	1937	12	26	0.16
204	1938	1938	1	15	1.52
204	1938	1938	1	17	0.05
204	1938	1938	1	18	0.04
204	1938	1938	1	19	0.37
204	1938	1938	1	20	0.09
204	1938	1938	1	29	0.49
204	1938	1938	2	1	1.78
204	1938	1938	2	2	0.10
204	1938	1938	2	3	0.95
204	1938	1938	2	4	0.35
204	1938	1938	2	5	0.06
204	1938	1938	2	9	0.22
204	1938	1938	2	10	0.21
204	1938	1938	2	11	2.15
204	1938	1938	2	12	1.13
204	1938	1938	2	14	0.27
204	1938	1938	2	15	0.06
204	1938	1938	2	18	0.03
204	1938	1938	2	19	0.19
204	1938	1938	2	28	0.17
204	1938	1938	3	1	1.18

station id	water year	year	month	day	daily rain
204	1938	1938	3	2	0.52
204	1938	1938	3	3	1.98
204	1938	1938	3	4	0.13
204	1938	1938	3	6	0.05
204	1938	1938	3	7	0.27
204	1938	1938	3	8	0.26
204	1938	1938	3	12	0.79
204	1938	1938	3	13	0.44
204	1938	1938	3	14	0.06
204	1938	1938	3	17	0.05
204	1938	1938	3	24	0.06
204	1938	1938	4	5	0.07
204	1938	1938	4	13	0.14
204	1938	1938	4	25	0.80
204	1938	1938	4	26	0.07
204	1938	1938	4	29	0.10
204	1938	1938	4	30	0.25
204	1938	1938	5	1	0.02
204	1939	1938	9	27	0.56
204	1939	1938	9	28	0.33
204	1939	1938	10	13	0.02
204	1939	1938	10	15	0.03
204	1939	1938	10	31	0.11
204	1939	1938	11	30	0.13
204	1939	1938	12	14	0.05
204	1939	1938	12	15	0.33
204	1939	1938	12	16	0.94
204	1939	1938	12	18	0.08
204	1939	1938	12	19	0.15
204	1939	1938	12	20	1.12
204	1939	1938	12	21	0.87
204	1939	1939	1	3	0.11
204	1939	1939	1	5	0.76
204	1939	1939	1	6	0.39
204	1939	1939	1	21	0.76
204	1939	1939	1	22	0.18
204	1939	1939	1	28	0.03
204	1939	1939	1	30	0.82
204	1939	1939	2	1	0.16
204	1939	1939	2	3	0.52
204	1939	1939	2	4	0.49
204	1939	1939	2	7	0.06
204	1939	1939	2	8	0.22
204	1939	1939	2	9	0.20
204	1939	1939	2	10	0.31

station id	water year	year	month	day	daily rain
204	1939	1939	3	9	0.35
204	1939	1939	3	10	1.47
204	1939	1939	3	20	0.07
204	1939	1939	3	26	0.63
204	1939	1939	3	27	0.32
204	1939	1939	4	1	0.07
204	1939	1939	4	13	0.03
204	1939	1939	5	11	0.05
204	1940	1939	9	25	1.85
204	1940	1939	9	26	0.10
204	1940	1939	10	1	0.06
204	1940	1939	10	7	0.50
204	1940	1939	11	26	1.05
204	1940	1939	12	11	0.48
204	1940	1939	12	24	0.97
204	1940	1940	1	2	0.25
204	1940	1940	1	3	0.12
204	1940	1940	1	4	0.35
204	1940	1940	1	6	0.15
204	1940	1940	1	7	0.10
204	1940	1940	1	8	0.44
204	1940	1940	1	9	0.22
204	1940	1940	1	10	0.41
204	1940	1940	1	11	1.49
204	1940	1940	1	12	0.35
204	1940	1940	1	23	0.20
204	1940	1940	1	24	0.66
204	1940	1940	1	26	0.03
204	1940	1940	2	1	0.10
204	1940	1940	2	2	0.18
204	1940	1940	2	3	0.10
204	1940	1940	2	4	0.73
204	1940	1940	2	7	0.09
204	1940	1940	2	14	0.54
204	1940	1940	2	15	0.17
204	1940	1940	2	18	0.03
204	1940	1940	2	26	0.56
204	1940	1940	2	29	0.25
204	1940	1940	3	27	0.16
204	1940	1940	3	30	0.03
204	1940	1940	3	31	0.87
204	1940	1940	4	1	0.81
204	1940	1940	4	26	0.41
204	1940	1940	4	27	0.71
204	1941	1940	10	8	0.03

station id	water year	year	month	day	daily rain
204	1941	1940	10	25	0.40
204	1941	1940	10	26	0.03
204	1941	1940	11	18	0.10
204	1941	1940	12	16	0.64
204	1941	1940	12	17	0.97
204	1941	1940	12	18	0.09
204	1941	1940	12	19	0.29
204	1941	1940	12	22	0.95
204	1941	1940	12	23	1.90
204	1941	1940	12	24	0.25
204	1941	1940	12	25	0.39
204	1941	1940	12	27	0.17
204	1941	1940	12	29	0.25
204	1941	1940	12	30	0.10
204	1941	1940	12	31	0.04
204	1941	1941	1	4	0.10
204	1941	1941	1	5	0.19
204	1941	1941	1	7	0.68
204	1941	1941	1	8	0.53
204	1941	1941	1	9	2.10
204	1941	1941	1	10	0.21
204	1941	1941	1	11	0.03
204	1941	1941	1	14	0.28
204	1941	1941	1	16	0.03
204	1941	1941	1	20	0.33
204	1941	1941	1	22	0.81
204	1941	1941	1	23	0.03
204	1941	1941	1	24	0.57
204	1941	1941	1	26	0.55
204	1941	1941	2	6	1.10
204	1941	1941	2	8	0.55
204	1941	1941	2	9	0.03
204	1941	1941	2	10	0.45
204	1941	1941	2	11	0.72
204	1941	1941	2	12	0.60
204	1941	1941	2	15	0.92
204	1941	1941	2	16	0.06
204	1941	1941	2	17	2.12
204	1941	1941	2	18	0.03
204	1941	1941	2	20	0.12
204	1941	1941	2	21	0.28
204	1941	1941	2	22	0.60
204	1941	1941	2	24	0.52
204	1941	1941	2	25	0.05
204	1941	1941	3	1	1.79

station id	water year	year	month	day	daily rain
204	1941	1941	3	2	0.38
204	1941	1941	3	3	0.12
204	1941	1941	3	4	1.56
204	1941	1941	3	5	0.63
204	1941	1941	3	12	0.32
204	1941	1941	3	13	2.21
204	1941	1941	3	14	0.35
204	1941	1941	3	15	0.17
204	1941	1941	3	29	1.66
204	1941	1941	3	31	0.94
204	1941	1941	4	1	0.81
204	1941	1941	4	2	0.32
204	1941	1941	4	5	0.92
204	1941	1941	4	10	0.11
204	1941	1941	4	11	1.12
204	1941	1941	4	30	0.55
204	1941	1941	5	12	0.06
204	1941	1941	7	26	0.05
204	1941	1941	8	15	0.03
204	1942	1941	10	20	0.19
204	1942	1941	10	22	0.36
204	1942	1941	10	27	0.50
204	1942	1941	11	30	0.32
204	1942	1941	12	3	0.61
204	1942	1941	12	4	0.22
204	1942	1941	12	9	0.03
204	1942	1941	12	10	0.08
204	1942	1941	12	11	0.75
204	1942	1941	12	13	0.05
204	1942	1941	12	15	0.37
204	1942	1941	12	17	0.15
204	1942	1941	12	21	0.04
204	1942	1941	12	26	0.31
204	1942	1941	12	27	0.02
204	1942	1941	12	28	3.87
204	1942	1941	12	29	0.55
204	1942	1941	12	30	0.35
204	1942	1941	12	31	0.51
204	1942	1942	1	1	0.51
204	1942	1942	1	22	0.74
204	1942	1942	1	23	0.02
204	1942	1942	1	25	0.27
204	1942	1942	1	26	0.07
204	1942	1942	1	28	0.24
204	1942	1942	1	29	0.01

station id	water year	year	month	day	daily rain
204	1942	1942	2	3	0.10
204	1942	1942	2	7	0.03
204	1942	1942	2	22	0.55
204	1942	1942	2	24	0.02
204	1942	1942	3	11	0.50
204	1942	1942	3	12	0.03
204	1942	1942	3	15	1.42
204	1942	1942	4	4	0.35
204	1942	1942	4	5	0.05
204	1942	1942	4	6	0.55
204	1942	1942	4	10	0.08
204	1942	1942	4	11	0.06
204	1942	1942	4	13	0.03
204	1942	1942	4	14	0.54
204	1942	1942	4	17	0.48
204	1942	1942	4	21	0.06
204	1942	1942	4	22	1.35
204	1942	1942	4	28	0.08
204	1942	1942	5	1	0.07
204	1942	1942	5	11	0.06
204	1942	1942	5	26	0.10
204	1942	1942	8	10	0.07
204	1943	1942	10	28	0.11
204	1943	1942	10	29	0.69
204	1943	1942	11	4	0.01
204	1943	1942	11	15	0.11
204	1943	1942	11	18	0.04
204	1943	1942	11	19	0.48
204	1943	1942	11	20	0.08
204	1943	1942	12	7	0.02
204	1943	1942	12	24	1.53
204	1943	1942	12	25	0.38
204	1943	1943	1	21	0.30
204	1943	1943	1	22	2.83
204	1943	1943	1	23	2.14
204	1943	1943	1	24	0.23
204	1943	1943	1	25	0.10
204	1943	1943	1	26	0.30
204	1943	1943	1	27	0.50
204	1943	1943	1	30	0.12
204	1943	1943	1	31	0.31
204	1943	1943	2	8	0.09
204	1943	1943	2	9	0.15
204	1943	1943	2	17	0.12
204	1943	1943	2	21	0.35

station id	water year	year	month	day	daily rain
204	1943	1943	2	22	0.97
204	1943	1943	2	23	0.25
204	1943	1943	2	24	0.25
204	1943	1943	3	3	0.14
204	1943	1943	3	4	0.95
204	1943	1943	3	5	0.45
204	1943	1943	3	6	0.03
204	1943	1943	3	7	0.05
204	1943	1943	3	8	0.15
204	1943	1943	3	9	0.35
204	1943	1943	3	10	0.24
204	1943	1943	3	11	0.07
204	1943	1943	3	18	0.30
204	1943	1943	3	30	0.11
204	1943	1943	4	6	0.87
204	1943	1943	4	8	0.12
204	1943	1943	4	15	0.01
204	1944	1943	10	19	0.37
204	1944	1943	10	20	0.07
204	1944	1943	10	21	0.03
204	1944	1943	10	27	0.37
204	1944	1943	10	28	0.09
204	1944	1943	11	18	0.04
204	1944	1943	11	20	0.13
204	1944	1943	12	6	0.74
204	1944	1943	12	10	0.09
204	1944	1943	12	11	0.93
204	1944	1943	12	12	0.03
204	1944	1943	12	18	0.02
204	1944	1943	12	20	0.06
204	1944	1943	12	21	0.58
204	1944	1943	12	28	0.58
204	1944	1943	12	29	0.87
204	1944	1943	12	30	0.32
204	1944	1944	1	2	0.10
204	1944	1944	1	3	0.22
204	1944	1944	1	4	0.04
204	1944	1944	1	6	0.22
204	1944	1944	1	24	0.55
204	1944	1944	1	25	0.03
204	1944	1944	1	27	0.03
204	1944	1944	1	30	0.74
204	1944	1944	2	3	0.13
204	1944	1944	2	4	1.02
204	1944	1944	2	9	0.43

station id	water year	year	month	day	daily rain
204	1944	1944	2	15	0.15
204	1944	1944	2	17	0.03
204	1944	1944	2	20	1.57
204	1944	1944	2	21	0.91
204	1944	1944	2	22	2.13
204	1944	1944	2	23	0.33
204	1944	1944	2	24	0.12
204	1944	1944	2	26	0.09
204	1944	1944	2	27	0.25
204	1944	1944	2	29	0.20
204	1944	1944	3	1	0.23
204	1944	1944	3	2	0.29
204	1944	1944	3	4	0.14
204	1944	1944	3	5	0.35
204	1944	1944	3	14	0.03
204	1944	1944	4	9	0.03
204	1944	1944	4	12	0.05
204	1944	1944	4	27	1.51
204	1944	1944	4	28	0.06
204	1944	1944	5	15	0.04
204	1944	1944	5	18	0.02
204	1945	1944	11	1	0.17
204	1945	1944	11	5	0.28
204	1945	1944	11	10	0.28
204	1945	1944	11	11	0.74
204	1945	1944	11	12	0.77
204	1945	1944	11	13	0.10
204	1945	1944	11	14	0.48
204	1945	1944	11	15	0.35
204	1945	1944	12	2	0.25
204	1945	1944	12	22	0.22
204	1945	1944	12	23	0.50
204	1945	1944	12	28	0.28
204	1945	1944	12	29	0.30
204	1945	1945	1	31	0.10
204	1945	1945	2	1	1.25
204	1945	1945	2	2	1.75
204	1945	1945	2	3	0.69
204	1945	1945	2	4	0.05
204	1945	1945	2	5	0.02
204	1945	1945	2	15	0.04
204	1945	1945	2	28	0.15
204	1945	1945	3	2	0.31
204	1945	1945	3	4	0.25
204	1945	1945	3	15	0.42

station id	water year	year	month	day	daily rain
204	1945	1945	3	17	0.95
204	1945	1945	3	21	0.14
204	1945	1945	3	22	0.02
204	1945	1945	3	23	0.69
204	1945	1945	3	26	0.45
204	1945	1945	3	27	0.03
204	1945	1945	4	9	0.09
204	1945	1945	5	13	0.02
204	1945	1945	6	4	0.02
204	1945	1945	8	2	0.09
204	1946	1945	10	15	0.02
204	1946	1945	10	30	0.44
204	1946	1945	10	31	0.06
204	1946	1945	11	6	0.09
204	1946	1945	11	7	0.10
204	1946	1945	11	11	0.14
204	1946	1945	11	15	0.04
204	1946	1945	11	25	0.22
204	1946	1945	11	29	0.31
204	1946	1945	12	5	0.41
204	1946	1945	12	6	0.33
204	1946	1945	12	22	2.02
204	1946	1945	12	23	0.70
204	1946	1945	12	25	0.40
204	1946	1945	12	26	0.02
204	1946	1946	1	3	0.33
204	1946	1946	1	5	0.31
204	1946	1946	2	3	0.85
204	1946	1946	2	4	0.30
204	1946	1946	2	11	0.07
204	1946	1946	2	16	0.15
204	1946	1946	2	20	0.03
204	1946	1946	3	13	0.06
204	1946	1946	3	14	0.12
204	1946	1946	3	19	0.92
204	1946	1946	3	20	0.31
204	1946	1946	3	28	0.32
204	1946	1946	3	29	0.63
204	1946	1946	3	30	2.14
204	1946	1946	3	31	0.27
204	1946	1946	4	1	1.18
204	1946	1946	4	7	0.01
204	1946	1946	5	22	0.03
204	1946	1946	5	26	0.05
204	1946	1946	5	27	0.03

station id	water year	year	month	day	daily rain
204	1947	1946	10	1	0.08
204	1947	1946	10	16	0.22
204	1947	1946	11	8	0.04
204	1947	1946	11	12	0.70
204	1947	1946	11	13	1.20
204	1947	1946	11	14	0.47
204	1947	1946	11	20	1.73
204	1947	1946	11	21	0.12
204	1947	1946	11	23	0.54
204	1947	1946	11	24	0.04
204	1947	1946	12	5	0.14
204	1947	1946	12	6	0.08
204	1947	1946	12	7	0.15
204	1947	1946	12	24	0.05
204	1947	1946	12	25	0.23
204	1947	1946	12	26	0.34
204	1947	1946	12	27	0.29
204	1947	1946	12	28	0.05
204	1947	1947	1	13	0.01
204	1947	1947	1	28	0.42
204	1947	1947	1	29	0.10
204	1947	1947	2	9	0.13
204	1947	1947	2	10	0.46
204	1947	1947	2	12	0.02
204	1947	1947	2	13	0.02
204	1947	1947	2	17	0.07
204	1947	1947	3	2	0.05
204	1947	1947	3	4	0.35
204	1947	1947	3	20	0.05
204	1947	1947	3	21	0.02
204	1947	1947	3	28	0.39
204	1947	1947	3	29	0.01
204	1947	1947	3	30	0.04
204	1947	1947	4	3	0.04
204	1947	1947	4	4	0.05
204	1947	1947	4	25	0.03
204	1947	1947	5	27	0.11
204	1947	1947	6	7	0.03
204	1947	1947	8	9	0.05
204	1948	1947	10	11	0.14
204	1948	1947	10	17	0.08
204	1948	1947	10	29	0.02
204	1948	1947	10	30	0.10
204	1948	1947	11	2	0.01
204	1948	1947	12	4	0.04

station id	water year	year	month	day	daily rain
204	1948	1947	12	5	0.14
204	1948	1947	12	6	0.02
204	1948	1947	12	18	0.03
204	1948	1947	12	21	0.33
204	1948	1948	1	3	0.01
204	1948	1948	2	2	0.02
204	1948	1948	2	5	0.70
204	1948	1948	2	6	0.29
204	1948	1948	2	7	0.14
204	1948	1948	2	28	0.20
204	1948	1948	2	29	0.01
204	1948	1948	3	9	0.11
204	1948	1948	3	14	1.10
204	1948	1948	3	15	0.22
204	1948	1948	3	17	0.62
204	1948	1948	3	19	0.05
204	1948	1948	3	20	0.04
204	1948	1948	3	24	0.71
204	1948	1948	3	25	0.34
204	1948	1948	3	29	0.07
204	1948	1948	4	3	0.36
204	1948	1948	4	4	0.02
204	1948	1948	4	6	0.04
204	1948	1948	4	9	0.15
204	1948	1948	4	10	0.26
204	1948	1948	4	11	0.06
204	1948	1948	4	22	0.05
204	1948	1948	4	29	0.78
204	1948	1948	5	19	0.05
204	1948	1948	5	30	0.20
204	1948	1948	5	31	0.51
204	1948	1948	6	4	0.06
204	1949	1948	10	12	0.15
204	1949	1948	12	4	0.25
204	1949	1948	12	6	0.05
204	1949	1948	12	14	0.09
204	1949	1948	12	15	0.09
204	1949	1948	12	17	1.41
204	1949	1948	12	18	0.05
204	1949	1948	12	23	0.05
204	1949	1948	12	25	0.03
204	1949	1948	12	26	0.39
204	1949	1948	12	27	1.05
204	1949	1948	12	28	0.12
204	1949	1949	1	1	0.02

station id	water year	year	month	day	daily rain
204	1949	1949	1	2	0.11
204	1949	1949	1	12	0.24
204	1949	1949	1	19	0.02
204	1949	1949	1	20	0.34
204	1949	1949	1	22	0.19
204	1949	1949	1	23	0.34
204	1949	1949	1	24	0.02
204	1949	1949	2	3	0.12
204	1949	1949	2	5	0.14
204	1949	1949	2	7	0.37
204	1949	1949	2	8	0.01
204	1949	1949	2	12	0.21
204	1949	1949	2	24	0.22
204	1949	1949	2	25	0.25
204	1949	1949	2	26	0.08
204	1949	1949	2	27	0.21
204	1949	1949	3	2	0.21
204	1949	1949	3	3	0.07
204	1949	1949	3	4	1.19
204	1949	1949	3	5	0.52
204	1949	1949	3	6	0.06
204	1949	1949	3	8	0.06
204	1949	1949	3	10	0.11
204	1949	1949	3	11	0.52
204	1949	1949	3	12	0.20
204	1949	1949	3	16	0.05
204	1949	1949	3	20	0.71
204	1949	1949	3	23	0.34
204	1949	1949	3	24	0.08
204	1949	1949	4	17	0.24
204	1949	1949	5	18	0.16
204	1949	1949	5	19	0.56
204	1949	1949	5	20	0.03
204	1950	1949	10	19	0.02
204	1950	1949	11	8	0.13
204	1950	1949	11	10	1.50
204	1950	1949	12	8	2.33
204	1950	1949	12	9	0.11
204	1950	1949	12	15	0.43
204	1950	1949	12	18	0.21
204	1950	1949	12	19	0.55
204	1950	1950	1	2	0.06
204	1950	1950	1	8	0.10
204	1950	1950	1	9	0.66
204	1950	1950	1	11	0.48

station id	water year	year	month	day	daily rain
204	1950	1950	1	12	0.15
204	1950	1950	1	14	0.20
204	1950	1950	1	15	0.26
204	1950	1950	1	17	0.15
204	1950	1950	1	24	0.02
204	1950	1950	1	28	0.19
204	1950	1950	1	29	0.25
204	1950	1950	2	5	0.22
204	1950	1950	2	6	0.99
204	1950	1950	2	10	0.23
204	1950	1950	2	11	0.02
204	1950	1950	3	2	0.10
204	1950	1950	3	25	1.39
204	1950	1950	3	26	0.02
204	1950	1950	4	8	0.62
204	1950	1950	5	3	0.15
204	1950	1950	7	10	0.90
204	1951	1950	10	27	0.77
204	1951	1950	10	31	0.09
204	1951	1950	11	13	0.09
204	1951	1950	11	14	0.30
204	1951	1950	11	15	0.05
204	1951	1950	11	17	0.06
204	1951	1950	11	18	0.52
204	1951	1950	11	19	0.25
204	1951	1950	11	20	0.56
204	1951	1950	12	1	0.06
204	1951	1950	12	4	0.40
204	1951	1950	12	7	0.02
204	1951	1950	12	14	0.04
204	1951	1950	12	15	0.13
204	1951	1950	12	26	0.03
204	1951	1951	1	5	0.19
204	1951	1951	1	10	0.50
204	1951	1951	1	11	0.02
204	1951	1951	1	12	0.41
204	1951	1951	1	16	0.16
204	1951	1951	1	18	0.05
204	1951	1951	1	19	0.34
204	1951	1951	1	29	0.42
204	1951	1951	2	5	0.02
204	1951	1951	2	12	0.09
204	1951	1951	2	23	0.10
204	1951	1951	2	25	0.20
204	1951	1951	2	27	1.20

station id	water year	year	month	day	daily rain
204	1951	1951	3	1	1.14
204	1951	1951	3	2	0.17
204	1951	1951	3	5	0.05
204	1951	1951	3	6	0.06
204	1951	1951	4	4	0.10
204	1951	1951	4	19	0.19
204	1951	1951	4	25	0.65
204	1951	1951	4	26	0.01
204	1951	1951	4	28	0.74
204	1951	1951	5	4	0.02
204	1952	1951	10	25	0.59
204	1952	1951	10	26	0.21
204	1952	1951	11	20	0.95
204	1952	1951	11	21	0.24
204	1952	1951	11	22	0.02
204	1952	1951	12	1	0.05
204	1952	1951	12	2	0.54
204	1952	1951	12	4	0.70
204	1952	1951	12	5	0.83
204	1952	1951	12	12	0.29
204	1952	1951	12	13	0.10
204	1952	1951	12	19	0.43
204	1952	1951	12	29	0.28
204	1952	1951	12	30	0.80
204	1952	1951	12	31	0.29
204	1952	1952	1	7	0.74
204	1952	1952	1	8	0.10
204	1952	1952	1	11	0.05
204	1952	1952	1	12	0.44
204	1952	1952	1	13	0.64
204	1952	1952	1	14	0.05
204	1952	1952	1	15	1.36
204	1952	1952	1	16	1.44
204	1952	1952	1	17	0.30
204	1952	1952	1	18	0.48
204	1952	1952	1	21	0.08
204	1952	1952	1	24	0.04
204	1952	1952	1	27	0.87
204	1952	1952	2	2	0.03
204	1952	1952	2	12	0.18
204	1952	1952	2	17	0.11
204	1952	1952	2	21	0.04
204	1952	1952	3	1	0.47
204	1952	1952	3	2	0.06
204	1952	1952	3	4	0.17

station id	water year	year	month	day	daily rain
204	1952	1952	3	7	1.97
204	1952	1952	3	8	0.02
204	1952	1952	3	9	0.30
204	1952	1952	3	10	0.07
204	1952	1952	3	11	0.18
204	1952	1952	3	13	0.18
204	1952	1952	3	15	3.58
204	1952	1952	3	16	0.55
204	1952	1952	3	19	0.20
204	1952	1952	3	20	0.03
204	1952	1952	4	7	0.09
204	1952	1952	4	8	0.20
204	1952	1952	4	10	0.19
204	1952	1952	4	11	0.04
204	1952	1952	4	14	0.01
204	1952	1952	4	26	0.04
204	1952	1952	5	12	0.02
204	1952	1952	6	6	0.03
204	1952	1952	7	30	0.02
204	1953	1952	11	14	0.65
204	1953	1952	11	15	1.31
204	1953	1952	11	16	0.66
204	1953	1952	11	23	0.04
204	1953	1952	11	30	0.74
204	1953	1952	12	2	1.13
204	1953	1952	12	6	0.16
204	1953	1952	12	7	0.15
204	1953	1952	12	8	0.15
204	1953	1952	12	20	1.41
204	1953	1952	12	27	0.29
204	1953	1952	12	28	1.01
204	1953	1952	12	31	1.09
204	1953	1953	1	6	0.10
204	1953	1953	1	7	0.07
204	1953	1953	1	8	0.09
204	1953	1953	1	13	0.17
204	1953	1953	1	14	0.75
204	1953	1953	1	15	0.07
204	1953	1953	1	20	0.01
204	1953	1953	3	2	0.39
204	1953	1953	3	10	0.10
204	1953	1953	3	20	0.59
204	1953	1953	4	8	0.03
204	1953	1953	4	20	0.16
204	1953	1953	4	27	0.13

station id	water year	year	month	day	daily rain
204	1953	1953	4	28	0.95
204	1954	1953	11	5	0.24
204	1954	1953	11	14	2.05
204	1954	1953	11	15	0.07
204	1954	1953	11	20	0.15
204	1954	1953	12	4	0.25
204	1954	1954	1	11	0.43
204	1954	1954	1	12	0.52
204	1954	1954	1	13	0.14
204	1954	1954	1	17	0.02
204	1954	1954	1	18	0.12
204	1954	1954	1	19	0.22
204	1954	1954	1	20	1.24
204	1954	1954	1	23	0.03
204	1954	1954	1	24	0.50
204	1954	1954	1	25	1.42
204	1954	1954	2	13	0.82
204	1954	1954	2	14	0.39
204	1954	1954	2	15	0.05
204	1954	1954	2	17	0.03
204	1954	1954	2	18	0.18
204	1954	1954	3	9	0.15
204	1954	1954	3	10	0.07
204	1954	1954	3	16	0.02
204	1954	1954	3	17	1.39
204	1954	1954	3	18	0.03
204	1954	1954	3	20	1.02
204	1954	1954	3	21	0.34
204	1954	1954	3	24	0.11
204	1954	1954	3	25	0.39
204	1954	1954	3	30	0.79
204	1954	1954	4	28	0.26
204	1954	1954	5	15	0.02
204	1955	1954	11	11	0.31
204	1955	1954	11	12	0.10
204	1955	1954	11	16	0.88
204	1955	1954	12	3	0.32
204	1955	1954	12	4	1.53
204	1955	1954	12	10	0.82
204	1955	1954	12	15	0.01
204	1955	1955	1	1	0.10
204	1955	1955	1	2	0.72
204	1955	1955	1	5	0.02
204	1955	1955	1	10	1.06
204	1955	1955	1	11	0.22

station id	water year	year	month	day	daily rain
204	1955	1955	1	16	0.62
204	1955	1955	1	17	0.08
204	1955	1955	1	18	1.06
204	1955	1955	1	19	0.47
204	1955	1955	1	20	0.02
204	1955	1955	1	31	0.05
204	1955	1955	2	1	0.01
204	1955	1955	2	17	0.76
204	1955	1955	2	18	0.06
204	1955	1955	2	26	0.12
204	1955	1955	2	27	0.33
204	1955	1955	2	28	0.14
204	1955	1955	3	9	0.01
204	1955	1955	3	10	0.09
204	1955	1955	3	11	0.23
204	1955	1955	4	18	0.06
204	1955	1955	4	21	0.05
204	1955	1955	4	22	1.06
204	1955	1955	4	23	0.02
204	1955	1955	4	26	0.14
204	1955	1955	4	30	0.53
204	1955	1955	5	1	0.10
204	1955	1955	5	2	0.09
204	1955	1955	5	7	0.21
204	1955	1955	5	8	0.79
204	1955	1955	5	30	0.02
204	1955	1955	6	14	0.02
204	1955	1955	8	5	0.01
204	1956	1955	11	14	1.40
204	1956	1955	11	17	0.25
204	1956	1955	11	18	0.11
204	1956	1955	11	21	0.20
204	1956	1955	12	1	0.01
204	1956	1955	12	2	0.13
204	1956	1955	12	4	0.34
204	1956	1955	12	5	0.02
204	1956	1955	12	6	0.12
204	1956	1955	12	7	0.18
204	1956	1955	12	9	0.02
204	1956	1955	12	20	0.04
204	1956	1955	12	23	0.17
204	1956	1955	12	24	1.25
204	1956	1955	12	25	3.15
204	1956	1955	12	26	0.12
204	1956	1955	12	27	0.74

station id	water year	year	month	day	daily rain
204	1956	1955	12	31	0.18
204	1956	1956	1	2	0.02
204	1956	1956	1	16	0.04
204	1956	1956	1	20	0.02
204	1956	1956	1	21	0.02
204	1956	1956	1	23	0.16
204	1956	1956	1	25	1.17
204	1956	1956	1	26	2.24
204	1956	1956	1	27	0.76
204	1956	1956	1	31	0.27
204	1956	1956	2	18	0.04
204	1956	1956	2	23	0.30
204	1956	1956	2	24	0.18
204	1956	1956	2	26	0.07
204	1956	1956	4	1	0.06
204	1956	1956	4	2	0.02
204	1956	1956	4	11	0.06
204	1956	1956	4	12	0.94
204	1956	1956	4	14	0.04
204	1956	1956	4	15	0.01
204	1956	1956	4	27	0.36
204	1956	1956	4	28	0.39
204	1956	1956	5	4	0.04
204	1956	1956	5	9	0.73
204	1956	1956	5	10	0.42
204	1957	1956	10	2	0.01
204	1957	1956	10	4	0.53
204	1957	1956	10	6	0.04
204	1957	1956	10	7	0.02
204	1957	1956	10	31	0.04
204	1957	1956	12	5	0.06
204	1957	1956	12	6	0.30
204	1957	1957	1	4	0.40
204	1957	1957	1	7	0.04
204	1957	1957	1	12	0.01
204	1957	1957	1	13	1.23
204	1957	1957	1	14	0.02
204	1957	1957	1	20	0.10
204	1957	1957	1	21	0.58
204	1957	1957	1	23	0.03
204	1957	1957	1	24	0.23
204	1957	1957	1	26	0.39
204	1957	1957	1	27	0.01
204	1957	1957	1	29	0.13
204	1957	1957	2	8	0.41

station id	water year	year	month	day	daily rain
204	1957	1957	2	9	0.47
204	1957	1957	2	10	0.02
204	1957	1957	2	17	0.01
204	1957	1957	2	18	0.03
204	1957	1957	2	20	0.01
204	1957	1957	2	23	0.91
204	1957	1957	2	24	0.04
204	1957	1957	2	28	0.30
204	1957	1957	3	1	0.76
204	1957	1957	3	9	0.05
204	1957	1957	3	10	0.15
204	1957	1957	3	16	0.17
204	1957	1957	3	19	0.11
204	1957	1957	4	14	0.06
204	1957	1957	4	17	0.01
204	1957	1957	4	18	0.97
204	1957	1957	4	20	0.13
204	1957	1957	4	21	0.13
204	1957	1957	5	11	0.02
204	1957	1957	5	12	0.25
204	1957	1957	5	15	0.09
204	1957	1957	5	19	0.60
204	1957	1957	5	20	0.05
204	1957	1957	5	21	0.27
204	1957	1957	6	10	0.08
204	1958	1957	10	11	0.18
204	1958	1957	10	12	0.01
204	1958	1957	10	13	0.06
204	1958	1957	10	14	0.34
204	1958	1957	10	20	0.01
204	1958	1957	10	21	0.22
204	1958	1957	11	3	0.20
204	1958	1957	11	14	0.11
204	1958	1957	11	15	0.09
204	1958	1957	11	17	0.03
204	1958	1957	12	5	1.06
204	1958	1957	12	6	0.54
204	1958	1957	12	15	0.25
204	1958	1957	12	16	0.65
204	1958	1957	12	17	0.91
204	1958	1957	12	18	0.01
204	1958	1957	12	19	0.07
204	1958	1957	12	22	0.02
204	1958	1958	1	2	0.09
204	1958	1958	1	10	0.18

station id	water year	year	month	day	daily rain
204	1958	1958	1	24	0.01
204	1958	1958	1	25	0.67
204	1958	1958	1	26	1.62
204	1958	1958	1	27	0.29
204	1958	1958	1	30	0.17
204	1958	1958	2	3	1.43
204	1958	1958	2	4	0.79
204	1958	1958	2	5	0.34
204	1958	1958	2	7	0.10
204	1958	1958	2	8	0.26
204	1958	1958	2	13	0.52
204	1958	1958	2	19	1.73
204	1958	1958	2	25	1.84
204	1958	1958	2	26	0.18
204	1958	1958	3	1	0.12
204	1958	1958	3	2	0.01
204	1958	1958	3	6	0.32
204	1958	1958	3	7	0.02
204	1958	1958	3	9	0.02
204	1958	1958	3	11	0.15
204	1958	1958	3	12	0.01
204	1958	1958	3	13	0.11
204	1958	1958	3	14	0.07
204	1958	1958	3	15	0.69
204	1958	1958	3	16	0.81
204	1958	1958	3	17	0.14
204	1958	1958	3	20	0.06
204	1958	1958	3	21	0.63
204	1958	1958	3	22	0.76
204	1958	1958	3	24	0.07
204	1958	1958	3	27	0.97
204	1958	1958	3	28	0.39
204	1958	1958	3	30	0.31
204	1958	1958	3	31	0.19
204	1958	1958	4	1	1.11
204	1958	1958	4	2	0.58
204	1958	1958	4	3	1.61
204	1958	1958	4	4	0.52
204	1958	1958	4	5	1.26
204	1958	1958	4	6	1.31
204	1958	1958	5	1	0.05
204	1958	1958	5	11	0.01
204	1958	1958	5	12	0.02
204	1958	1958	5	22	0.25
204	1959	1958	9	7	0.59

station id	water year	year	month	day	daily rain
204	1959	1958	9	8	0.32
204	1959	1958	9	23	0.56
204	1959	1958	9	24	0.15
204	1959	1958	11	10	0.10
204	1959	1958	11	11	0.03
204	1959	1958	11	15	0.04
204	1959	1958	12	28	0.10
204	1959	1958	12	29	0.11
204	1959	1959	1	6	2.05
204	1959	1959	1	7	0.07
204	1959	1959	1	10	0.08
204	1959	1959	1	13	0.30
204	1959	1959	2	7	0.02
204	1959	1959	2	8	0.18
204	1959	1959	2	10	0.21
204	1959	1959	2	11	1.57
204	1959	1959	2	12	0.45
204	1959	1959	2	16	0.58
204	1959	1959	2	17	0.34
204	1959	1959	2	18	0.03
204	1959	1959	2	19	0.09
204	1959	1959	2	21	1.32
204	1959	1959	2	22	0.19
204	1959	1959	4	25	0.31
204	1959	1959	4	26	0.19
204	1959	1959	4	27	0.18
204	1960	1959	9	17	0.01
204	1960	1959	9	19	0.04
204	1960	1959	12	10	0.06
204	1960	1959	12	24	0.36
204	1960	1959	12	25	0.47
204	1960	1960	1	1	0.02
204	1960	1960	1	10	2.30
204	1960	1960	1	11	0.12
204	1960	1960	1	12	0.78
204	1960	1960	1	14	0.20
204	1960	1960	1	15	0.53
204	1960	1960	1	23	0.39
204	1960	1960	1	25	0.16
204	1960	1960	2	2	2.02
204	1960	1960	2	3	0.04
204	1960	1960	2	4	0.13
204	1960	1960	2	6	0.13
204	1960	1960	2	9	0.40
204	1960	1960	2	10	0.41

station id	water year	year	month	day	daily rain
204	1960	1960	2	11	0.05
204	1960	1960	2	19	0.04
204	1960	1960	2	29	0.75
204	1960	1960	3	13	0.29
204	1960	1960	3	23	0.01
204	1960	1960	3	28	0.49
204	1960	1960	4	23	0.17
204	1960	1960	4	24	0.12
204	1960	1960	4	27	1.47
204	1960	1960	4	28	0.89
204	1961	1960	10	6	0.64
204	1961	1960	11	4	0.38
204	1961	1960	11	6	0.67
204	1961	1960	11	12	0.24
204	1961	1960	11	13	0.44
204	1961	1960	11	14	0.08
204	1961	1960	11	26	0.77
204	1961	1960	11	27	0.65
204	1961	1960	12	2	0.95
204	1961	1960	12	11	0.07
204	1961	1961	1	26	0.89
204	1961	1961	1	27	0.01
204	1961	1961	2	1	0.11
204	1961	1961	2	12	0.01
204	1961	1961	3	6	0.08
204	1961	1961	3	15	0.58
204	1961	1961	3	17	0.10
204	1961	1961	3	25	0.09
204	1961	1961	3	27	0.02
204	1961	1961	3	28	0.01
204	1961	1961	4	22	0.25
204	1961	1961	5	7	0.16
204	1962	1961	11	20	2.16
204	1962	1961	11	21	0.47
204	1962	1961	11	25	0.02
204	1962	1961	11	26	0.64
204	1962	1961	11	30	0.06
204	1962	1961	12	2	2.13
204	1962	1961	12	3	0.16
204	1962	1961	12	14	0.04
204	1962	1961	12	15	0.01
204	1962	1961	12	16	0.01
204	1962	1961	12	17	0.01
204	1962	1962	1	13	0.10
204	1962	1962	1	20	2.00

station id	water year	year	month	day	daily rain
204	1962	1962	1	21	0.34
204	1962	1962	1	22	0.38
204	1962	1962	1	23	0.12
204	1962	1962	2	7	0.32
204	1962	1962	2	8	1.24
204	1962	1962	2	9	0.89
204	1962	1962	2	10	2.61
204	1962	1962	2	11	2.27
204	1962	1962	2	12	0.76
204	1962	1962	2	14	0.17
204	1962	1962	2	15	1.02
204	1962	1962	2	16	0.36
204	1962	1962	2	17	0.04
204	1962	1962	2	19	1.76
204	1962	1962	2	20	0.13
204	1962	1962	2	21	0.40
204	1962	1962	2	24	0.02
204	1962	1962	2	25	0.10
204	1962	1962	2	26	0.42
204	1962	1962	3	2	0.08
204	1962	1962	3	3	0.08
204	1962	1962	3	5	0.05
204	1962	1962	3	6	0.75
204	1962	1962	3	7	0.34
204	1962	1962	3	8	0.02
204	1962	1962	3	15	0.06
204	1962	1962	3	19	0.21
204	1962	1962	3	20	0.02
204	1962	1962	3	21	0.02
204	1962	1962	3	23	0.32
204	1962	1962	3	28	0.02
204	1962	1962	4	28	0.04
204	1962	1962	5	12	0.01
204	1962	1962	5	17	0.08
204	1962	1962	5	27	0.01
204	1963	1962	10	14	0.46
204	1963	1962	11	2	0.01
204	1963	1962	12	16	0.28
204	1963	1962	12	17	0.16
204	1963	1963	1	30	0.06
204	1963	1963	1	31	0.42
204	1963	1963	2	1	0.52
204	1963	1963	2	2	0.32
204	1963	1963	2	9	0.16
204	1963	1963	2	10	2.65

station id	water year	year	month	day	daily rain
204	1963	1963	2	11	0.86
204	1963	1963	2	13	0.20
204	1963	1963	2	14	0.05
204	1963	1963	3	7	0.02
204	1963	1963	3	9	0.18
204	1963	1963	3	10	0.07
204	1963	1963	3	15	0.16
204	1963	1963	3	16	0.06
204	1963	1963	3	17	1.52
204	1963	1963	3	23	0.46
204	1963	1963	3	28	1.16
204	1963	1963	4	7	0.05
204	1963	1963	4	8	0.12
204	1963	1963	4	9	0.02
204	1963	1963	4	10	0.03
204	1963	1963	4	14	0.68
204	1963	1963	4	15	0.21
204	1963	1963	4	17	0.02
204	1963	1963	4	18	0.02
204	1963	1963	4	19	0.02
204	1963	1963	4	20	0.04
204	1963	1963	4	21	0.43
204	1963	1963	4	26	0.97
204	1963	1963	5	9	0.23
204	1963	1963	5	11	0.01
204	1963	1963	5	25	0.01
204	1963	1963	5	28	0.05
204	1963	1963	6	11	0.14
204	1963	1963	6	12	0.03
204	1963	1963	8	8	0.27
204	1963	1963	8	9	0.04
204	1964	1963	9	5	0.28
204	1964	1963	9	18	0.29
204	1964	1963	9	19	0.44
204	1964	1963	10	10	0.12
204	1964	1963	10	11	0.13
204	1964	1963	10	16	0.89
204	1964	1963	11	3	0.09
204	1964	1963	11	6	0.57
204	1964	1963	11	7	0.04
204	1964	1963	11	15	0.27
204	1964	1963	11	20	0.93
204	1964	1963	11	21	0.05
204	1964	1963	11	24	0.08
204	1964	1963	12	9	0.14

station id	water year	year	month	day	daily rain
204	1964	1963	12	10	0.02
204	1964	1964	1	18	0.05
204	1964	1964	1	20	0.05
204	1964	1964	1	21	0.68
204	1964	1964	1	22	0.83
204	1964	1964	1	23	0.10
204	1964	1964	1	26	0.10
204	1964	1964	2	16	0.03
204	1964	1964	2	29	0.09
204	1964	1964	3	2	0.17
204	1964	1964	3	8	0.04
204	1964	1964	3	12	0.02
204	1964	1964	3	13	0.12
204	1964	1964	3	22	0.03
204	1964	1964	3	23	1.20
204	1964	1964	3	24	0.30
204	1964	1964	3	25	0.11
204	1964	1964	4	1	1.34
204	1964	1964	4	23	0.02
204	1964	1964	4	24	0.04
204	1964	1964	4	28	0.02
204	1964	1964	4	29	0.07
204	1964	1964	5	5	0.03
204	1964	1964	5	6	0.24
204	1964	1964	5	7	0.14
204	1964	1964	5	17	0.03
204	1964	1964	6	9	0.07
204	1964	1964	7	27	0.02
204	1965	1964	10	27	0.01
204	1965	1964	10	28	0.47
204	1965	1964	10	29	0.98
204	1965	1964	10	30	0.01
204	1965	1964	11	1	0.10
204	1965	1964	11	8	0.16
204	1965	1964	11	9	0.64
204	1965	1964	11	10	0.84
204	1965	1964	11	11	0.06
204	1965	1964	11	12	0.59
204	1965	1964	11	13	0.01
204	1965	1964	11	14	0.01
204	1965	1964	12	18	0.01
204	1965	1964	12	19	0.18
204	1965	1964	12	20	0.18
204	1965	1964	12	21	0.01
204	1965	1964	12	23	0.17

station id	water year	year	month	day	daily rain
204	1965	1964	12	24	0.11
204	1965	1964	12	27	0.38
204	1965	1964	12	28	0.45
204	1965	1964	12	29	0.03
204	1965	1964	12	30	0.08
204	1965	1964	12	31	0.51
204	1965	1965	1	4	0.14
204	1965	1965	1	5	0.03
204	1965	1965	1	6	0.12
204	1965	1965	1	7	0.23
204	1965	1965	1	24	0.18
204	1965	1965	1	25	0.02
204	1965	1965	2	5	0.40
204	1965	1965	2	6	0.10
204	1965	1965	2	7	0.01
204	1965	1965	3	5	0.50
204	1965	1965	3	6	0.09
204	1965	1965	3	7	0.22
204	1965	1965	3	8	0.21
204	1965	1965	3	9	0.05
204	1965	1965	3	10	0.25
204	1965	1965	3	11	0.02
204	1965	1965	3	31	1.03
204	1965	1965	4	1	0.01
204	1965	1965	4	2	0.19
204	1965	1965	4	3	0.49
204	1965	1965	4	4	0.33
204	1965	1965	4	5	0.07
204	1965	1965	4	6	0.09
204	1965	1965	4	7	0.26
204	1965	1965	4	8	1.43
204	1965	1965	4	9	0.14
204	1965	1965	4	10	1.03
204	1965	1965	4	11	0.12
204	1965	1965	4	12	0.01
204	1965	1965	4	13	0.03
204	1966	1965	10	15	0.01
204	1966	1965	11	13	0.31
204	1966	1965	11	14	0.21
204	1966	1965	11	15	0.63
204	1966	1965	11	16	1.35
204	1966	1965	11	17	0.58
204	1966	1965	11	18	0.03
204	1966	1965	11	22	0.01
204	1966	1965	11	23	0.35

station id	water year	year	month	day	daily rain
204	1966	1965	11	24	1.98
204	1966	1965	11	25	0.32
204	1966	1965	11	26	0.02
204	1966	1965	12	10	0.02
204	1966	1965	12	12	0.38
204	1966	1965	12	13	0.07
204	1966	1965	12	14	0.13
204	1966	1965	12	25	0.04
204	1966	1965	12	29	1.90
204	1966	1965	12	30	0.49
204	1966	1965	12	31	0.40
204	1966	1966	1	1	0.23
204	1966	1966	1	20	0.12
204	1966	1966	1	26	0.09
204	1966	1966	1	30	1.39
204	1966	1966	1	31	0.20
204	1966	1966	2	2	0.15
204	1966	1966	2	5	0.03
204	1966	1966	2	6	0.59
204	1966	1966	2	8	0.01
204	1966	1966	2	10	0.02
204	1966	1966	2	26	0.07
204	1966	1966	3	2	0.25
204	1966	1966	3	3	0.03
204	1966	1966	4	10	0.09
204	1966	1966	5	5	0.03
204	1966	1966	6	16	0.02
204	1967	1966	9	29	0.09
204	1967	1966	11	7	0.68
204	1967	1966	11	8	0.64
204	1967	1966	11	16	0.03
204	1967	1966	11	20	0.35
204	1967	1966	11	21	0.03
204	1967	1966	11	22	0.09
204	1967	1966	11	29	0.20
204	1967	1967	1	22	1.43
204	1967	1967	1	24	1.05
204	1967	1967	1	25	1.89
204	1967	1967	1	30	0.04
204	1967	1967	1	31	0.26
204	1967	1967	2	25	0.31
204	1967	1967	3	4	0.17
204	1967	1967	3	11	0.12
204	1967	1967	3	12	0.65
204	1967	1967	3	13	0.41

station id	water year	year	month	day	daily rain
204	1967	1967	3	14	0.23
204	1967	1967	3	17	0.11
204	1967	1967	3	31	0.61
204	1967	1967	4	1	0.21
204	1967	1967	4	2	0.26
204	1967	1967	4	4	0.10
204	1967	1967	4	5	0.40
204	1967	1967	4	7	0.56
204	1967	1967	4	8	0.02
204	1967	1967	4	11	0.84
204	1967	1967	4	12	0.03
204	1967	1967	4	15	0.10
204	1967	1967	4	16	0.10
204	1967	1967	4	18	0.63
204	1967	1967	4	19	0.52
204	1967	1967	4	20	0.21
204	1967	1967	4	21	0.15
204	1967	1967	4	22	0.56
204	1967	1967	4	23	0.01
204	1967	1967	4	24	0.22
204	1967	1967	4	29	0.06
204	1968	1967	9	21	0.05
204	1968	1967	9	28	0.10
204	1968	1967	9	29	0.13
204	1967	1966	12	3	1.70
204	1967	1966	12	5	0.34
204	1967	1966	12	6	2.00
204	1967	1966	12	7	1.35
204	1968	1967	11	19	0.37
204	1968	1967	11	20	0.35
204	1968	1967	11	21	0.44
204	1968	1967	11	22	0.27
204	1968	1967	11	27	0.02
204	1968	1967	11	30	0.61
204	1968	1967	12	1	0.05
204	1968	1967	12	4	0.02
204	1968	1967	12	5	0.05
204	1968	1967	12	7	0.08
204	1968	1967	12	19	0.57
204	1968	1967	12	20	0.23
204	1968	1967	12	21	0.03
204	1968	1968	1	10	0.06
204	1968	1968	1	11	0.18
204	1968	1968	1	16	0.03
204	1968	1968	1	27	0.01

station id	water year	year	month	day	daily rain
204	1968	1968	1	28	0.82
204	1968	1968	1	30	0.35
204	1968	1968	2	13	0.16
204	1968	1968	2	17	0.62
204	1968	1968	2	18	0.08
204	1968	1968	2	21	0.02
204	1968	1968	3	7	0.09
204	1968	1968	3	8	1.44
204	1968	1968	3	9	0.02
204	1968	1968	3	13	0.91
204	1968	1968	3	14	0.02
204	1968	1968	3	17	0.35
204	1968	1968	4	2	0.97
204	1968	1968	5	12	0.02
204	1968	1968	5	13	0.14
204	1969	1968	10	13	0.20
204	1969	1968	10	14	1.36
204	1969	1968	10	30	0.37
204	1969	1968	11	3	0.16
204	1969	1968	11	4	0.05
204	1969	1968	11	15	0.90
204	1969	1968	11	16	0.05
204	1969	1968	11	30	0.02
204	1969	1968	12	10	0.29
204	1969	1968	12	14	0.14
204	1969	1968	12	15	0.11
204	1969	1968	12	16	0.34
204	1969	1968	12	20	0.10
204	1969	1968	12	25	0.10
204	1969	1968	12	26	0.60
204	1969	1968	12	27	0.01
204	1969	1968	12	29	0.11
204	1969	1969	1	14	0.67
204	1969	1969	1	19	1.19
204	1969	1969	1	20	1.47
204	1969	1969	1	21	1.20
204	1969	1969	1	22	0.36
204	1969	1969	1	24	0.40
204	1969	1969	1	25	2.44
204	1969	1969	1	26	1.07
204	1969	1969	1	27	0.05
204	1969	1969	1	28	0.17
204	1969	1969	1	29	0.35
204	1969	1969	1	31	0.02
204	1969	1969	2	5	0.56

station id	water year	year	month	day	daily rain
204	1969	1969	2	6	1.00
204	1969	1969	2	7	0.30
204	1969	1969	2	12	0.37
204	1969	1969	2	15	0.37
204	1969	1969	2	16	0.12
204	1969	1969	2	18	0.41
204	1969	1969	2	19	0.50
204	1969	1969	2	20	0.48
204	1969	1969	2	21	0.01
204	1969	1969	2	22	0.80
204	1969	1969	2	23	0.85
204	1969	1969	2	24	0.46
204	1969	1969	2	25	2.46
204	1969	1969	2	26	0.32
204	1969	1969	2	28	0.46
204	1969	1969	3	1	0.58
204	1969	1969	3	10	0.30
204	1969	1969	3	13	0.08
204	1969	1969	3	21	0.17
204	1969	1969	3	22	0.20
204	1969	1969	4	3	0.78
204	1969	1969	4	5	1.08
204	1969	1969	4	6	0.02
204	1969	1969	4	10	0.02
204	1969	1969	5	4	0.10
204	1970	1969	9	6	0.03
204	1970	1969	9	7	0.05
204	1970	1969	9	16	0.03
204	1970	1969	10	16	0.08
204	1970	1969	10	17	0.05
204	1970	1969	11	6	0.86
204	1970	1969	11	7	0.64
204	1970	1969	11	8	0.04
204	1970	1969	12	9	0.15
204	1970	1969	12	20	0.10
204	1970	1969	12	21	0.05
204	1970	1969	12	22	0.08
204	1970	1969	12	25	0.04
204	1970	1969	12	26	0.11
204	1970	1970	1	9	0.11
204	1970	1970	1	10	1.05
204	1970	1970	1	11	0.07
204	1970	1970	1	12	0.14
204	1970	1970	1	15	0.07
204	1970	1970	1	16	1.02

station id	water year	year	month	day	daily rain
204	1970	1970	1	17	0.40
204	1970	1970	1	20	0.08
204	1970	1970	1	24	0.12
204	1970	1970	2	10	0.10
204	1970	1970	2	11	0.32
204	1970	1970	2	13	0.12
204	1970	1970	2	17	0.06
204	1970	1970	2	28	0.75
204	1970	1970	3	1	1.60
204	1970	1970	3	2	0.50
204	1970	1970	3	5	1.05
204	1970	1970	3	10	0.05
204	1970	1970	3	11	0.05
204	1970	1970	4	14	0.09
204	1970	1970	4	27	0.10
204	1971	1970	10	21	0.03
204	1971	1970	11	4	0.02
204	1971	1970	11	5	0.13
204	1971	1970	11	6	0.14
204	1971	1970	11	7	0.03
204	1971	1970	11	26	1.38
204	1971	1970	11	28	0.15
204	1971	1970	11	29	0.60
204	1971	1970	11	30	0.48
204	1971	1970	12	1	0.04
204	1971	1970	12	2	0.56
204	1971	1970	12	3	0.02
204	1971	1970	12	9	0.11
204	1971	1970	12	14	0.10
204	1971	1970	12	16	0.13
204	1971	1970	12	17	0.51
204	1971	1970	12	18	0.30
204	1971	1970	12	19	1.03
204	1971	1970	12	21	1.03
204	1971	1970	12	22	0.53
204	1971	1970	12	26	0.08
204	1971	1971	1	2	0.23
204	1971	1971	1	12	0.16
204	1971	1971	1	13	0.24
204	1971	1971	1	14	0.16
204	1971	1971	1	20	0.01
204	1971	1971	2	17	0.57
204	1971	1971	2	19	0.05
204	1971	1971	3	13	0.62
204	1971	1971	3	26	0.03

station id	water year	year	month	day	daily rain
204	1971	1971	3	27	0.01
204	1971	1971	4	14	0.60
204	1971	1971	4	18	0.14
204	1971	1971	5	3	0.05
204	1971	1971	5	6	0.03
204	1971	1971	5	7	0.08
204	1971	1971	5	27	0.10
204	1971	1971	5	28	0.69
204	1972	1971	9	30	0.04
204	1972	1971	10	15	0.09
204	1972	1971	10	16	0.12
204	1972	1971	10	25	0.06
204	1972	1971	11	11	0.01
204	1972	1971	11	12	0.25
204	1972	1971	11	14	0.01
204	1972	1971	11	29	0.09
204	1972	1971	12	3	0.40
204	1972	1971	12	4	0.05
204	1972	1971	12	13	0.23
204	1972	1971	12	22	0.63
204	1972	1971	12	23	0.58
204	1972	1971	12	24	0.26
204	1972	1971	12	25	0.32
204	1972	1971	12	26	0.65
204	1972	1971	12	27	2.75
204	1972	1971	12	28	0.15
204	1972	1972	1	27	0.07
204	1972	1972	1	28	0.02
204	1972	1972	2	5	0.15
204	1972	1972	2	22	0.13
204	1972	1972	4	11	0.10
204	1972	1972	4	12	0.05
204	1972	1972	4	13	0.04
204	1972	1972	5	20	0.10
204	1972	1972	7	30	0.05
204	1973	1972	10	12	0.23
204	1973	1972	10	13	0.08
204	1973	1972	10	15	0.09
204	1973	1972	10	16	0.03
204	1973	1972	10	18	0.10
204	1973	1972	10	19	0.02
204	1973	1972	11	4	0.52
204	1973	1972	11	10	0.34
204	1973	1972	11	11	0.30
204	1973	1972	11	13	0.07

station id	water year	year	month	day	daily rain
204	1973	1972	11	14	1.07
204	1973	1972	11	15	0.83
204	1973	1972	11	16	0.71
204	1973	1972	12	4	0.53
204	1973	1972	12	5	0.06
204	1973	1972	12	6	0.35
204	1973	1972	12	7	0.25
204	1973	1972	12	8	0.03
204	1973	1973	1	4	0.05
204	1973	1973	1	5	0.14
204	1973	1973	1	8	0.03
204	1973	1973	1	9	0.54
204	1973	1973	1	10	0.35
204	1973	1973	1	16	0.10
204	1973	1973	1	17	1.21
204	1973	1973	1	18	0.17
204	1973	1973	1	19	2.12
204	1973	1973	1	20	0.09
204	1973	1973	1	26	0.02
204	1973	1973	1	29	0.17
204	1973	1973	2	3	0.12
204	1973	1973	2	4	0.67
204	1973	1973	2	5	0.02
204	1973	1973	2	6	0.56
204	1973	1973	2	7	0.61
204	1973	1973	2	8	0.03
204	1973	1973	2	10	0.32
204	1973	1973	2	11	1.94
204	1973	1973	2	12	0.14
204	1973	1973	2	13	0.60
204	1973	1973	2	15	0.13
204	1973	1973	2	24	0.46
204	1973	1973	2	27	0.10
204	1973	1973	2	28	1.51
204	1973	1973	3	4	0.24
204	1973	1973	3	7	0.34
204	1973	1973	3	8	0.35
204	1973	1973	3	9	0.10
204	1973	1973	3	11	0.38
204	1973	1973	3	12	0.17
204	1973	1973	3	13	0.01
204	1973	1973	3	20	1.48
204	1973	1973	3	21	0.03
204	1973	1973	3	22	0.38
204	1973	1973	4	13	0.05

station id	water year	year	month	day	daily rain
204	1973	1973	5	31	0.19
204	1974	1973	9	5	0.05
204	1974	1973	10	8	0.12
204	1974	1973	10	22	0.05
204	1974	1973	10	23	0.15
204	1974	1973	11	12	0.51
204	1974	1973	11	14	0.04
204	1974	1973	11	17	0.25
204	1974	1973	11	18	0.85
204	1974	1973	11	23	0.74
204	1974	1973	11	26	0.03
204	1974	1973	12	1	1.03
204	1974	1973	12	14	0.07
204	1974	1973	12	22	0.37
204	1974	1973	12	27	0.15
204	1974	1973	12	28	0.61
204	1974	1974	1	1	0.10
204	1974	1974	1	2	0.07
204	1974	1974	1	4	1.51
204	1974	1974	1	5	0.42
204	1974	1974	1	6	0.43
204	1974	1974	1	7	1.38
204	1974	1974	1	8	0.88
204	1974	1974	1	12	0.13
204	1974	1974	1	13	0.02
204	1974	1974	1	17	0.84
204	1974	1974	1	19	0.02
204	1974	1974	1	20	0.03
204	1974	1974	1	21	0.09
204	1974	1974	2	13	0.05
204	1974	1974	2	20	0.08
204	1974	1974	3	1	0.10
204	1974	1974	3	2	0.90
204	1974	1974	3	3	0.27
204	1974	1974	3	4	0.10
204	1974	1974	3	7	0.03
204	1974	1974	3	8	0.98
204	1974	1974	3	26	0.38
204	1974	1974	3	27	0.43
204	1974	1974	3	28	0.06
204	1974	1974	3	29	0.10
204	1974	1974	3	30	0.50
204	1974	1974	3	31	0.15
204	1974	1974	4	2	0.85
204	1974	1974	4	9	0.05

station id	water year	year	month	day	daily rain
204	1974	1974	4	24	0.06
204	1975	1974	10	8	0.04
204	1975	1974	10	28	0.54
204	1975	1974	10	29	0.43
204	1975	1974	11	1	0.03
204	1975	1974	11	22	0.23
204	1975	1974	12	4	3.14
204	1975	1974	12	28	1.40
204	1975	1974	12	29	0.56
204	1975	1974	12	31	0.02
204	1975	1975	1	7	0.05
204	1975	1975	1	8	0.04
204	1975	1975	1	9	0.07
204	1975	1975	1	31	0.05
204	1975	1975	2	1	0.18
204	1975	1975	2	2	0.65
204	1975	1975	2	3	2.28
204	1975	1975	2	4	0.15
204	1975	1975	2	5	0.45
204	1975	1975	2	9	0.22
204	1975	1975	2	10	0.20
204	1975	1975	2	13	0.05
204	1975	1975	2	14	0.05
204	1975	1975	3	5	0.04
204	1975	1975	3	6	1.35
204	1975	1975	3	7	0.86
204	1975	1975	3	8	1.18
204	1975	1975	3	9	0.03
204	1975	1975	3	10	0.08
204	1975	1975	3	11	0.64
204	1975	1975	3	14	0.40
204	1975	1975	3	16	0.13
204	1975	1975	3	22	0.50
204	1975	1975	3	25	0.06
204	1975	1975	3	26	0.02
204	1975	1975	4	5	0.39
204	1975	1975	4	6	0.35
204	1975	1975	4	25	0.12
204	1976	1975	10	7	0.05
204	1976	1975	10	11	0.50
204	1976	1975	10	27	0.07
204	1976	1975	10	30	0.17
204	1976	1975	10	31	0.05
204	1976	1975	12	12	0.03
204	1976	1975	12	13	0.11

station id	water year	year	month	day	daily rain
204	1976	1975	12	14	0.03
204	1976	1976	1	11	0.01
204	1976	1976	2	6	0.24
204	1976	1976	2	7	0.53
204	1976	1976	2	8	0.65
204	1976	1976	2	9	1.89
204	1976	1976	2	10	1.05
204	1976	1976	2	11	2.00
204	1976	1976	2	14	0.12
204	1976	1976	2	15	0.03
204	1976	1976	2	19	0.01
204	1976	1976	2	20	0.02
204	1976	1976	2	24	0.14
204	1976	1976	3	2	0.82
204	1976	1976	3	3	0.09
204	1976	1976	3	4	0.76
204	1976	1976	4	5	0.15
204	1976	1976	4	6	0.10
204	1976	1976	4	7	0.03
204	1976	1976	4	9	0.38
204	1976	1976	4	10	0.10
204	1976	1976	4	12	0.08
204	1976	1976	4	14	0.40
204	1976	1976	4	16	0.07
204	1976	1976	5	8	0.03
204	1976	1976	6	11	0.13
204	1976	1976	7	16	0.02
204	1976	1976	8	16	0.07
204	1976	1976	8	19	0.20
204	1976	1976	8	20	0.17
204	1977	1976	9	10	0.14
204	1977	1976	9	11	2.32
204	1977	1976	9	20	0.03
204	1977	1976	9	29	2.18
204	1977	1976	9	30	0.15
204	1977	1976	10	1	0.27
204	1977	1976	10	21	0.06
204	1977	1976	10	23	0.05
204	1977	1976	11	11	0.01
204	1977	1976	11	12	0.26
204	1977	1976	11	13	0.05
204	1977	1976	11	14	0.07
204	1977	1976	12	30	0.48
204	1977	1976	12	31	0.29
204	1977	1977	1	1	0.02

station id	water year	year	month	day	daily rain
204	1977	1977	1	3	0.84
204	1977	1977	1	5	0.83
204	1977	1977	1	6	0.73
204	1977	1977	1	21	0.08
204	1977	1977	1	28	0.10
204	1977	1977	2	21	0.03
204	1977	1977	2	23	0.05
204	1977	1977	2	24	0.05
204	1977	1977	3	16	1.28
204	1977	1977	3	17	0.09
204	1977	1977	3	25	0.47
204	1977	1977	3	30	0.06
204	1977	1977	3	31	0.12
204	1977	1977	4	9	0.01
204	1977	1977	5	1	0.03
204	1977	1977	5	8	0.66
204	1977	1977	5	9	1.72
204	1977	1977	5	10	0.10
204	1977	1977	5	12	0.07
204	1977	1977	5	13	0.24
204	1977	1977	5	23	0.02
204	1978	1977	11	5	0.14
204	1978	1977	12	15	0.12
204	1978	1977	12	16	0.02
204	1978	1977	12	17	0.03
204	1978	1977	12	18	0.46
204	1978	1977	12	19	0.28
204	1978	1977	12	22	0.19
204	1978	1977	12	23	0.51
204	1978	1977	12	24	0.03
204	1978	1977	12	26	0.12
204	1978	1977	12	27	0.05
204	1978	1977	12	28	1.25
204	1978	1977	12	29	0.04
204	1978	1978	1	3	0.40
204	1978	1978	1	4	0.12
204	1978	1978	1	5	0.52
204	1978	1978	1	6	0.29
204	1978	1978	1	9	0.10
204	1978	1978	1	10	1.01
204	1978	1978	1	11	0.15
204	1978	1978	1	13	0.01
204	1978	1978	1	15	1.23
204	1978	1978	1	16	0.05
204	1978	1978	1	17	1.27

station id	water year	year	month	day	daily rain
204	1978	1978	1	18	0.13
204	1978	1978	1	19	0.29
204	1978	1978	1	20	0.05
204	1978	1978	2	5	0.10
204	1978	1978	2	6	0.05
204	1978	1978	2	7	0.02
204	1978	1978	2	8	1.18
204	1978	1978	2	9	1.76
204	1978	1978	2	10	3.07
204	1978	1978	2	11	0.45
204	1978	1978	2	13	1.44
204	1978	1978	2	14	0.10
204	1978	1978	2	28	0.05
204	1978	1978	3	1	0.80
204	1978	1978	3	2	0.58
204	1978	1978	3	3	0.33
204	1978	1978	3	4	1.90
204	1978	1978	3	5	1.10
204	1978	1978	3	6	0.07
204	1978	1978	3	9	0.43
204	1978	1978	3	10	0.25
204	1978	1978	3	12	0.26
204	1978	1978	3	22	0.82
204	1978	1978	3	23	0.09
204	1978	1978	3	30	0.04
204	1978	1978	3	31	0.99
204	1978	1978	4	4	0.50
204	1978	1978	4	7	0.49
204	1978	1978	4	8	0.34
204	1978	1978	4	15	0.20
204	1978	1978	4	16	0.95
204	1978	1978	4	17	0.05
204	1978	1978	4	25	0.35
204	1979	1978	9	4	1.89
204	1979	1978	9	5	0.28
204	1979	1978	11	11	0.33
204	1979	1978	11	13	0.60
204	1979	1978	11	14	0.05
204	1979	1978	11	20	0.17
204	1979	1978	11	21	0.47
204	1979	1978	11	22	0.46
204	1979	1978	12	2	0.15
204	1979	1978	12	17	0.70
204	1979	1978	12	18	0.37
204	1979	1978	12	19	0.74

station id	water year	year	month	day	daily rain
204	1979	1979	1	5	0.27
204	1979	1979	1	6	0.48
204	1979	1979	1	9	0.15
204	1979	1979	1	12	0.04
204	1979	1979	1	14	1.29
204	1979	1979	1	15	0.95
204	1979	1979	1	16	0.18
204	1979	1979	1	17	0.53
204	1979	1979	1	18	0.05
204	1979	1979	1	31	0.65
204	1979	1979	2	1	0.70
204	1979	1979	2	2	0.30
204	1979	1979	2	3	0.29
204	1979	1979	2	14	0.49
204	1979	1979	2	15	0.29
204	1979	1979	2	19	0.09
204	1979	1979	2	21	1.18
204	1979	1979	2	22	0.23
204	1979	1979	2	23	0.20
204	1979	1979	2	25	0.03
204	1979	1979	3	1	0.43
204	1979	1979	3	14	0.04
204	1979	1979	3	16	0.14
204	1979	1979	3	17	0.44
204	1979	1979	3	19	0.45
204	1979	1979	3	20	0.71
204	1979	1979	3	27	1.53
204	1979	1979	3	28	0.79
204	1979	1979	3	29	0.67
204	1979	1979	3	30	0.02
204	1979	1979	5	7	0.04
204	1980	1979	9	29	0.20
204	1980	1979	10	14	0.10
204	1980	1979	10	20	0.63
204	1980	1979	10	26	0.19
204	1980	1979	11	4	0.15
204	1980	1979	11	8	0.52
204	1980	1979	11	26	0.02
204	1980	1979	12	21	0.11
204	1980	1979	12	22	0.03
204	1980	1979	12	24	0.38
204	1980	1979	12	25	1.28
204	1980	1980	1	8	0.08
204	1980	1980	1	9	0.13
204	1980	1980	1	10	1.08

station id	water year	year	month	day	daily rain
204	1980	1980	1	11	0.53
204	1980	1980	1	12	0.53
204	1980	1980	1	13	0.20
204	1980	1980	1	14	0.80
204	1980	1980	1	15	0.35
204	1980	1980	1	16	0.11
204	1980	1980	1	17	0.14
204	1980	1980	1	18	0.10
204	1980	1980	1	29	0.20
204	1980	1980	2	14	0.05
204	1980	1980	2	15	0.52
204	1980	1980	2	16	1.01
204	1980	1980	2	17	1.84
204	1980	1980	2	18	0.95
204	1980	1980	2	19	0.97
204	1980	1980	2	20	0.83
204	1980	1980	2	21	0.61
204	1980	1980	2	28	0.13
204	1980	1980	3	3	0.45
204	1980	1980	3	5	0.45
204	1980	1980	3	6	1.22
204	1980	1980	3	7	0.05
204	1980	1980	3	22	0.02
204	1980	1980	3	26	0.23
204	1980	1980	4	5	0.01
204	1980	1980	4	6	0.18
204	1980	1980	4	22	0.66
204	1980	1980	4	23	0.35
204	1980	1980	4	24	0.02
204	1980	1980	4	28	0.33
204	1980	1980	5	11	0.27
204	1980	1980	5	20	0.01
204	1980	1980	7	3	0.01
204	1981	1980	12	4	0.70
204	1981	1980	12	5	0.16
204	1981	1981	1	3	0.05
204	1981	1981	1	4	0.02
204	1981	1981	1	23	1.11
204	1981	1981	1	27	0.02
204	1981	1981	1	28	1.08
204	1981	1981	1	29	0.57
204	1981	1981	1	30	0.02
204	1981	1981	2	8	0.04
204	1981	1981	2	9	1.61
204	1981	1981	2	11	0.03

station id	water year	year	month	day	daily rain
204	1981	1981	2	12	0.02
204	1981	1981	2	13	0.02
204	1981	1981	2	26	1.01
204	1981	1981	2	28	0.02
204	1981	1981	3	1	1.85
204	1981	1981	3	2	0.40
204	1981	1981	3	5	2.45
204	1981	1981	3	14	0.13
204	1981	1981	3	19	0.14
204	1981	1981	3	20	0.54
204	1981	1981	3	21	0.05
204	1981	1981	3	22	0.60
204	1981	1981	3	26	0.08
204	1981	1981	3	27	0.10
204	1981	1981	4	19	0.42
204	1981	1981	4	20	0.06
204	1982	1981	10	1	0.02
204	1982	1981	10	28	0.24
204	1982	1981	10	29	0.31
204	1982	1981	11	14	0.14
204	1982	1981	11	17	0.12
204	1982	1981	11	27	0.41
204	1982	1981	11	28	0.19
204	1982	1981	11	29	0.06
204	1982	1981	12	13	0.01
204	1982	1981	12	21	0.26
204	1982	1981	12	30	0.55
204	1982	1981	12	31	0.04
204	1982	1982	1	1	0.19
204	1982	1982	1	2	0.29
204	1982	1982	1	3	0.08
204	1982	1982	1	5	0.35
204	1982	1982	1	6	0.03
204	1982	1982	1	11	0.02
204	1982	1982	1	19	0.04
204	1982	1982	1	20	0.65
204	1982	1982	1	21	0.96
204	1982	1982	1	27	0.04
204	1982	1982	1	28	0.03
204	1982	1982	1	29	0.22
204	1982	1982	2	8	0.02
204	1982	1982	2	10	0.07
204	1982	1982	2	11	0.33
204	1982	1982	2	14	0.05
204	1982	1982	2	15	0.05

station id	water year	year	month	day	daily rain
204	1982	1982	2	16	0.27
204	1982	1982	3	1	0.07
204	1982	1982	3	2	0.66
204	1982	1982	3	3	0.04
204	1982	1982	3	11	0.20
204	1982	1982	3	12	0.55
204	1982	1982	3	14	0.14
204	1982	1982	3	15	0.37
204	1982	1982	3	16	0.32
204	1982	1982	3	17	1.14
204	1982	1982	3	18	0.65
204	1982	1982	3	19	0.28
204	1982	1982	3	26	0.35
204	1982	1982	3	29	0.30
204	1982	1982	3	30	0.43
204	1982	1982	4	1	1.30
204	1982	1982	4	2	0.21
204	1982	1982	4	10	0.10
204	1982	1982	4	11	1.01
204	1982	1982	4	12	0.28
204	1983	1982	9	16	0.06
204	1983	1982	9	24	0.04
204	1983	1982	9	26	0.21
204	1983	1982	10	24	0.29
204	1983	1982	10	26	0.34
204	1983	1982	10	29	0.52
204	1983	1982	10	30	0.33
204	1983	1982	11	9	0.73
204	1983	1982	11	10	0.65
204	1983	1982	11	11	0.11
204	1983	1982	11	19	0.68
204	1983	1982	11	23	0.35
204	1983	1982	11	24	0.06
204	1983	1982	11	28	0.13
204	1983	1982	11	29	0.50
204	1983	1982	11	30	1.43
204	1983	1982	12	1	0.59
204	1983	1982	12	2	0.09
204	1983	1982	12	22	0.25
204	1983	1982	12	23	1.53
204	1983	1983	1	19	0.90
204	1983	1983	1	22	0.26
204	1983	1983	1	23	2.35
204	1983	1983	1	24	0.67
204	1983	1983	1	27	2.20

station id	water year	year	month	day	daily rain
204	1983	1983	1	28	0.38
204	1983	1983	1	29	1.40
204	1983	1983	2	3	0.29
204	1983	1983	2	6	0.54
204	1983	1983	2	7	0.21
204	1983	1983	2	8	1.03
204	1983	1983	2	13	0.75
204	1983	1983	2	24	0.14
204	1983	1983	2	26	1.30
204	1983	1983	2	27	0.77
204	1983	1983	2	28	0.20
204	1983	1983	3	1	2.03
204	1983	1983	3	2	1.40
204	1983	1983	3	3	0.52
204	1983	1983	3	4	0.25
204	1983	1983	3	5	0.40
204	1983	1983	3	6	0.05
204	1983	1983	3	7	0.10
204	1983	1983	3	14	0.45
204	1983	1983	3	17	0.36
204	1983	1983	3	18	0.47
204	1983	1983	3	19	0.19
204	1983	1983	3	21	1.10
204	1983	1983	3	23	0.36
204	1983	1983	3	24	0.79
204	1983	1983	3	25	0.12
204	1983	1983	3	28	0.08
204	1983	1983	4	6	0.02
204	1983	1983	4	12	0.36
204	1983	1983	4	18	1.01
204	1983	1983	4	19	0.63
204	1983	1983	4	20	1.08
204	1983	1983	4	21	0.32
204	1983	1983	4	28	0.28
204	1983	1983	4	29	0.03
204	1983	1983	4	30	0.45
204	1983	1983	5	1	0.15
204	1983	1983	5	2	0.09
204	1983	1983	5	6	0.02
204	1983	1983	8	19	0.31
204	1984	1983	9	30	0.05
204	1984	1983	10	1	1.22
204	1984	1983	11	1	0.22
204	1984	1983	11	2	0.44
204	1984	1983	11	11	0.22

station id	water year	year	month	day	daily rain
204	1984	1983	11	12	0.29
204	1984	1983	11	13	0.15
204	1984	1983	11	14	0.04
204	1984	1983	11	17	0.07
204	1984	1983	11	18	0.17
204	1984	1983	11	20	0.42
204	1984	1983	11	21	0.36
204	1984	1983	11	25	0.82
204	1984	1983	12	1	0.04
204	1984	1983	12	4	0.86
204	1984	1983	12	9	0.11
204	1984	1983	12	10	0.72
204	1984	1983	12	11	0.01
204	1984	1983	12	12	0.17
204	1984	1983	12	25	1.30
204	1984	1983	12	26	0.25
204	1984	1983	12	27	0.15
204	1984	1984	1	17	0.01
204	1984	1984	2	2	0.08
204	1984	1984	2	10	0.15
204	1984	1984	2	14	0.04
204	1984	1984	2	16	0.14
204	1984	1984	3	14	0.54
204	1984	1984	3	31	0.03
204	1984	1984	4	6	0.35
204	1984	1984	4	19	0.24
204	1985	1984	10	12	0.20
204	1985	1984	10	15	0.50
204	1985	1984	11	8	0.42
204	1985	1984	11	13	1.19
204	1985	1984	11	16	0.62
204	1985	1984	11	17	0.04
204	1985	1984	11	25	0.57
204	1985	1984	11	28	0.30
204	1985	1984	12	3	0.10
204	1985	1984	12	8	0.32
204	1985	1984	12	10	0.33
204	1985	1984	12	16	0.54
204	1985	1984	12	18	0.08
204	1985	1984	12	19	1.44
204	1985	1984	12	20	0.82
204	1985	1985	1	7	0.28
204	1985	1985	1	10	0.12
204	1985	1985	1	29	0.18
204	1985	1985	2	2	0.24

station id	water year	year	month	day	daily rain
204	1985	1985	2	8	0.03
204	1985	1985	2	9	0.70
204	1985	1985	3	3	0.08
204	1985	1985	3	6	0.20
204	1985	1985	3	7	0.33
204	1985	1985	3	11	0.11
204	1985	1985	3	18	0.04
204	1985	1985	3	19	0.04
204	1985	1985	3	27	0.39
204	1985	1985	3	28	0.21
204	1985	1985	8	17	0.02
204	1986	1985	10	22	0.41
204	1986	1985	11	11	0.80
204	1986	1985	11	12	0.15
204	1986	1985	11	24	0.01
204	1986	1985	11	25	0.70
204	1986	1985	11	26	0.42
204	1986	1985	11	29	0.96
204	1986	1985	11	30	0.45
204	1986	1985	12	2	0.37
204	1986	1985	12	3	0.02
204	1986	1985	12	29	0.03
204	1986	1985	12	30	0.02
204	1986	1986	1	5	0.60
204	1986	1986	1	15	0.02
204	1986	1986	1	30	0.23
204	1986	1986	1	31	0.34
204	1986	1986	2	1	0.25
204	1986	1986	2	3	0.10
204	1986	1986	2	12	0.06
204	1986	1986	2	13	1.33
204	1986	1986	2	14	0.42
204	1986	1986	2	15	1.69
204	1986	1986	2	18	0.47
204	1986	1986	2	19	0.38
204	1986	1986	3	8	0.27
204	1986	1986	3	9	0.80
204	1986	1986	3	10	0.72
204	1986	1986	3	11	0.32
204	1986	1986	3	12	0.27
204	1986	1986	3	13	0.85
204	1986	1986	3	16	1.49
204	1986	1986	3	17	0.65
204	1986	1986	4	6	0.15
204	1986	1986	4	7	0.03

station id	water year	year	month	day	daily rain
204	1986	1986	4	8	0.09
204	1987	1986	9	24	0.25
204	1987	1986	9	25	0.52
204	1987	1986	9	26	0.01
204	1987	1986	11	18	1.25
204	1987	1986	12	6	0.68
204	1987	1986	12	16	0.30
204	1987	1986	12	20	0.27
204	1987	1987	1	4	0.74
204	1987	1987	1	5	0.10
204	1987	1987	1	7	0.55
204	1987	1987	1	23	0.03
204	1987	1987	1	28	0.12
204	1987	1987	1	30	0.01
204	1987	1987	2	9	0.02
204	1987	1987	2	10	0.08
204	1987	1987	2	12	0.71
204	1987	1987	2	13	0.17
204	1987	1987	2	22	0.38
204	1987	1987	2	24	0.15
204	1987	1987	2	25	0.28
204	1987	1987	2	26	0.05
204	1987	1987	3	5	1.36
204	1987	1987	3	6	1.49
204	1987	1987	3	9	0.40
204	1987	1987	3	13	0.08
204	1987	1987	3	16	0.22
204	1987	1987	3	21	0.41
204	1987	1987	3	22	0.28
204	1987	1987	4	4	0.30
204	1987	1987	6	6	0.50
204	1988	1987	10	23	0.56
204	1988	1987	10	24	0.05
204	1988	1987	10	27	0.28
204	1988	1987	10	28	0.03
204	1988	1987	10	29	0.05
204	1988	1987	10	31	0.35
204	1988	1987	11	1	0.06
204	1988	1987	11	4	0.07
204	1988	1987	11	5	0.65
204	1988	1987	11	14	0.19
204	1988	1987	11	17	0.32
204	1988	1987	11	20	0.09
204	1988	1987	12	5	0.99
204	1988	1987	12	7	0.10

station id	water year	year	month	day	daily rain
204	1988	1987	12	9	0.05
204	1988	1987	12	16	0.80
204	1988	1987	12	17	0.26
204	1988	1987	12	28	0.30
204	1988	1987	12	29	0.60
204	1988	1987	12	30	0.58
204	1988	1988	1	6	0.82
204	1988	1988	1	9	0.03
204	1988	1988	1	17	0.47
204	1988	1988	1	18	0.62
204	1988	1988	2	27	0.10
204	1988	1988	2	28	0.98
204	1988	1988	2	29	1.34
204	1988	1988	3	1	0.88
204	1988	1988	3	2	0.15
204	1988	1988	4	15	1.40
204	1988	1988	4	20	1.06
204	1988	1988	4	21	0.12
204	1988	1988	4	23	0.41
204	1988	1988	5	6	0.02
204	1988	1988	5	29	0.09
204	1988	1988	6	24	0.19
204	1989	1988	11	14	0.22
204	1989	1988	11	17	0.08
204	1989	1988	11	24	0.25
204	1989	1988	11	25	0.51
204	1989	1988	12	16	0.82
204	1989	1988	12	17	1.23
204	1989	1988	12	18	0.38
204	1989	1988	12	20	0.08
204	1989	1988	12	21	0.65
204	1989	1988	12	23	0.25
204	1989	1988	12	25	0.74
204	1989	1988	12	30	0.12
204	1989	1989	1	5	0.03
204	1989	1989	1	6	0.21
204	1989	1989	1	7	0.09
204	1989	1989	1	24	0.06
204	1989	1989	2	3	0.03
204	1989	1989	2	4	0.28
204	1989	1989	2	5	0.12
204	1989	1989	2	8	0.36
204	1989	1989	2	9	0.32
204	1989	1989	2	20	0.05
204	1989	1989	3	2	0.42

station id	water year	year	month	day	daily rain
204	1989	1989	3	3	0.10
204	1989	1989	3	11	0.02
204	1989	1989	3	25	0.12
204	1989	1989	3	26	0.04
204	1989	1989	4	24	0.07
204	1989	1989	4	25	0.11
204	1989	1989	4	26	0.04
204	1989	1989	5	8	0.08
204	1989	1989	5	9	0.36
204	1990	1989	9	16	0.16
204	1990	1989	9	17	0.08
204	1990	1989	9	19	0.08
204	1990	1989	9	29	0.30
204	1990	1989	10	22	0.03
204	1990	1989	10	24	0.44
204	1990	1989	10	25	0.01
204	1990	1989	11	27	0.27
204	1990	1990	1	2	0.42
204	1990	1990	1	13	1.30
204	1990	1990	1	14	0.54
204	1990	1990	1	15	0.64
204	1990	1990	1	16	0.01
204	1990	1990	1	17	0.39
204	1990	1990	1	31	0.11
204	1990	1990	2	1	0.07
204	1990	1990	2	4	0.69
204	1990	1990	2	17	1.00
204	1990	1990	2	18	0.30
204	1990	1990	3	5	0.25
204	1990	1990	3	12	0.18
204	1990	1990	4	16	0.28
204	1990	1990	4	24	0.13
204	1990	1990	5	24	0.02
204	1990	1990	5	28	0.37
204	1991	1990	9	21	0.02
204	1991	1990	9	22	0.16
204	1991	1990	9	23	0.05
204	1991	1990	11	20	0.09
204	1991	1990	11	26	0.20
204	1991	1990	12	16	0.15
204	1991	1990	12	20	0.39
204	1991	1991	1	3	0.12
204	1991	1991	1	4	0.39
204	1991	1991	1	5	0.08
204	1991	1991	1	9	0.39

station id	water year	year	month	day	daily rain
204	1991	1991	1	10	0.22
204	1991	1991	2	5	0.15
204	1991	1991	2	28	1.54
204	1991	1991	3	1	1.77
204	1991	1991	3	2	0.25
204	1991	1991	3	5	0.78
204	1991	1991	3	11	0.21
204	1991	1991	3	13	0.32
204	1991	1991	3	14	0.23
204	1991	1991	3	16	0.20
204	1991	1991	3	18	1.86
204	1991	1991	3	19	3.69
204	1991	1991	3	20	0.77
204	1991	1991	3	21	0.17
204	1991	1991	3	25	0.79
204	1991	1991	3	26	0.35
204	1991	1991	3	27	0.94
204	1991	1991	4	1	0.07
204	1991	1991	4	21	0.13
204	1992	1991	10	27	0.38
204	1992	1991	11	18	0.19
204	1992	1991	12	8	0.16
204	1992	1991	12	28	1.55
204	1992	1991	12	29	0.91
204	1992	1991	12	30	1.31
204	1992	1992	1	3	0.18
204	1992	1992	1	4	0.07
204	1992	1992	1	5	1.27
204	1992	1992	1	6	0.71
204	1992	1992	1	7	0.20
204	1992	1992	1	8	0.14
204	1992	1992	2	6	0.30
204	1992	1992	2	7	0.23
204	1992	1992	2	8	0.01
204	1992	1992	2	10	1.21
204	1992	1992	2	11	0.74
204	1992	1992	2	12	2.01
204	1992	1992	2	13	0.88
204	1992	1992	2	15	1.25
204	1992	1992	2	16	0.25
204	1992	1992	2	17	0.03
204	1992	1992	2	20	0.04
204	1992	1992	3	2	0.36
204	1992	1992	3	3	0.31
204	1992	1992	3	4	0.05

station id	water year	year	month	day	daily rain
204	1992	1992	3	6	0.72
204	1992	1992	3	7	0.10
204	1992	1992	3	15	0.02
204	1992	1992	3	20	0.11
204	1992	1992	3	21	0.22
204	1992	1992	3	22	0.02
204	1992	1992	3	23	0.60
204	1992	1992	3	26	0.01
204	1992	1992	3	27	0.19
204	1992	1992	3	31	0.19
204	1992	1992	7	9	0.04
204	1992	1992	7	13	0.04
204	1993	1992	10	21	0.07
204	1993	1992	10	22	0.02
204	1993	1992	10	27	0.09
204	1993	1992	10	30	0.70
204	1993	1992	10	31	0.19
204	1993	1992	12	4	0.13
204	1993	1992	12	7	2.14
204	1993	1992	12	8	0.07
204	1993	1992	12	9	0.02
204	1993	1992	12	11	0.30
204	1993	1992	12	12	0.11
204	1993	1992	12	18	0.23
204	1993	1992	12	29	0.78
204	1993	1992	12	30	0.34
204	1993	1993	1	2	0.65
204	1993	1993	1	6	0.03
204	1993	1993	1	7	1.31
204	1993	1993	1	8	0.27
204	1993	1993	1	9	0.22
204	1993	1993	1	10	0.05
204	1993	1993	1	11	0.45
204	1993	1993	1	13	0.81
204	1993	1993	1	14	1.51
204	1993	1993	1	16	0.14
204	1993	1993	1	17	0.02
204	1993	1993	1	18	1.52
204	1993	1993	1	19	0.12
204	1993	1993	1	22	0.05
204	1993	1993	2	5	0.07
204	1993	1993	2	8	1.58
204	1993	1993	2	9	0.83
204	1993	1993	2	10	0.08
204	1993	1993	2	18	0.33

station id	water year	year	month	day	daily rain
204	1993	1993	2	19	1.98
204	1993	1993	2	20	0.30
204	1993	1993	2	21	0.05
204	1993	1993	2	23	1.21
204	1993	1993	2	24	0.17
204	1993	1993	2	26	0.54
204	1993	1993	3	1	0.33
204	1993	1993	3	17	0.03
204	1993	1993	3	18	0.01
204	1993	1993	3	24	0.10
204	1993	1993	3	25	1.76
204	1993	1993	3	26	1.66
204	1993	1993	3	29	0.85
204	1993	1993	4	18	0.10
204	1993	1993	5	25	0.28
204	1993	1993	6	5	0.11
204	1994	1993	10	11	0.16
204	1994	1993	10	18	0.10
204	1994	1993	11	11	0.28
204	1994	1993	11	12	0.05
204	1994	1993	11	13	0.14
204	1994	1993	11	22	0.03
204	1994	1993	11	30	0.52
204	1994	1993	12	12	1.04
204	1994	1993	12	15	0.52
204	1994	1993	12	19	0.01
204	1994	1994	1	24	0.57
204	1994	1994	1	25	1.11
204	1994	1994	1	26	0.08
204	1994	1994	2	4	0.80
204	1994	1994	2	7	0.50
204	1994	1994	2	8	0.79
204	1994	1994	2	9	0.04
204	1994	1994	2	11	0.03
204	1994	1994	2	17	0.94
204	1994	1994	2	18	0.22
204	1994	1994	2	19	0.07
204	1994	1994	2	20	1.04
204	1994	1994	3	6	0.97
204	1994	1994	3	7	0.18
204	1994	1994	3	19	0.23
204	1994	1994	3	25	1.05
204	1994	1994	4	9	0.15
204	1994	1994	4	25	0.07
204	1994	1994	4	26	0.52

station id	water year	year	month	day	daily rain
204	1994	1994	4	27	0.05
204	1994	1994	5	8	0.59
204	1994	1994	5	17	0.13
204	1994	1994	5	18	0.35
204	1994	1994	5	19	0.04
204	1995	1994	9	23	0.04
204	1995	1994	9	28	0.03
204	1995	1994	9	29	0.02
204	1995	1994	10	4	0.44
204	1995	1994	10	5	0.20
204	1995	1994	11	8	0.13
204	1995	1994	11	10	1.09
204	1995	1994	11	16	0.27
204	1995	1994	11	26	0.24
204	1995	1994	12	13	0.28
204	1995	1994	12	14	0.06
204	1995	1994	12	15	0.12
204	1995	1994	12	25	0.73
204	1995	1995	1	3	1.23
204	1995	1995	1	4	0.85
204	1995	1995	1	5	1.65
204	1995	1995	1	6	0.04
204	1995	1995	1	7	0.80
204	1995	1995	1	9	0.55
204	1995	1995	1	10	2.50
204	1995	1995	1	11	1.12
204	1995	1995	1	12	0.34
204	1995	1995	1	13	0.02
204	1995	1995	1	14	0.04
204	1995	1995	1	15	0.48
204	1995	1995	1	16	0.48
204	1995	1995	1	17	0.01
204	1995	1995	1	21	0.47
204	1995	1995	1	23	0.24
204	1995	1995	1	24	0.98
204	1995	1995	1	25	2.20
204	1995	1995	1	26	0.92
204	1995	1995	2	8	0.22
204	1995	1995	2	9	0.08
204	1995	1995	2	14	1.55
204	1995	1995	3	2	0.02
204	1995	1995	3	3	0.10
204	1995	1995	3	5	0.43
204	1995	1995	3	6	1.00
204	1995	1995	3	10	0.25

station id	water year	year	month	day	daily rain
204	1995	1995	3	11	2.15
204	1995	1995	3	12	0.58
204	1995	1995	3	21	0.62
204	1995	1995	3	22	0.13
204	1995	1995	3	23	1.41
204	1995	1995	3	24	0.05
204	1995	1995	4	14	0.07
204	1995	1995	4	16	0.27
204	1995	1995	4	21	0.11
204	1995	1995	5	2	0.04
204	1995	1995	5	7	0.10
204	1995	1995	5	14	0.10
204	1995	1995	5	15	0.50
204	1995	1995	5	16	0.05
204	1995	1995	6	15	0.25
204	1995	1995	6	16	0.54
204	1996	1995	11	1	0.25
204	1996	1995	12	13	0.73
204	1996	1995	12	14	0.08
204	1996	1995	12	21	0.02
204	1996	1995	12	23	0.30
204	1996	1995	12	25	0.04
204	1996	1996	1	17	0.57
204	1996	1996	1	19	0.15
204	1996	1996	1	22	0.10
204	1996	1996	1	25	0.47
204	1996	1996	1	28	0.19
204	1996	1996	1	31	0.20
204	1996	1996	2	1	0.75
204	1996	1996	2	3	0.50
204	1996	1996	2	4	0.47
204	1996	1996	2	5	0.42
204	1996	1996	2	6	1.10
204	1996	1996	2	16	0.16
204	1996	1996	2	19	0.29
204	1996	1996	2	20	2.47
204	1996	1996	2	21	1.13
204	1996	1996	2	22	0.33
204	1996	1996	2	25	0.46
204	1996	1996	2	26	0.27
204	1996	1996	2	27	0.62
204	1996	1996	3	1	0.04
204	1996	1996	3	4	0.30
204	1996	1996	3	5	0.26
204	1996	1996	3	6	0.02

station id	water year	year	month	day	daily rain
204	1996	1996	3	13	0.85
204	1996	1996	3	14	0.80
204	1996	1996	3	28	0.06
204	1996	1996	4	2	0.41
204	1996	1996	4	16	0.13
204	1996	1996	4	17	0.16
204	1996	1996	4	18	0.15
204	1996	1996	5	16	0.20
204	1996	1996	5	17	0.02
204	1996	1996	6	26	0.03
204	1997	1996	10	25	0.03
204	1997	1996	10	26	0.04
204	1997	1996	10	30	2.18
204	1997	1996	11	17	0.07
204	1997	1996	11	18	0.16
204	1997	1996	11	20	0.16
204	1997	1996	11	21	0.65
204	1997	1996	11	22	0.71
204	1997	1996	11	23	0.09
204	1997	1996	12	7	0.33
204	1997	1996	12	10	0.78
204	1997	1996	12	11	1.72
204	1997	1996	12	12	0.35
204	1997	1996	12	13	0.05
204	1997	1996	12	22	0.85
204	1997	1996	12	27	0.26
204	1997	1996	12	30	0.11
204	1997	1996	12	31	0.17
204	1997	1997	1	2	0.72
204	1997	1997	1	3	0.36
204	1997	1997	1	5	0.08
204	1997	1997	1	14	0.52
204	1997	1997	1	15	0.04
204	1997	1997	1	16	0.43
204	1997	1997	1	17	0.12
204	1997	1997	1	20	0.51
204	1997	1997	1	21	0.04
204	1997	1997	1	22	0.29
204	1997	1997	1	23	0.53
204	1997	1997	1	24	0.01
204	1997	1997	1	25	0.02
204	1997	1997	1	26	0.36
204	1997	1997	1	27	0.21
204	1997	1997	2	11	0.08
204	1997	1997	7	23	0.13

station id	water year	year	month	day	daily rain
204	1998	1997	9	3	0.54
204	1998	1997	11	10	0.07
204	1998	1997	11	11	0.30
204	1998	1997	11	12	0.02
204	1998	1997	11	13	0.11
204	1998	1997	11	14	0.23
204	1998	1997	11	16	0.49
204	1998	1997	11	19	0.07
204	1998	1997	11	20	0.16
204	1998	1997	11	26	0.93
204	1998	1997	11	27	0.53
204	1998	1997	11	30	0.75
204	1998	1997	12	1	0.23
204	1998	1997	12	5	0.86
204	1998	1997	12	6	1.68
204	1998	1997	12	9	0.39
204	1998	1997	12	10	0.11
204	1998	1997	12	15	0.11
204	1998	1997	12	19	0.70
204	1998	1998	1	3	0.05
204	1998	1998	1	4	0.10
204	1998	1998	1	5	0.28
204	1998	1998	1	9	0.03
204	1998	1998	1	10	0.90
204	1998	1998	1	11	0.14
204	1998	1998	1	13	0.21
204	1998	1998	1	15	0.10
204	1998	1998	1	16	0.82
204	1998	1998	1	19	0.53
204	1998	1998	1	29	0.64
204	1998	1998	1	30	0.20
204	1998	1998	1	31	0.19
204	1998	1998	2	1	0.03
204	1998	1998	2	2	3.22
204	1998	1998	2	3	2.75
204	1998	1998	2	4	0.54
204	1998	1998	2	5	0.02
204	1998	1998	2	6	0.86
204	1998	1998	2	7	0.61
204	1998	1998	2	8	1.13
204	1998	1998	2	9	0.31
204	1998	1998	2	11	0.03
204	1998	1998	2	13	0.12
204	1998	1998	2	14	0.41
204	1998	1998	2	15	1.15

station id	water year	year	month	day	daily rain
204	1998	1998	2	17	0.80
204	1998	1998	2	20	0.62
204	1998	1998	2	22	1.01
204	1998	1998	2	23	0.69
204	1998	1998	2	24	0.64
204	1998	1998	3	6	0.37
204	1998	1998	3	14	0.14
204	1998	1998	3	25	1.47
204	1998	1998	3	26	0.42
204	1998	1998	3	28	0.46
204	1998	1998	3	29	0.19
204	1998	1998	4	1	1.20
204	1998	1998	4	2	0.30
204	1998	1998	4	4	0.62
204	1998	1998	4	6	0.06
204	1998	1998	4	7	0.03
204	1998	1998	4	11	0.01
204	1998	1998	4	12	0.93
204	1998	1998	4	13	0.09
204	1998	1998	4	23	0.07
204	1998	1998	4	24	0.03
204	1998	1998	5	2	0.12
204	1998	1998	5	3	0.54
204	1998	1998	5	4	0.03
204	1998	1998	5	5	0.32
204	1998	1998	5	6	0.15
204	1998	1998	5	12	0.21
204	1998	1998	5	13	0.75
204	1998	1998	5	29	0.26
204	1998	1998	6	7	0.03
204	1998	1998	6	11	0.02
204	1999	1998	9	4	0.08
204	1999	1998	9	5	0.42
204	1999	1998	10	25	0.14
204	1999	1998	11	8	0.45
204	1999	1998	11	11	0.07
204	1999	1998	11	24	0.04
204	1999	1998	11	28	1.37
204	1999	1998	11	29	0.06
204	1999	1998	12	1	0.69
204	1999	1998	12	2	0.05
204	1999	1998	12	4	0.16
204	1999	1998	12	6	0.17
204	1999	1998	12	21	0.05
204	1999	1999	1	20	0.34

station id	water year	year	month	day	daily rain
204	1999	1999	1	21	0.26
204	1999	1999	1	24	0.27
204	1999	1999	1	25	0.04
204	1999	1999	1	26	0.34
204	1999	1999	1	27	0.40
204	1999	1999	1	31	0.97
204	1999	1999	2	1	0.13
204	1999	1999	2	6	0.01
204	1999	1999	2	7	0.07
204	1999	1999	2	8	0.10
204	1999	1999	2	9	0.14
204	1999	1999	2	10	0.64
204	1999	1999	2	21	0.07
204	1999	1999	2	25	0.02
204	1999	1999	2	26	0.03
204	1999	1999	3	9	0.23
204	1999	1999	3	11	0.24
204	1999	1999	3	15	1.31
204	1999	1999	3	16	1.13
204	1999	1999	3	20	1.04
204	1999	1999	3	21	0.15
204	1999	1999	3	23	0.05
204	1999	1999	3	25	1.17
204	1999	1999	3	26	0.86
204	1999	1999	3	31	0.13
204	1999	1999	4	4	0.02
204	1999	1999	4	6	0.25
204	1999	1999	4	7	0.04
204	1999	1999	4	9	0.29
204	1999	1999	4	11	0.12
204	1999	1999	4	12	1.41
204	1999	1999	4	30	0.00
204	1999	1999	6	3	0.00
204	1999	1999	7	13	0.00
204	1999	1999	8	27	0.13
204	2000	1999	9	22	0.00
204	2000	1999	11	8	1.48
204	2000	1999	11	17	0.08
204	2000	1999	11	20	0.10
204	2000	1999	12	10	0.03
204	2000	2000	1	17	0.02
204	2000	2000	1	18	0.20
204	2000	2000	1	19	0.05
204	2000	2000	1	21	0.04
204	2000	2000	1	23	0.14

station id	water year	year	month	day	daily rain
204	2000	2000	1	24	0.31
204	2000	2000	1	25	0.47
204	2000	2000	1	26	0.21
204	2000	2000	1	30	0.02
204	2000	2000	1	31	0.07
204	2000	2000	2	4	0.28
204	2000	2000	2	10	0.26
204	2000	2000	2	11	0.33
204	2000	2000	2	12	0.98
204	2000	2000	2	13	0.23
204	2000	2000	2	14	0.71
204	2000	2000	2	15	0.34
204	2000	2000	2	16	0.11
204	2000	2000	2	17	0.16
204	2000	2000	2	20	0.45
204	2000	2000	2	21	1.48
204	2000	2000	2	22	1.10
204	2000	2000	2	23	1.33
204	2000	2000	2	24	0.16
204	2000	2000	2	27	0.52
204	2000	2000	2	28	0.32
204	2000	2000	2	29	0.02
204	2000	2000	3	1	0.05
204	2000	2000	3	3	0.11
204	2000	2000	3	4	0.05
204	2000	2000	3	5	0.60
204	2000	2000	3	6	0.71
204	2000	2000	3	7	0.01
204	2000	2000	3	8	0.35
204	2000	2000	3	9	0.00
204	2000	2000	4	15	0.39
204	2000	2000	4	17	1.47
204	2000	2000	4	18	1.56
204	2000	2000	4	19	0.03
204	2000	2000	6	8	0.08
204	2000	2000	6	9	0.10
204	2001	2000	10	8	0.01
204	2001	2000	10	11	0.59
204	2001	2000	10	12	0.08
204	2001	2000	10	26	0.04
204	2001	2000	10	27	0.82
204	2001	2000	10	28	0.00
204	2001	2000	10	29	0.73
204	2001	2000	10	30	0.03
204	2001	2000	12	12	0.03

station id	water year	year	month	day	daily rain
204	2001	2000	12	14	0.00
204	2001	2001	1	8	0.52
204	2001	2001	1	9	0.17
204	2001	2001	1	11	2.20
204	2001	2001	1	12	0.79
204	2001	2001	1	13	0.05
204	2001	2001	1	24	0.58
204	2001	2001	1	25	0.18
204	2001	2001	1	26	0.60
204	2001	2001	1	27	0.04
204	2001	2001	2	10	0.76
204	2001	2001	2	11	0.12
204	2001	2001	2	12	0.77
204	2001	2001	2	13	1.10
204	2001	2001	2	14	0.30
204	2001	2001	2	18	0.05
204	2001	2001	2	19	0.24
204	2001	2001	2	20	0.64
204	2001	2001	2	21	0.00
204	2001	2001	2	23	0.20
204	2001	2001	2	24	0.17
204	2001	2001	2	25	0.40
204	2001	2001	2	26	0.22
204	2001	2001	2	27	0.10
204	2001	2001	2	28	0.15
204	2001	2001	3	1	0.16
204	2001	2001	3	4	0.16
204	2001	2001	3	5	2.20
204	2001	2001	3	6	1.42
204	2001	2001	3	7	0.05
204	2001	2001	4	5	0.02
204	2001	2001	4	7	0.85
204	2001	2001	4	8	0.12
204	2001	2001	4	10	0.03
204	2001	2001	4	21	0.64
204	2002	2001	9	1	0.00
204	2002	2001	10	30	0.22
204	2002	2001	10	31	0.32
204	2002	2001	11	6	0.01
204	2002	2001	11	11	0.36
204	2002	2001	11	12	0.01
204	2002	2001	11	13	1.16
204	2002	2001	11	24	0.04
204	2002	2001	11	25	0.92
204	2002	2001	11	29	0.51

station id	water year	year	month	day	daily rain
204	2002	2001	11	30	0.02
204	2002	2001	12	2	0.01
204	2002	2001	12	3	0.01
204	2002	2001	12	10	0.04
204	2002	2001	12	14	0.08
204	2002	2001	12	15	0.01
204	2002	2001	12	20	0.08
204	2002	2001	12	21	1.19
204	2002	2001	12	23	0.02
204	2002	2001	12	29	0.21
204	2002	2001	12	30	0.04
204	2002	2001	12	31	0.21
204	2002	2002	1	3	0.21
204	2002	2002	1	12	0.01
204	2002	2002	1	27	0.18
204	2002	2002	1	28	0.44
204	2002	2002	1	29	0.09
204	2002	2002	1	30	0.01
204	2002	2002	2	7	0.01
204	2002	2002	2	17	0.25
204	2002	2002	3	7	0.26
204	2002	2002	3	8	0.06
204	2002	2002	3	18	0.10
204	2002	2002	3	23	0.02
204	2002	2002	3	24	0.22
204	2002	2002	4	17	0.01
204	2002	2002	4	26	0.10
204	2002	2002	4	27	0.08
204	2002	2002	5	20	0.00
204	2002	2002	5	21	0.15
204	2002	2002	8	22	0.01
204	2003	2002	9	6	0.00
204	2003	2002	9	29	0.01
204	2003	2002	11	7	0.14
204	2003	2002	11	8	1.31
204	2003	2002	11	9	1.01
204	2003	2002	11	10	0.14
204	2003	2002	11	27	0.01
204	2003	2002	12	5	0.01
204	2003	2002	12	7	0.03
204	2003	2002	12	15	0.35
204	2003	2002	12	17	1.70
204	2003	2002	12	18	0.23
204	2003	2002	12	20	1.43
204	2003	2002	12	21	0.06

station id	water year	year	month	day	daily rain
204	2003	2002	12	22	0.65
204	2003	2002	12	23	0.01
204	2003	2002	12	29	0.47
204	2003	2002	12	30	0.02
204	2003	2002	12	31	0.04
204	2003	2003	1	11	0.04
204	2003	2003	2	11	0.50
204	2003	2003	2	12	0.49
204	2003	2003	2	13	0.48
204	2003	2003	2	14	0.15
204	2003	2003	2	25	0.50
204	2003	2003	2	26	0.03
204	2003	2003	2	27	0.31
204	2003	2003	3	5	0.05
204	2003	2003	3	15	1.45
204	2003	2003	3	16	0.20
204	2003	2003	4	13	0.50
204	2003	2003	4	14	0.93
204	2003	2003	4	15	0.07
204	2003	2003	4	28	0.15
204	2003	2003	4	29	0.02
204	2003	2003	5	3	0.90
204	2003	2003	5	4	0.35
204	2003	2003	5	7	0.05
204	2003	2003	5	8	0.01
204	2003	2003	6	5	0.01
204	2003	2003	6	6	0.01
204	2003	2003	6	10	0.01
204	2004	2003	9	26	0.01
204	2004	2003	11	1	0.33
204	2004	2003	11	3	0.15
204	2004	2003	11	4	0.05
204	2004	2003	11	9	0.70
204	2004	2003	11	10	0.05
204	2004	2003	11	12	0.01
204	2004	2003	11	16	0.03
204	2004	2003	12	7	0.01
204	2004	2003	12	8	0.05
204	2004	2003	12	11	0.23
204	2004	2003	12	12	0.01
204	2004	2003	12	15	0.30
204	2004	2003	12	16	0.01
204	2004	2003	12	20	0.02
204	2004	2003	12	21	0.11
204	2004	2003	12	23	0.07

station id	water year	year	month	day	daily rain
204	2004	2003	12	24	0.05
204	2004	2003	12	25	0.13
204	2004	2003	12	26	0.91
204	2004	2004	1	2	0.29
204	2004	2004	1	3	0.06
204	2004	2004	1	25	0.14
204	2004	2004	1	28	0.20
204	2004	2004	2	3	0.98
204	2004	2004	2	18	0.41
204	2004	2004	2	19	0.46
204	2004	2004	2	21	0.12
204	2004	2004	2	22	0.27
204	2004	2004	2	23	1.03
204	2004	2004	2	26	1.65
204	2004	2004	2	27	0.03
204	2004	2004	3	2	0.30
204	2004	2004	3	26	0.19
204	2005	2004	10	17	0.93
204	2005	2004	10	18	0.08
204	2005	2004	10	20	1.88
204	2005	2004	10	25	0.01
204	2005	2004	10	27	1.61
204	2005	2004	10	28	0.01
204	2005	2004	11	4	0.04
204	2005	2004	11	5	0.41
204	2005	2004	11	8	0.48
204	2005	2004	11	11	0.01
204	2005	2004	11	28	0.03
204	2005	2004	12	7	0.09
204	2005	2004	12	8	0.14
204	2005	2004	12	9	0.01
204	2005	2004	12	10	0.01
204	2005	2004	12	14	0.01
204	2005	2004	12	27	0.18
204	2005	2004	12	28	3.33
204	2005	2004	12	29	0.61
204	2005	2004	12	30	0.05
204	2005	2004	12	31	1.51
204	2005	2005	1	1	0.02
204	2005	2005	1	2	0.15
204	2005	2005	1	3	0.79
204	2005	2005	1	4	0.09
204	2005	2005	1	7	0.43
204	2005	2005	1	8	0.80
204	2005	2005	1	9	2.05

station id	water year	year	month	day	daily rain
204	2005	2005	1	10	0.87
204	2005	2005	1	11	0.58
204	2005	2005	1	12	0.18
204	2005	2005	1	26	0.01
204	2005	2005	1	27	0.05
204	2005	2005	1	28	0.04
204	2005	2005	1	29	0.04
204	2005	2005	2	11	0.21
204	2005	2005	2	12	0.04
204	2005	2005	2	18	1.05
204	2005	2005	2	19	0.86
204	2005	2005	2	20	0.29
204	2005	2005	2	21	0.91
204	2005	2005	2	22	0.63
204	2005	2005	2	23	0.98
204	2005	2005	2	28	0.28
204	2005	2005	3	3	0.02
204	2005	2005	3	4	0.31
204	2005	2005	3	5	1.09
204	2005	2005	3	9	0.01
204	2005	2005	3	14	0.03
204	2005	2005	3	19	0.29
204	2005	2005	3	20	0.14
204	2005	2005	3	22	0.15
204	2005	2005	3	23	1.61
204	2005	2005	3	24	0.08
204	2005	2005	3	28	0.10
204	2005	2005	4	4	0.08
204	2005	2005	4	8	0.04
204	2005	2005	4	9	0.05
204	2005	2005	4	28	0.45
204	2005	2005	4	29	0.18
204	2005	2005	4	30	0.01
204	2005	2005	5	5	0.11
204	2005	2005	5	6	0.46
204	2005	2005	5	9	0.23
204	2005	2005	5	10	0.03
204	2005	2005	6	18	0.01
204	2006	2005	9	17	0.04
204	2006	2005	9	26	0.05
204	2006	2005	9	28	0.01
204	2006	2005	10	18	0.60
204	2006	2005	10	20	0.01
204	2006	2005	10	24	0.02
204	2006	2005	10	26	0.01

station id	water year	year	month	day	daily rain
204	2006	2005	10	27	0.05
204	2006	2005	10	28	0.01
204	2006	2005	11	9	1.19
204	2006	2005	11	10	0.47
204	2006	2005	11	11	0.03
204	2006	2005	11	12	0.01
204	2006	2005	12	2	0.63
204	2006	2005	12	3	0.15
204	2006	2005	12	15	0.08
204	2006	2005	12	20	0.01
204	2006	2005	12	26	0.16
204	2006	2005	12	29	0.01
204	2006	2005	12	30	0.01
204	2006	2005	12	31	0.04
204	2006	2006	1	1	0.97
204	2006	2006	1	2	3.11
204	2006	2006	1	3	0.17
204	2006	2006	1	13	0.01
204	2006	2006	1	14	0.10
204	2006	2006	1	15	0.04
204	2006	2006	1	18	0.09
204	2006	2006	1	19	0.01
204	2006	2006	1	21	0.01
204	2006	2006	2	18	0.15
204	2006	2006	2	19	0.13
204	2006	2006	2	22	0.01
204	2006	2006	2	28	0.78
204	2006	2006	3	1	0.01
204	2006	2006	3	3	0.67
204	2006	2006	3	4	0.07
204	2006	2006	3	5	0.01
204	2006	2006	3	6	0.25
204	2006	2006	3	7	0.48
204	2006	2006	3	10	0.33
204	2006	2006	3	11	0.32
204	2006	2006	3	12	0.21
204	2006	2006	3	13	0.28
204	2006	2006	3	15	0.03
204	2006	2006	3	17	0.23
204	2006	2006	3	18	0.22
204	2006	2006	3	19	0.01
204	2006	2006	3	21	0.32
204	2006	2006	3	22	0.01
204	2006	2006	3	26	0.07
204	2006	2006	3	28	0.41

station id	water year	year	month	day	daily rain
204	2006	2006	3	29	0.21
204	2006	2006	3	30	0.03
204	2006	2006	3	31	0.04
204	2006	2006	4	1	0.10
204	2006	2006	4	3	0.43
204	2006	2006	4	4	1.54
204	2006	2006	4	5	0.81
204	2006	2006	4	6	0.19
204	2006	2006	4	11	0.05
204	2006	2006	4	14	0.04
204	2006	2006	4	15	0.19
204	2006	2006	4	17	0.01
204	2006	2006	4	18	0.01
204	2006	2006	4	22	0.03
204	2006	2006	4	23	0.04
204	2006	2006	4	26	0.21
204	2006	2006	4	27	0.42
204	2006	2006	4	30	0.01
204	2006	2006	5	4	0.01
204	2006	2006	5	21	0.02
204	2006	2006	5	22	0.81
204	2006	2006	5	23	0.01
204	2007	2006	10	5	0.01
204	2007	2006	10	13	0.08
204	2007	2006	10	14	0.59
204	2007	2006	10	18	0.01
204	2007	2006	11	14	0.04
204	2007	2006	11	27	0.17
204	2007	2006	12	9	0.09
204	2007	2006	12	10	0.57
204	2007	2006	12	11	0.13
204	2007	2006	12	12	0.01
204	2007	2006	12	17	0.06
204	2007	2006	12	22	0.16
204	2007	2006	12	27	0.11
204	2007	2006	12	28	0.10
204	2007	2007	1	5	0.03
204	2007	2007	1	17	0.04
204	2007	2007	1	18	0.01
204	2007	2007	1	27	0.08
204	2007	2007	1	28	0.39
204	2007	2007	1	29	0.66
204	2007	2007	2	11	0.59
204	2007	2007	2	12	0.08
204	2007	2007	2	13	0.01

station id	water year	year	month	day	daily rain
204	2007	2007	2	21	0.01
204	2007	2007	2	22	0.02
204	2007	2007	2	23	0.74
204	2007	2007	2	25	0.09
204	2007	2007	2	27	0.42
204	2007	2007	2	28	0.24
204	2007	2007	3	21	0.03
204	2007	2007	3	27	0.10
204	2007	2007	3	28	0.01
204	2007	2007	4	20	0.40
204	2007	2007	4	21	0.04
204	2007	2007	4	22	0.01
204	2007	2007	4	23	0.09
204	2007	2007	5	4	0.03
204	2007	2007	5	5	0.01
204	2007	2007	8	30	0.03
204	2008	2007	9	1	0.01
204	2008	2007	9	23	0.69
204	2008	2007	10	13	0.20
204	2008	2007	10	15	0.01
204	2008	2007	10	17	0.18
204	2008	2007	10	19	0.02
204	2008	2007	10	28	0.11
204	2008	2007	11	10	0.01
204	2008	2007	11	11	0.01
204	2008	2007	12	7	0.33
204	2008	2007	12	8	0.03
204	2008	2007	12	18	0.36
204	2008	2007	12	19	1.82
204	2008	2007	12	21	0.06
204	2008	2008	1	5	1.96
204	2008	2008	1	6	0.41
204	2008	2008	1	7	0.49
204	2008	2008	1	8	0.01
204	2008	2008	1	9	0.06
204	2008	2008	1	17	0.01
204	2008	2008	1	22	0.13
204	2008	2008	1	23	1.95
204	2008	2008	1	24	1.72
204	2008	2008	1	25	1.22
204	2008	2008	1	26	0.73
204	2008	2008	1	27	1.02
204	2008	2008	1	28	1.64
204	2008	2008	1	29	0.04
204	2008	2008	1	31	0.01

station id	water year	year	month	day	daily rain
204	2008	2008	2	3	1.00
204	2008	2008	2	4	0.07
204	2008	2008	2	20	0.16
204	2008	2008	2	22	0.02
204	2008	2008	2	23	0.01
204	2008	2008	2	24	0.44
204	2008	2008	2	25	0.02
204	2008	2008	3	2	0.01
204	2008	2008	3	16	0.01
204	2008	2008	4	3	0.04
204	2008	2008	4	25	0.01
204	2009	2008	10	5	0.02
204	2009	2008	11	1	0.01
204	2009	2008	11	2	0.25
204	2009	2008	11	4	0.31
204	2009	2008	11	9	0.03
204	2009	2008	11	26	1.39
204	2009	2008	11	27	0.17
204	2009	2008	12	1	0.01
204	2009	2008	12	13	0.07
204	2009	2008	12	15	1.00
204	2009	2008	12	16	0.21
204	2009	2008	12	17	0.27
204	2009	2008	12	20	0.01
204	2009	2008	12	22	0.17
204	2009	2008	12	23	0.09
204	2009	2008	12	25	0.03
204	2009	2008	12	26	0.16
204	2009	2009	1	3	0.03
204	2009	2009	1	22	0.06
204	2009	2009	1	23	0.04
204	2009	2009	1	24	0.09
204	2009	2009	1	25	0.01
204	2009	2009	2	5	0.28
204	2009	2009	2	6	0.29
204	2009	2009	2	7	0.72
204	2009	2009	2	8	0.10
204	2009	2009	2	9	0.42
204	2009	2009	2	10	0.20
204	2009	2009	2	12	0.11
204	2009	2009	2	14	0.43
204	2009	2009	2	16	1.21
204	2009	2009	2	17	0.89
204	2009	2009	2	18	0.12
204	2009	2009	2	22	0.21

station id	water year	year	month	day	daily rain
204	2009	2009	2	23	0.18
204	2009	2009	3	4	0.32
204	2009	2009	3	5	0.05
204	2009	2009	3	22	0.26
204	2009	2009	3	23	0.01
204	2009	2009	4	8	0.07
204	2009	2009	4	9	0.06
204	2009	2009	5	2	0.05
204	2009	2009	6	5	0.10
204	2010	2009	9	16	0.01
204	2010	2009	10	13	0.03
204	2010	2009	10	14	1.25
204	2010	2009	10	15	0.13
204	2010	2009	12	7	0.53
204	2010	2009	12	8	0.37
204	2010	2009	12	11	0.93
204	2010	2009	12	12	0.16
204	2010	2009	12	13	0.63
204	2010	2009	12	22	0.16
204	2010	2009	12	30	0.06
204	2010	2009	12	31	0.01
204	2010	2010	1	13	0.94
204	2010	2010	1	18	0.66
204	2010	2010	1	19	0.76
204	2010	2010	1	20	1.05
204	2010	2010	1	21	1.32
204	2010	2010	1	22	1.18
204	2010	2010	1	23	0.21
204	2010	2010	1	27	0.56
204	2010	2010	1	30	0.01
204	2010	2010	2	2	0.01
204	2010	2010	2	5	0.20
204	2010	2010	2	6	0.54
204	2010	2010	2	7	0.51
204	2010	2010	2	9	0.20
204	2010	2010	2	10	0.27
204	2010	2010	2	20	0.07
204	2010	2010	2	21	0.17
204	2010	2010	2	22	0.05
204	2010	2010	2	24	0.10
204	2010	2010	2	25	0.12
204	2010	2010	2	27	1.32
204	2010	2010	2	28	0.04
204	2010	2010	3	3	0.07
204	2010	2010	3	4	0.26

station id	water year	year	month	day	daily rain
204	2010	2010	3	7	0.04
204	2010	2010	3	9	0.02
204	2010	2010	3	10	0.01
204	2010	2010	3	13	0.01
204	2010	2010	4	1	0.07
204	2010	2010	4	5	0.45
204	2010	2010	4	6	0.01
204	2010	2010	4	12	0.89
204	2010	2010	4	13	0.18
204	2010	2010	4	20	0.30
204	2010	2010	4	21	0.48
204	2010	2010	4	22	0.07
204	2010	2010	4	23	0.01
204	2010	2010	4	25	0.01
204	2010	2010	4	28	0.11
204	2010	2010	5	18	0.06
204	2011	2010	10	1	0.01
204	2011	2010	10	6	0.45
204	2011	2010	10	7	0.01
204	2011	2010	10	8	0.01
204	2011	2010	10	17	0.02
204	2011	2010	10	18	0.06
204	2011	2010	10	19	0.15
204	2011	2010	10	20	0.01
204	2011	2010	10	23	0.02
204	2011	2010	10	25	0.12
204	2011	2010	10	30	0.64
204	2011	2010	11	8	0.18
204	2011	2010	11	20	0.13
204	2011	2010	11	21	0.48
204	2011	2010	11	22	0.01
204	2011	2010	11	24	0.08
204	2011	2010	11	28	0.10
204	2011	2010	12	4	0.09
204	2011	2010	12	5	0.07
204	2011	2010	12	6	0.43
204	2011	2010	12	7	0.01
204	2011	2010	12	15	0.03
204	2011	2010	12	16	0.01
204	2011	2010	12	17	0.05
204	2011	2010	12	18	0.53
204	2011	2010	12	19	2.03
204	2011	2010	12	20	2.48
204	2011	2010	12	21	0.63
204	2011	2010	12	22	0.54

station id	water year	year	month	day	daily rain
204	2011	2010	12	23	0.14
204	2011	2010	12	26	0.62
204	2011	2010	12	29	1.02
204	2011	2011	1	2	0.61
204	2011	2011	1	3	0.28
204	2011	2011	1	4	0.01
204	2011	2011	1	30	0.12
204	2011	2011	1	31	0.44
204	2011	2011	2	1	0.01
204	2011	2011	2	16	0.17
204	2011	2011	2	17	0.17
204	2011	2011	2	18	0.01
204	2011	2011	2	19	2.23
204	2011	2011	2	20	0.38
204	2011	2011	2	26	0.77
204	2011	2011	3	2	0.07
204	2011	2011	3	3	0.02
204	2011	2011	3	4	0.01
204	2011	2011	3	7	0.13
204	2011	2011	3	19	0.37
204	2011	2011	3	20	2.78
204	2011	2011	3	21	0.80
204	2011	2011	3	23	0.01
204	2011	2011	3	24	0.17
204	2011	2011	3	25	0.28
204	2011	2011	3	27	0.07
204	2011	2011	3	28	0.01
204	2011	2011	4	8	0.02
204	2011	2011	4	9	0.08
204	2011	2011	4	10	0.01
204	2011	2011	4	21	0.02
204	2011	2011	4	22	0.01
204	2011	2011	5	15	0.02
204	2011	2011	5	17	0.08
204	2011	2011	5	18	0.09
204	2011	2011	5	19	0.01
204	2011	2011	6	5	0.03
204	2011	2011	6	6	0.22
204	2011	2011	6	7	0.01
204	2012	2011	9	11	0.03
204	2012	2011	9	12	0.01
204	2012	2011	10	4	0.06
204	2012	2011	10	5	0.31
204	2012	2011	10	6	0.27
204	2012	2011	11	4	0.11

station id	water year	year	month	day	daily rain
204	2012	2011	11	6	0.19
204	2012	2011	11	12	0.47
204	2012	2011	11	20	0.91
204	2012	2011	11	21	0.44
204	2012	2011	12	12	0.02
204	2012	2011	12	13	0.16
204	2012	2012	1	21	0.74
204	2012	2012	1	23	0.42
204	2012	2012	1	24	0.38
204	2012	2012	2	7	0.02
204	2012	2012	2	11	0.03
204	2012	2012	2	12	0.01
204	2012	2012	2	13	0.01
204	2012	2012	2	14	0.18
204	2012	2012	2	15	0.05
204	2012	2012	3	11	0.03
204	2012	2012	3	12	0.01
204	2012	2012	3	17	0.96
204	2012	2012	3	18	0.88
204	2012	2012	3	19	0.09
204	2012	2012	3	25	0.51
204	2012	2012	3	26	0.30
204	2012	2012	3	29	0.01
204	2012	2012	4	1	0.17
204	2012	2012	4	11	0.82
204	2012	2012	4	12	0.01
204	2012	2012	4	13	1.27
204	2012	2012	4	14	0.37
204	2012	2012	4	25	0.04
204	2012	2012	4	26	0.24
204	2012	2012	4	27	0.03
204	2013	2012	10	23	0.07
204	2013	2012	11	9	0.01
204	2013	2012	11	10	0.06
204	2013	2012	11	16	0.01
204	2013	2012	11	17	0.47
204	2013	2012	11	18	0.14
204	2013	2012	11	19	0.02
204	2013	2012	11	30	0.02
204	2013	2012	12	1	0.14
204	2013	2012	12	2	0.10
204	2013	2012	12	3	0.61
204	2013	2012	12	6	0.01
204	2013	2012	12	13	0.13
204	2013	2012	12	15	0.02

station id	water year	year	month	day	daily rain
204	2013	2012	12	16	0.11
204	2013	2012	12	18	0.18
204	2013	2012	12	22	0.05
204	2013	2012	12	23	0.14
204	2013	2012	12	24	0.60
204	2013	2012	12	26	0.22
204	2013	2012	12	27	0.01
204	2013	2012	12	29	0.35
204	2013	2012	12	30	0.27
204	2013	2012	12	31	0.01
204	2013	2013	1	6	0.39
204	2013	2013	1	7	0.18
204	2013	2013	1	25	0.10
204	2013	2013	1	26	0.13
204	2013	2013	1	28	0.03
204	2013	2013	2	8	0.27
204	2013	2013	2	9	0.23
204	2013	2013	2	13	0.01
204	2013	2013	2	16	0.01
204	2013	2013	2	20	0.14
204	2013	2013	3	6	0.02
204	2013	2013	3	7	0.15
204	2013	2013	3	8	0.74
204	2013	2013	3	9	0.01
204	2013	2013	3	31	0.06
204	2013	2013	4	1	0.03
204	2013	2013	4	2	0.02
204	2013	2013	4	4	0.01
204	2013	2013	4	8	0.02
204	2013	2013	5	6	0.01
204	2014	2013	10	28	0.08
204	2014	2013	10	29	0.20
204	2014	2013	10	31	0.01
204	2014	2013	11	20	0.01
204	2014	2013	11	21	0.22
204	2014	2013	11	29	0.24
204	2014	2013	11	30	0.01
204	2014	2013	12	7	0.20
204	2014	2013	12	20	0.01
204	2014	2014	2	3	0.48
204	2014	2014	2	4	0.01
204	2014	2014	2	7	0.36
204	2014	2014	2	8	0.01
204	2014	2014	2	9	0.03
204	2014	2014	2	10	0.01

station id	water year	year	month	day	daily rain
204	2014	2014	2	11	0.01
204	2014	2014	2	27	0.35
204	2014	2014	2	28	1.25
204	2014	2014	3	1	1.20
204	2014	2014	3	2	0.46
204	2014	2014	3	4	0.01
204	2014	2014	3	26	0.09
204	2014	2014	3	27	0.09
204	2014	2014	3	30	0.13
204	2014	2014	4	1	0.43
204	2014	2014	4	2	0.20
204	2014	2014	4	3	0.02
204	2014	2014	4	10	0.01
204	2014	2014	4	26	0.11
204	2014	2014	4	27	0.01
204	2015	2014	10	13	0.01
204	2015	2014	11	1	0.94
204	2015	2014	11	2	0.11
204	2015	2014	11	14	0.01
204	2015	2014	11	15	0.01
204	2015	2014	11	21	0.01
204	2015	2014	11	22	0.01
204	2015	2014	12	2	0.24
204	2015	2014	12	3	0.56
204	2015	2014	12	7	0.01
204	2015	2014	12	9	0.02
204	2015	2014	12	12	1.95
204	2015	2014	12	13	0.02
204	2015	2014	12	16	0.26
204	2015	2014	12	17	0.51
204	2015	2014	12	18	0.01
204	2015	2014	12	19	0.01
204	2015	2014	12	25	0.01
204	2015	2015	1	11	0.79
204	2015	2015	1	12	0.01
204	2015	2015	1	14	0.01
204	2015	2015	1	20	0.01
204	2015	2015	1	21	0.01
204	2015	2015	1	27	0.20
204	2015	2015	1	31	0.01
204	2015	2015	2	6	0.01
204	2015	2015	2	7	0.04
204	2015	2015	2	8	0.27
204	2015	2015	2	9	0.23
204	2015	2015	2	23	0.41

station id	water year	year	month	day	daily rain
204	2015	2015	2	24	0.01
204	2015	2015	3	1	0.02
204	2015	2015	3	2	0.04
204	2015	2015	3	3	0.33
204	2015	2015	3	5	0.01
204	2015	2015	4	8	0.17
204	2015	2015	4	26	0.15
204	2015	2015	5	15	0.06
204	2015	2015	6	10	0.08
204	2015	2015	7	19	0.05
204	2015	2015	7	20	0.02
204	2015	2015	8	1	0.01
204	2016	2015	9	15	0.05
204	2016	2015	10	5	0.03
204	2016	2015	10	15	0.08
204	2016	2015	10	16	0.01
204	2016	2015	11	3	0.26
204	2016	2015	11	9	0.10
204	2016	2015	11	10	0.14
204	2016	2015	11	16	0.20
204	2016	2015	11	25	0.05
204	2016	2015	12	11	0.30
204	2016	2015	12	12	0.12
204	2016	2015	12	14	0.18
204	2016	2015	12	20	0.45
204	2016	2015	12	21	0.01
204	2016	2015	12	22	0.51
204	2016	2015	12	23	0.07
204	2016	2015	12	25	0.04
204	2016	2015	12	28	0.03
204	2016	2016	1	5	0.49
204	2016	2016	1	6	0.68
204	2016	2016	1	7	1.13
204	2016	2016	1	8	0.02
204	2016	2016	1	10	0.02
204	2016	2016	1	11	0.15
204	2016	2016	1	13	0.01
204	2016	2016	1	14	0.05
204	2016	2016	1	15	0.01
204	2016	2016	1	16	0.02
204	2016	2016	1	17	0.01
204	2016	2016	1	18	0.04
204	2016	2016	1	19	0.02
204	2016	2016	1	20	0.57
204	2016	2016	1	22	0.01

station id	water year	year	month	day	daily rain
204	2016	2016	1	23	0.08
204	2016	2016	1	25	0.01
204	2016	2016	1	30	0.01
204	2016	2016	1	31	0.18
204	2016	2016	2	1	0.74
204	2016	2016	2	2	0.01
204	2016	2016	2	18	0.49
204	2016	2016	2	19	0.01
204	2016	2016	2	22	0.01
204	2016	2016	3	5	0.04
204	2016	2016	3	6	0.78
204	2016	2016	3	7	0.85
204	2016	2016	3	8	0.62
204	2016	2016	3	11	0.01
204	2016	2016	3	12	0.65
204	2016	2016	3	14	0.18
204	2016	2016	3	16	0.01
204	2016	2016	3	20	0.01
204	2016	2016	4	8	0.12
204	2016	2016	4	9	0.20
204	2016	2016	4	10	0.79
204	2016	2016	4	23	0.02
204	2016	2016	5	6	0.02
204	2016	2016	5	7	0.09
204	2017	2016	10	16	0.19
204	2017	2016	10	17	0.30
204	2017	2016	10	28	0.66
204	2017	2016	10	29	0.16
204	2017	2016	10	30	0.03
204	2017	2016	10	31	0.11
204	2017	2016	11	1	0.01
204	2017	2016	11	17	0.01
204	2017	2016	11	21	1.02
204	2017	2016	11	22	0.01
204	2017	2016	11	24	0.01
204	2017	2016	11	27	0.64
204	2017	2016	11	28	0.14
204	2017	2016	11	29	0.01
204	2017	2016	12	8	0.01
204	2017	2016	12	9	0.43
204	2017	2016	12	10	0.01
204	2017	2016	12	11	0.02
204	2017	2016	12	15	0.01
204	2017	2016	12	16	1.11
204	2017	2016	12	24	1.00

station id	water year	year	month	day	daily rain
204	2017	2016	12	27	0.01
204	2017	2016	12	30	0.02
204	2017	2016	12	31	0.06
204	2017	2017	1	1	0.09
204	2017	2017	1	5	0.29
204	2017	2017	1	6	0.01
204	2017	2017	1	7	0.21
204	2017	2017	1	8	0.49
204	2017	2017	1	9	1.65
204	2017	2017	1	10	0.09
204	2017	2017	1	11	0.51
204	2017	2017	1	12	0.17
204	2017	2017	1	13	0.12
204	2017	2017	1	14	0.01
204	2017	2017	1	16	0.01
204	2017	2017	1	19	0.77
204	2017	2017	1	20	0.33
204	2017	2017	1	21	1.03
204	2017	2017	1	22	0.39
204	2017	2017	1	23	0.66
204	2017	2017	1	24	0.30
204	2017	2017	1	26	0.01
204	2017	2017	1	29	0.01
204	2017	2017	2	2	0.02
204	2017	2017	2	3	0.12
204	2017	2017	2	4	0.16
204	2017	2017	2	5	0.01
204	2017	2017	2	6	0.91
204	2017	2017	2	7	0.06
204	2017	2017	2	8	0.47
204	2017	2017	2	9	0.01
204	2017	2017	2	10	0.12
204	2017	2017	2	11	0.51
204	2017	2017	2	12	0.16
204	2017	2017	2	14	0.01
204	2017	2017	2	17	0.97
204	2017	2017	2	18	2.22
204	2017	2017	2	19	0.21
204	2017	2017	2	20	0.55
204	2017	2017	2	21	0.08
204	2017	2017	2	22	0.01
204	2017	2017	2	26	0.11
204	2017	2017	2	27	0.02
204	2017	2017	2	28	0.10
204	2017	2017	3	1	0.01

station id	water year	year	month	day	daily rain
204	2017	2017	3	5	0.02
204	2017	2017	3	6	0.20
204	2017	2017	3	21	0.19
204	2017	2017	3	22	0.19
204	2017	2017	3	23	0.08
204	2017	2017	3	25	0.15
204	2017	2017	3	26	0.01
204	2017	2017	3	27	0.01
204	2017	2017	4	8	0.14
204	2017	2017	4	14	0.04
204	2017	2017	4	17	0.07
204	2017	2017	4	18	0.22
204	2017	2017	4	19	0.12
204	2017	2017	4	20	0.01
204	2017	2017	5	7	0.34
204	2017	2017	5	8	0.05
204	2017	2017	5	9	0.01
204	2018	2017	9	4	0.33
204	2018	2017	9	11	0.33
204	2018	2017	9	12	0.01
204	2018	2017	11	3	0.02
204	2018	2017	11	6	0.01
204	2018	2017	11	17	0.01
204	2018	2017	11	18	0.01
204	2018	2017	11	27	0.06
204	2018	2017	12	21	0.02
204	2018	2018	1	4	0.09
204	2018	2018	1	5	0.01
204	2018	2018	1	6	0.01
204	2018	2018	1	8	0.02
204	2018	2018	1	9	2.05
204	2018	2018	1	10	0.05
204	2018	2018	1	12	0.01
204	2018	2018	1	19	0.02
204	2018	2018	1	23	0.01
204	2018	2018	1	25	0.03
204	2018	2018	1	27	0.01
204	2018	2018	2	27	0.17
204	2018	2018	2	28	0.01
204	2018	2018	3	2	0.45
204	2018	2018	3	3	0.14
204	2018	2018	3	4	0.13
204	2018	2018	3	11	0.63
204	2018	2018	3	13	0.01
204	2018	2018	3	14	0.20

station id	water year	year	month	day	daily rain
204	2018	2018	3	15	0.18
204	2018	2018	3	17	0.20
204	2018	2018	3	20	0.01
204	2018	2018	3	21	0.99
204	2018	2018	3	22	1.69
204	2018	2018	3	23	0.90
204	2018	2018	4	8	0.09
204	2018	2018	4	16	0.02
204	2018	2018	4	17	0.04
204	2018	2018	4	19	0.16
204	2019	2018	10	3	0.23
204	2019	2018	10	4	0.11
204	2019	2018	11	22	0.50
204	2019	2018	11	23	0.01
204	2019	2018	11	24	0.08
204	2019	2018	11	25	0.01
204	2019	2018	11	29	0.76
204	2019	2018	11	30	0.71
204	2019	2018	12	1	0.01
204	2019	2018	12	2	0.04
204	2019	2018	12	5	0.08
204	2019	2018	12	6	0.01
204	2019	2018	12	7	0.12
204	2019	2018	12	9	0.01
204	2019	2018	12	12	0.01
204	2019	2018	12	17	0.20
204	2019	2018	12	19	0.01
204	2019	2018	12	25	0.38
204	2019	2018	12	26	0.01
204	2019	2019	1	6	1.02
204	2019	2019	1	7	0.74
204	2019	2019	1	9	0.01
204	2019	2019	1	10	0.24
204	2019	2019	1	11	0.01
204	2019	2019	1	12	1.32
204	2019	2019	1	14	0.04
204	2019	2019	1	15	0.33
204	2019	2019	1	16	0.34
204	2019	2019	1	17	1.28
204	2019	2019	1	18	0.03
204	2019	2019	1	20	0.01
204	2019	2019	1	21	0.12
204	2019	2019	1	31	0.94
204	2019	2019	2	1	0.08
204	2019	2019	2	2	1.51

station id	water year	year	month	day	daily rain
204	2019	2019	2	3	1.17
204	2019	2019	2	4	0.59
204	2019	2019	2	5	0.44
204	2019	2019	2	6	0.01
204	2019	2019	2	7	0.01
204	2019	2019	2	9	0.24
204	2019	2019	2	10	0.07
204	2019	2019	2	11	0.18
204	2019	2019	2	13	0.01
204	2019	2019	2	14	0.41
204	2019	2019	2	15	0.35
204	2019	2019	2	16	0.35
204	2019	2019	2	17	0.19
204	2019	2019	2	18	0.29
204	2019	2019	2	21	0.04
204	2019	2019	2	22	0.12
204	2019	2019	2	23	0.01
204	2019	2019	2	27	0.08
204	2019	2019	2	28	0.15
204	2019	2019	3	2	0.95
204	2019	2019	3	3	0.10
204	2019	2019	3	4	0.08
204	2019	2019	3	5	0.01
204	2019	2019	3	6	1.09
204	2019	2019	3	7	0.09
204	2019	2019	3	8	0.06
204	2019	2019	3	10	0.01
204	2019	2019	3	11	0.01
204	2019	2019	3	20	0.10
204	2019	2019	3	21	0.09
204	2019	2019	3	23	0.01
204	2019	2019	3	24	0.03
204	2019	2019	3	25	0.01
204	2019	2019	3	27	0.03
204	2019	2019	3	28	0.01
204	2019	2019	4	3	0.01
204	2019	2019	4	4	0.01
204	2019	2019	4	16	0.02
204	2019	2019	4	17	0.01
204	2019	2019	4	29	0.09
204	2019	2019	5	7	0.04
204	2019	2019	5	11	0.03
204	2019	2019	5	16	0.33
204	2019	2019	5	17	0.05
204	2019	2019	5	19	0.47

station id	water year	year	month	day	daily rain
204	2019	2019	5	20	0.06
204	2019	2019	5	21	0.02
204	2019	2019	5	22	0.01
204	2019	2019	5	26	0.02
204	2019	2019	5	27	0.04
204	2019	2019	6	21	0.02
204	2019	2019	8	11	0.01
204	2019	2019	8	24	0.01
204	2020	2019	11	9	0.01
204	2020	2019	11	12	0.01
204	2020	2019	11	20	0.05
204	2020	2019	11	23	0.01
204	2020	2019	11	27	0.77
204	2020	2019	11	28	0.41
204	2020	2019	11	29	0.11
204	2020	2019	12	1	0.50
204	2020	2019	12	4	0.43
204	2020	2019	12	5	0.05
204	2020	2019	12	7	0.01
204	2020	2019	12	8	0.19
204	2020	2019	12	9	0.11
204	2020	2019	12	12	0.01
204	2020	2019	12	14	0.01
204	2020	2019	12	23	1.33
204	2020	2019	12	24	0.50
204	2020	2019	12	26	1.11
204	2020	2019	12	27	0.01
204	2020	2019	12	30	0.36
204	2020	2020	1	10	0.08
204	2020	2020	1	12	0.01
204	2020	2020	1	16	0.01
204	2020	2020	1	17	0.42
204	2020	2020	1	21	0.04
204	2020	2020	1	24	0.01
204	2020	2020	1	28	0.01
204	2020	2020	2	9	0.01
204	2020	2020	2	18	0.01
204	2020	2020	3	2	0.08
204	2020	2020	3	10	0.04
204	2020	2020	3	11	1.23
204	2020	2020	3	12	0.67
204	2020	2020	3	14	0.02
204	2020	2020	3	15	0.10
204	2020	2020	3	16	1.15
204	2020	2020	3	17	1.22

station id	water year	year	month	day	daily rain
204	2020	2020	3	18	0.01
204	2020	2020	3	19	0.01
204	2020	2020	3	20	0.17
204	2020	2020	3	23	0.70
204	2020	2020	3	24	0.02
204	2020	2020	3	25	0.03
204	2020	2020	3	26	0.05
204	2020	2020	3	27	0.08
204	2020	2020	4	6	1.97
204	2020	2020	4	8	0.33
204	2020	2020	4	9	0.26
204	2020	2020	4	10	0.24
204	2020	2020	4	11	0.01
204	2020	2020	4	17	0.01
204	2020	2020	5	1	0.00

APPENDIX D-5

Map and Hydrographs of Wells in the San Antonio Creek Valley Groundwater Basin

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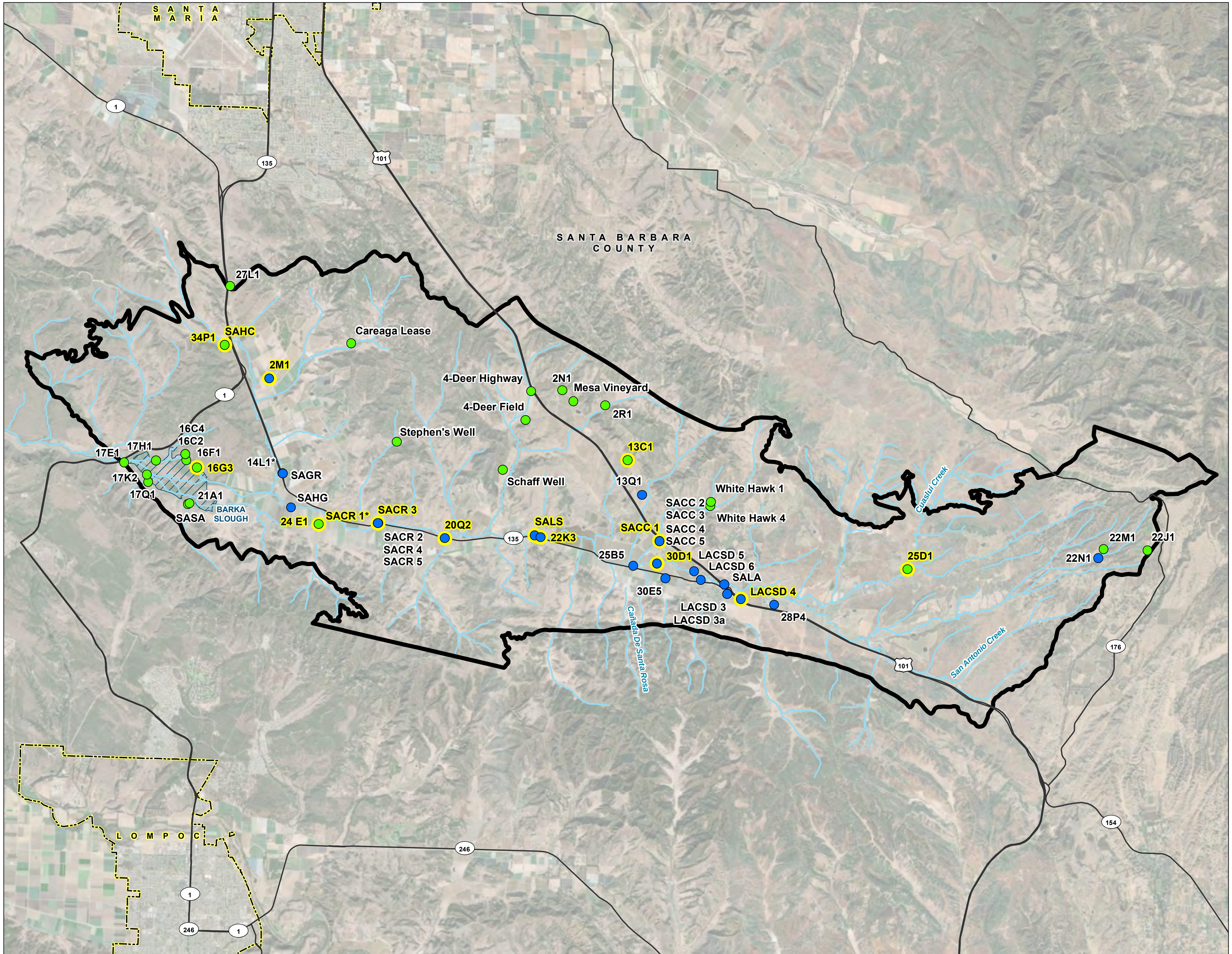


Wells Included in the San Antonio Creek Valley Groundwater Basin Groundwater Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Representative Well

Wells (by screened aquifer)

Paso Robles Formation

Careaga Sand

All Other Features

San Antonio Creek or Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000

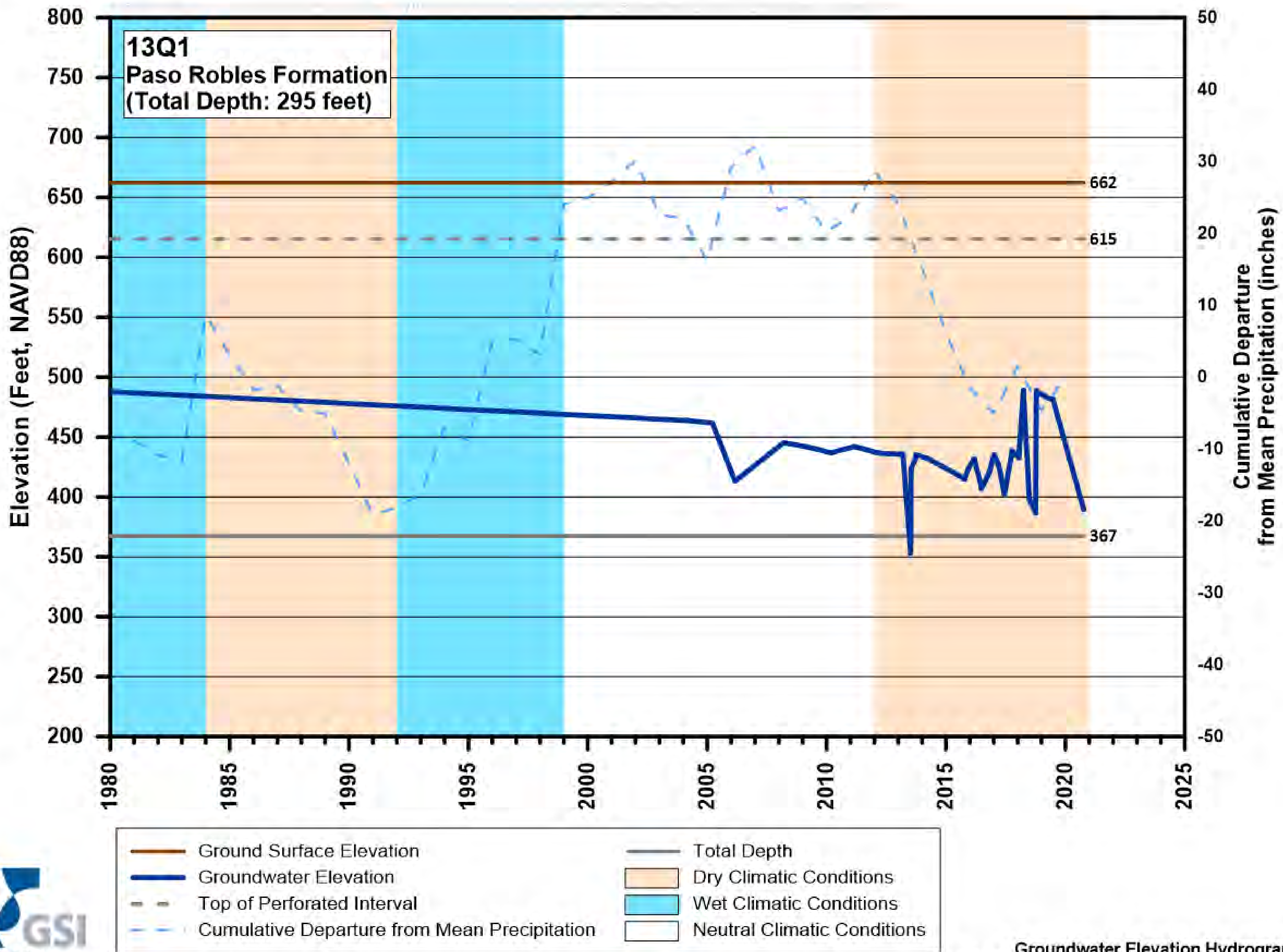
Feet

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\Section3\Figure3_11_Representative_Wells.mxd

Paso Robles Formation



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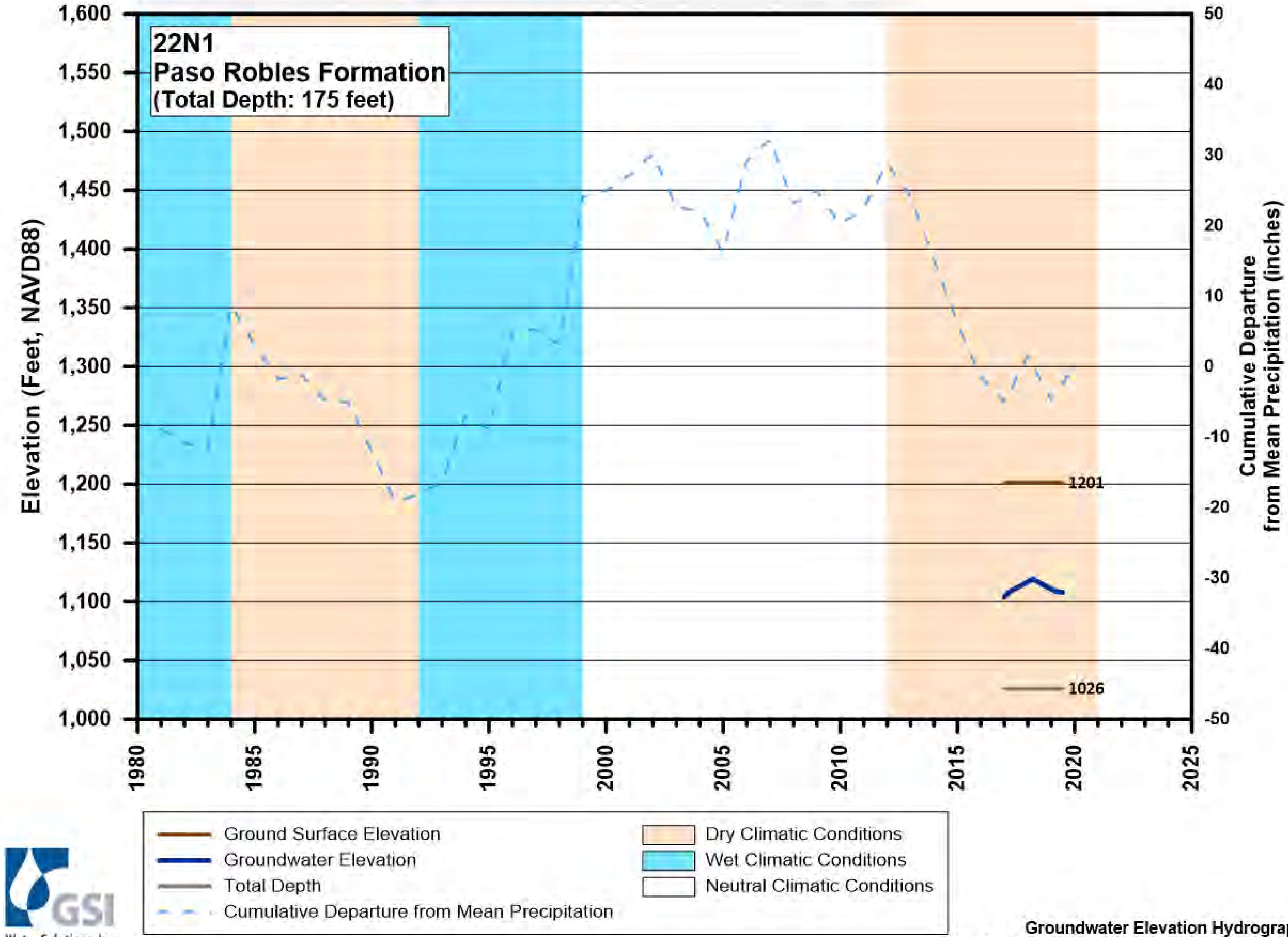
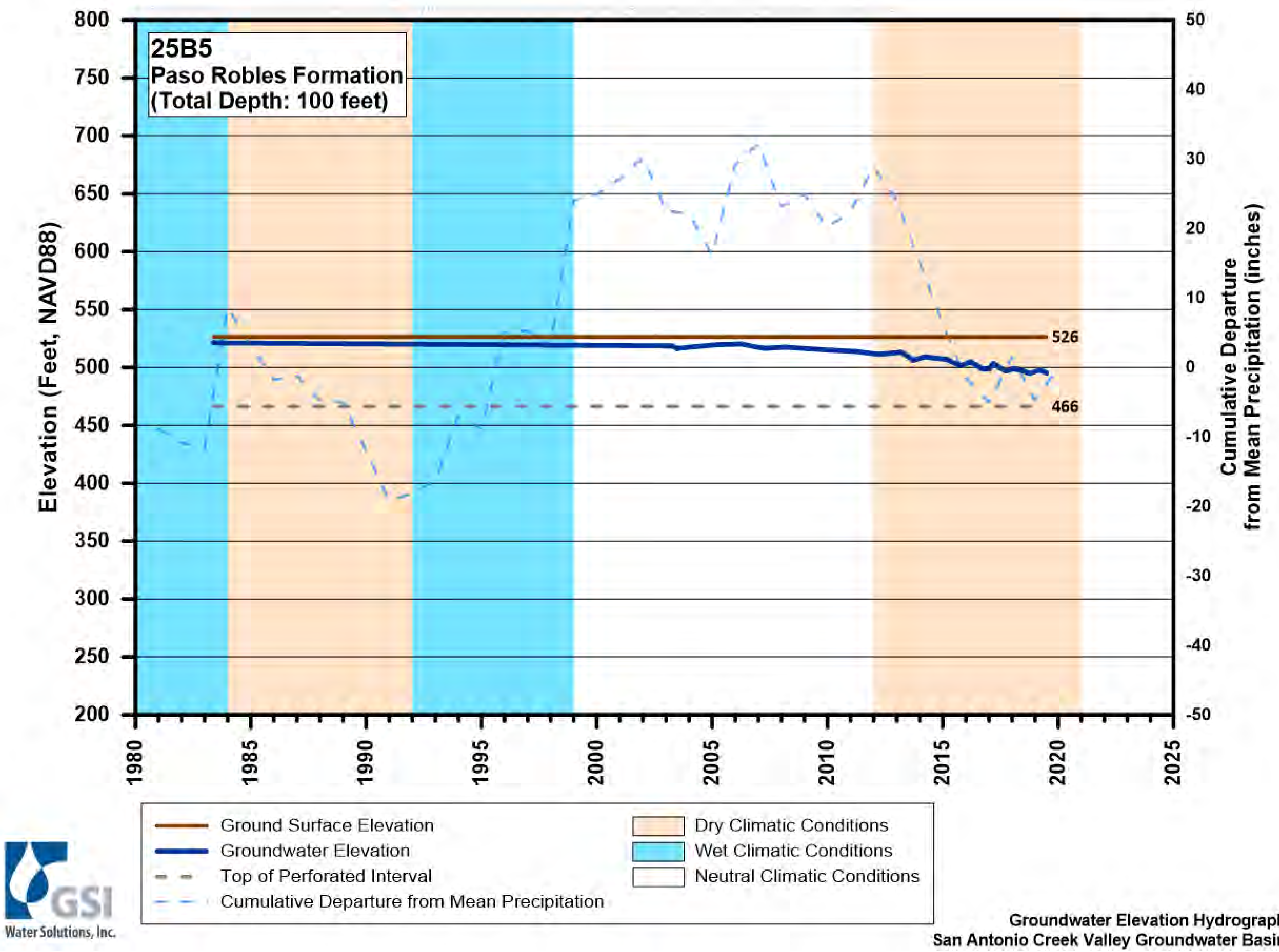
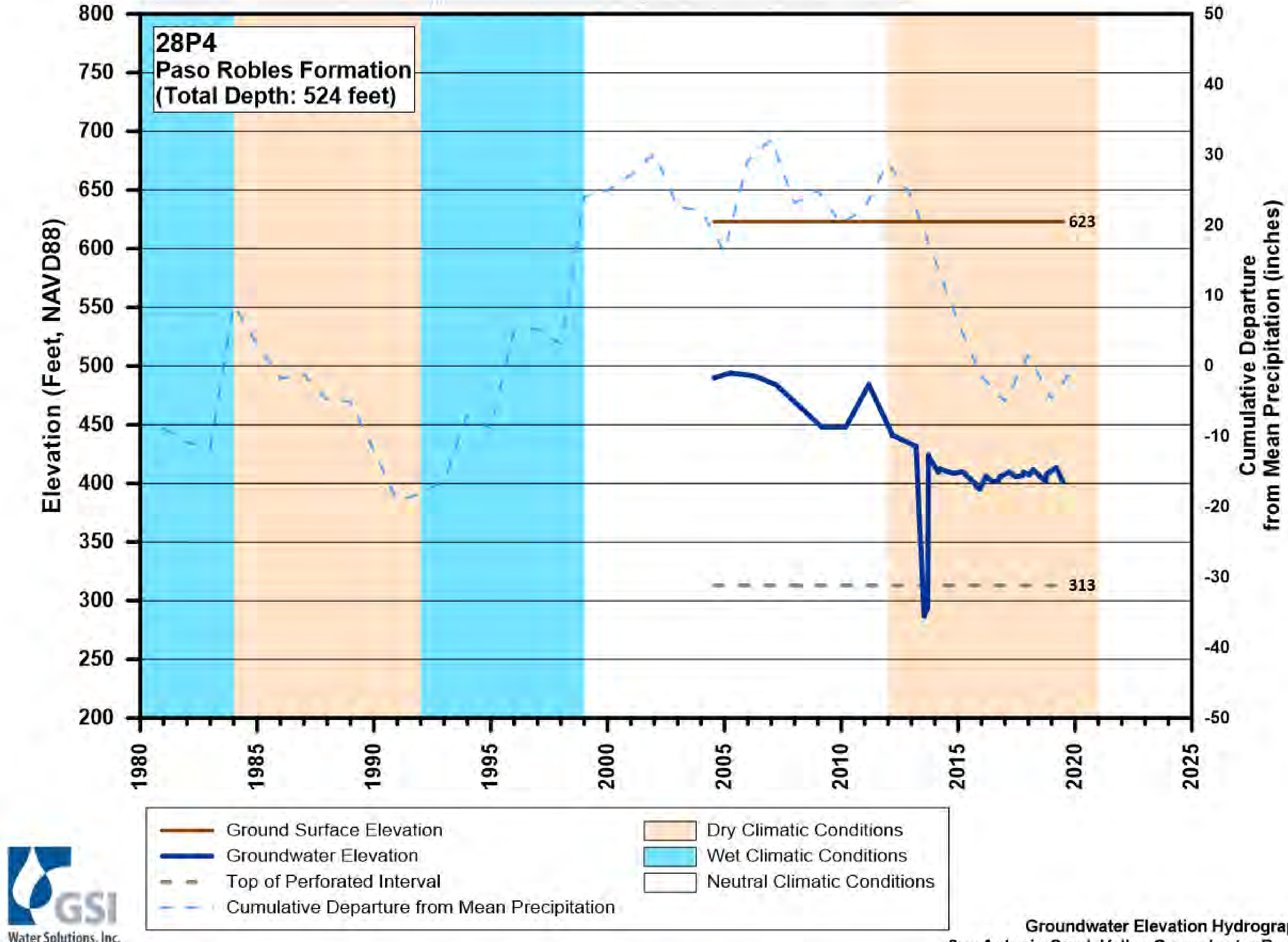
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



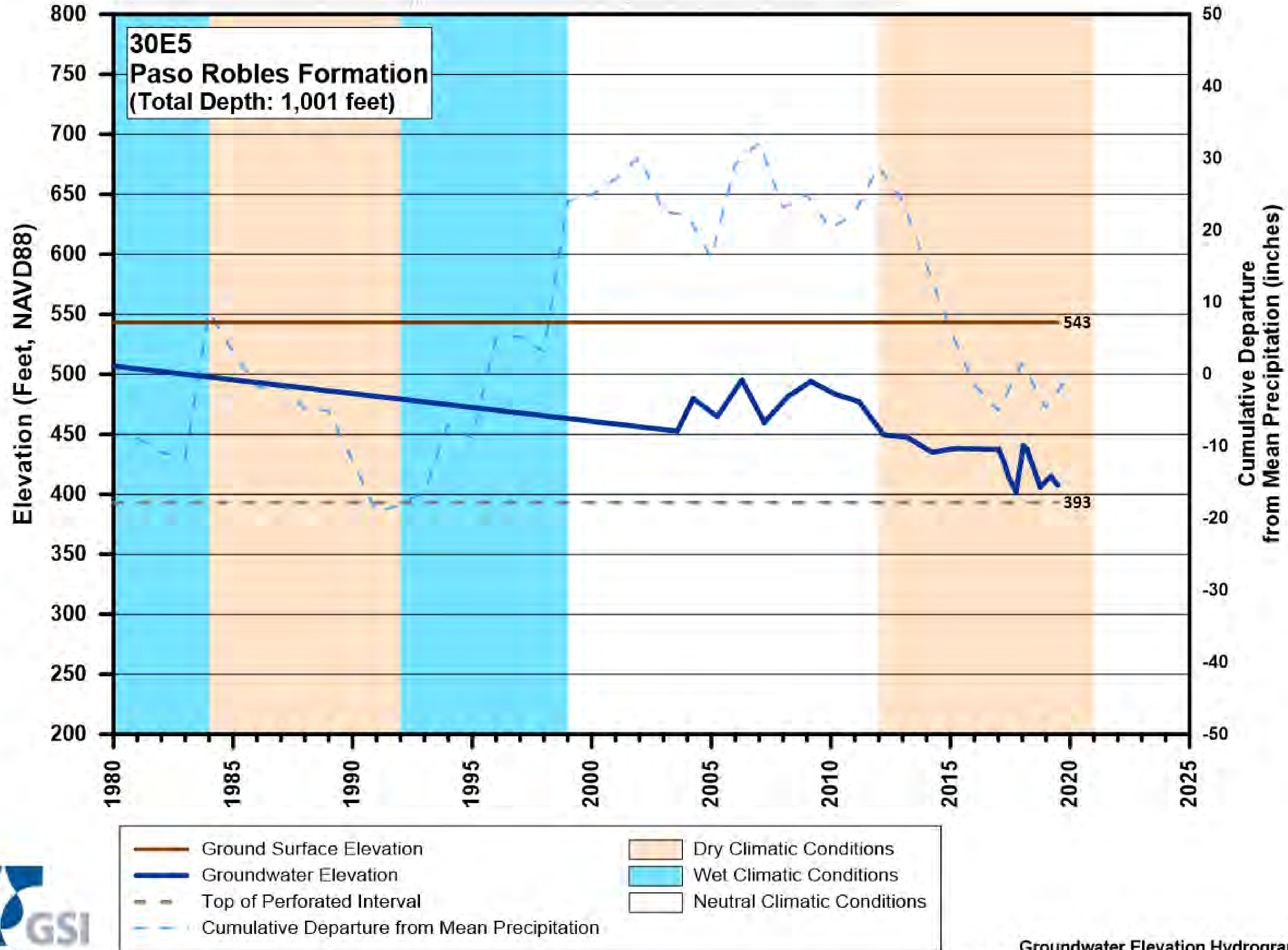
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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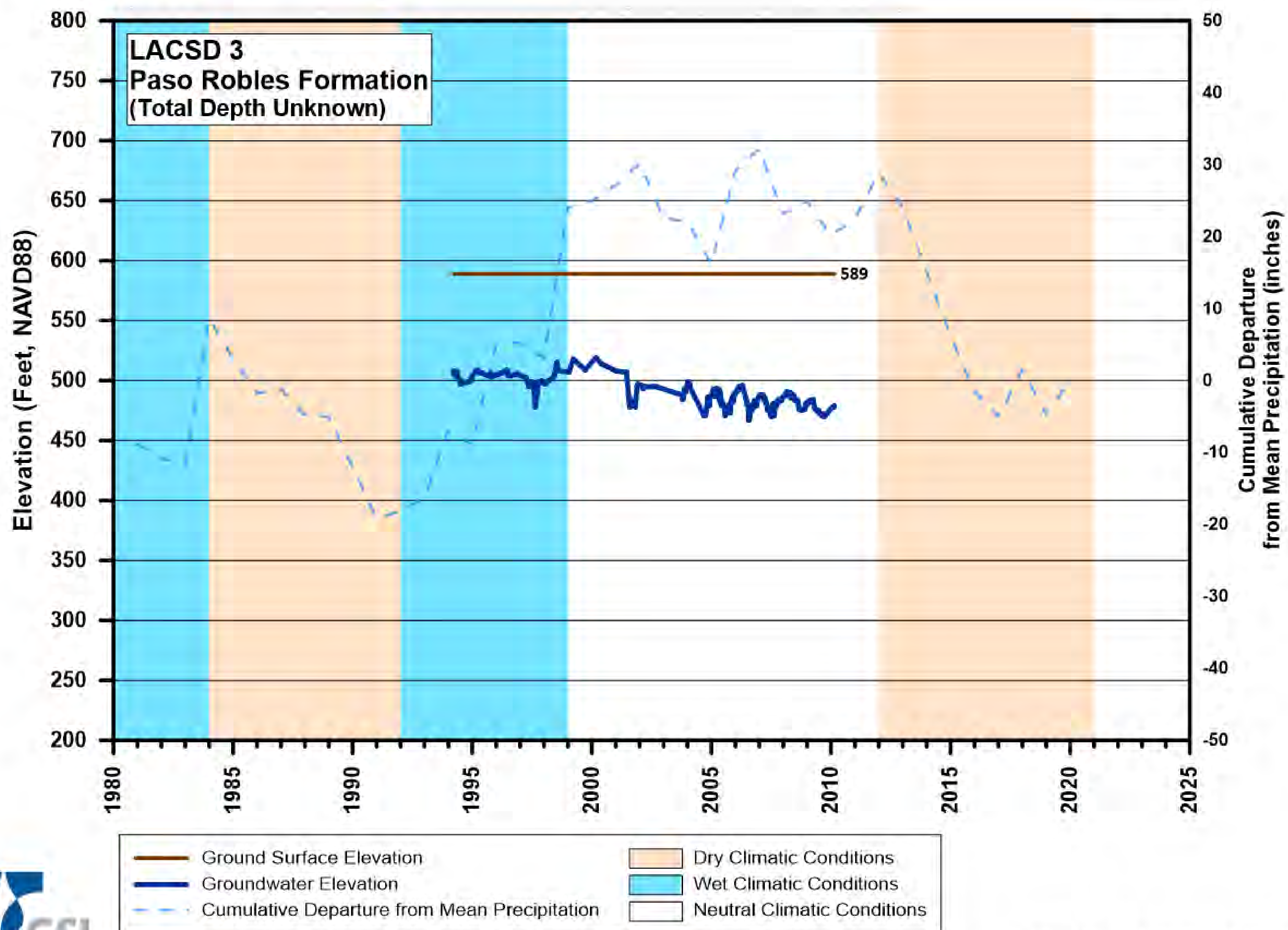
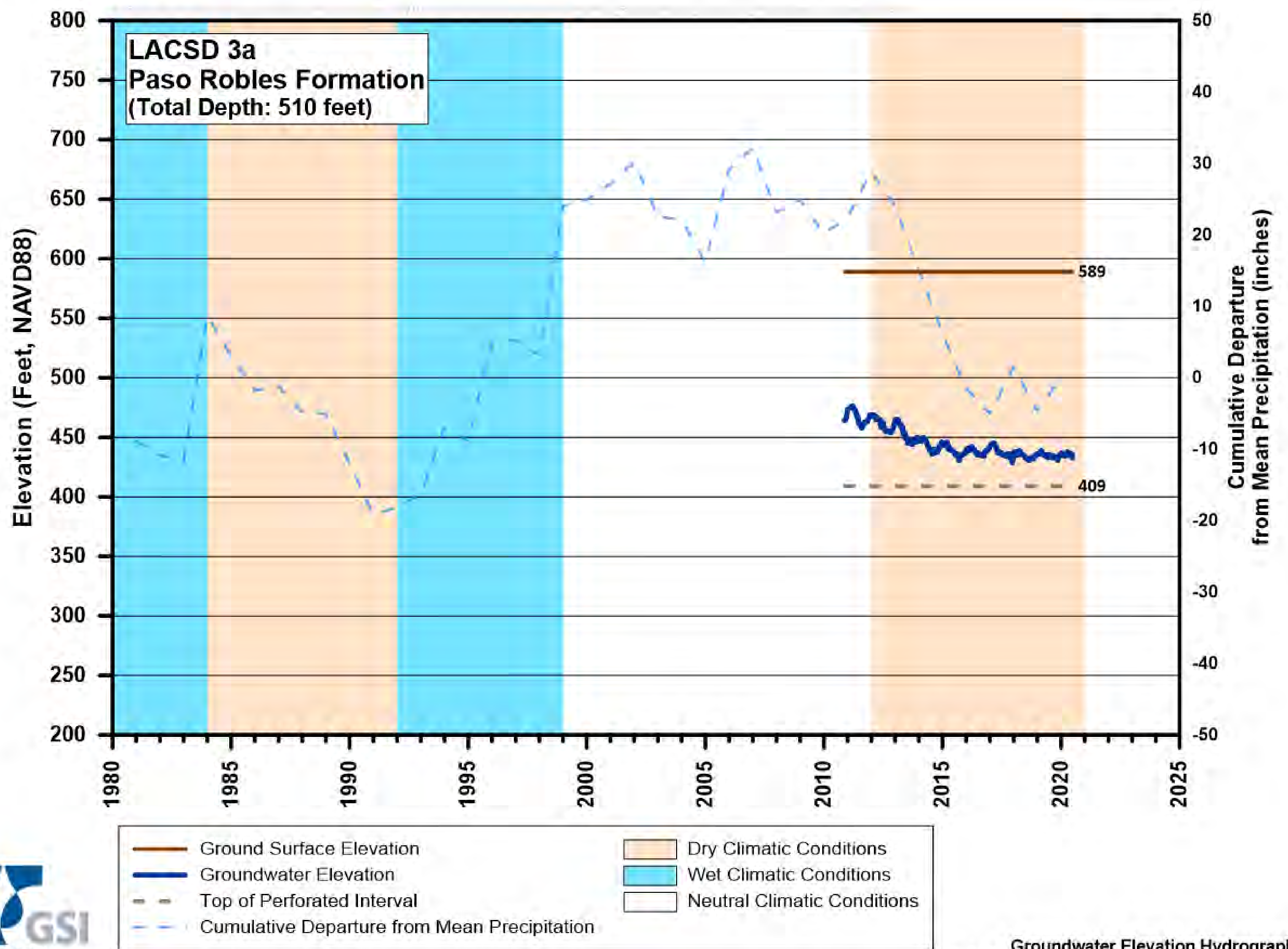
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



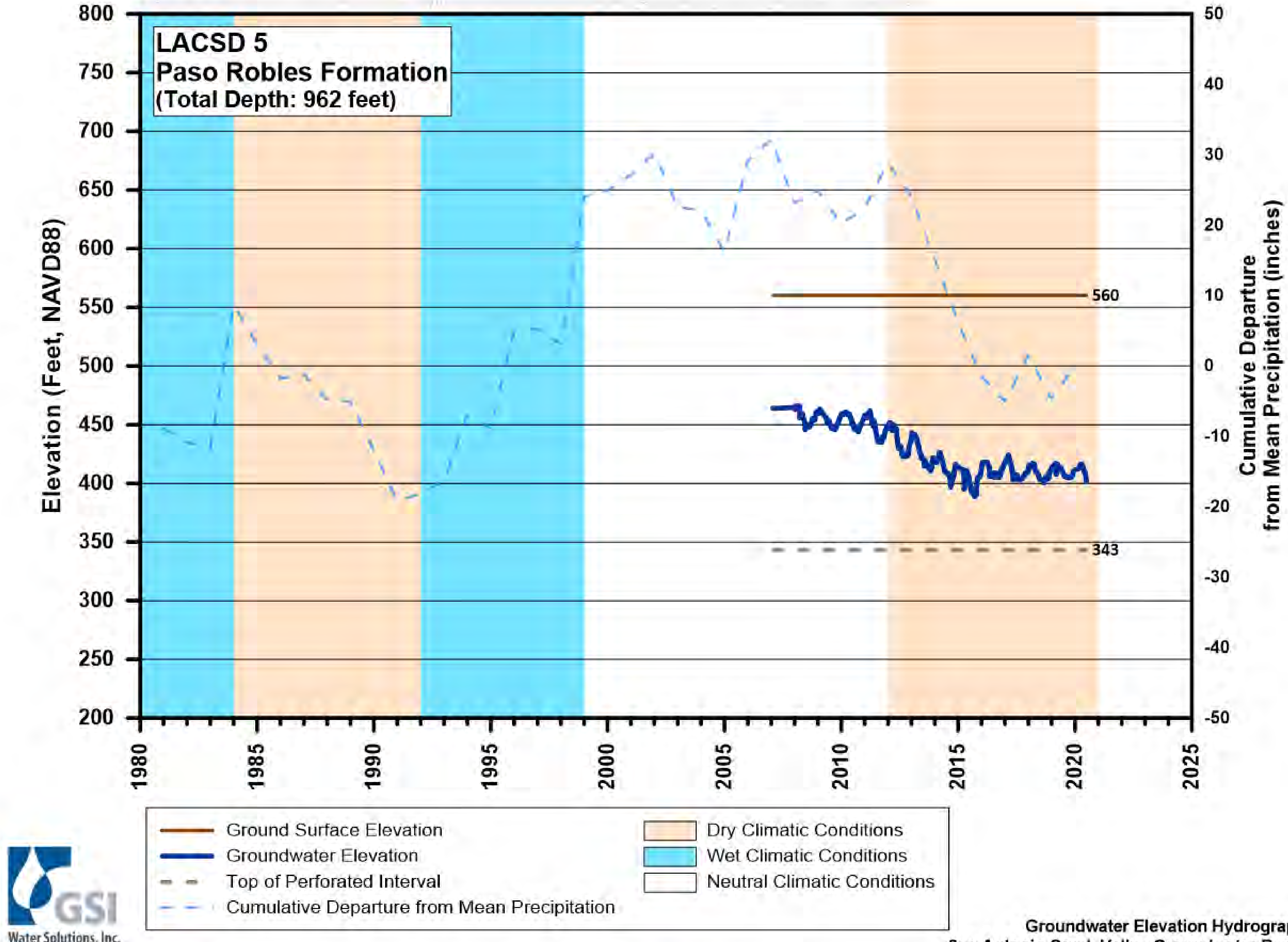
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

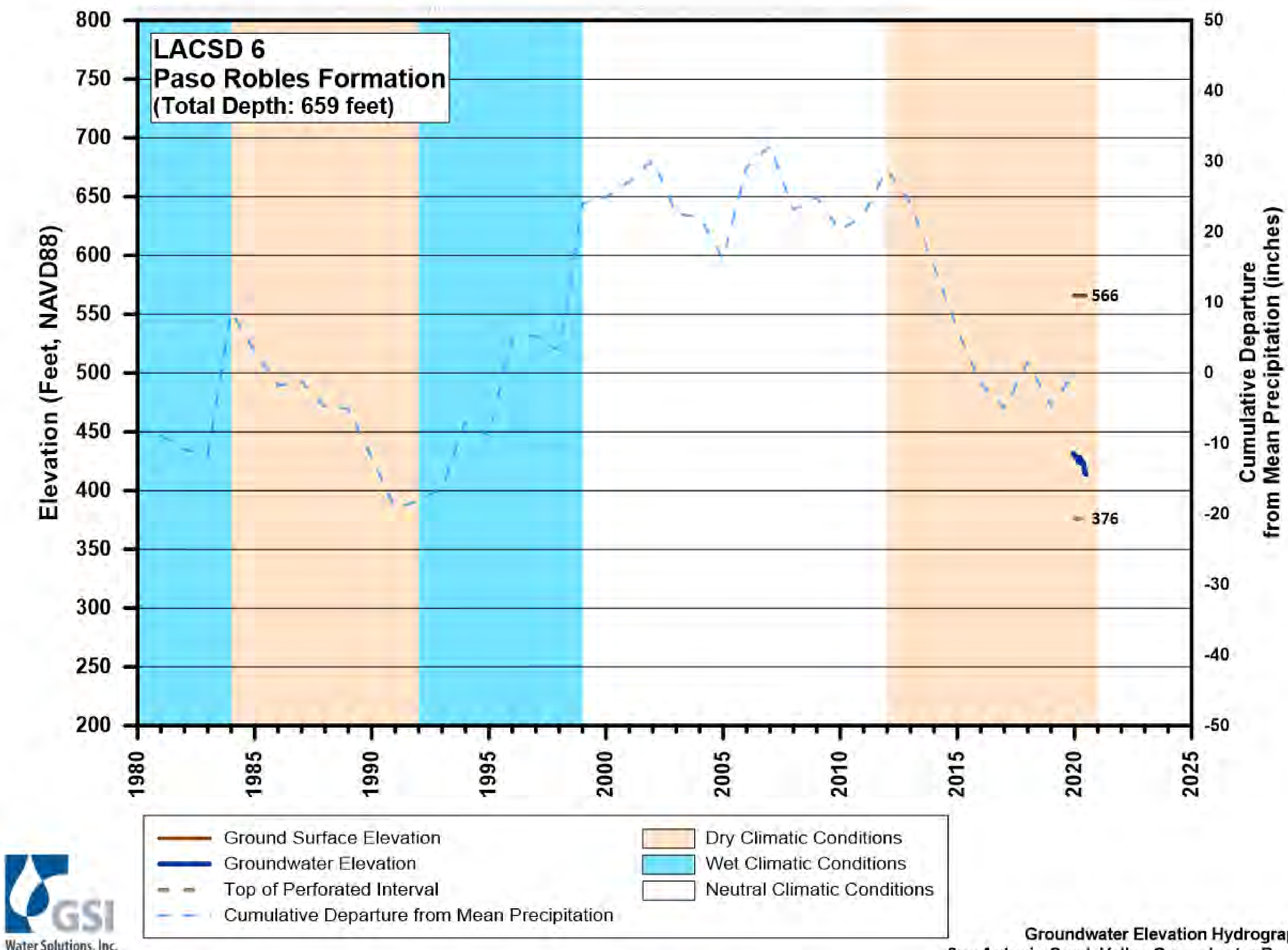


GSI Water Solutions, Inc.

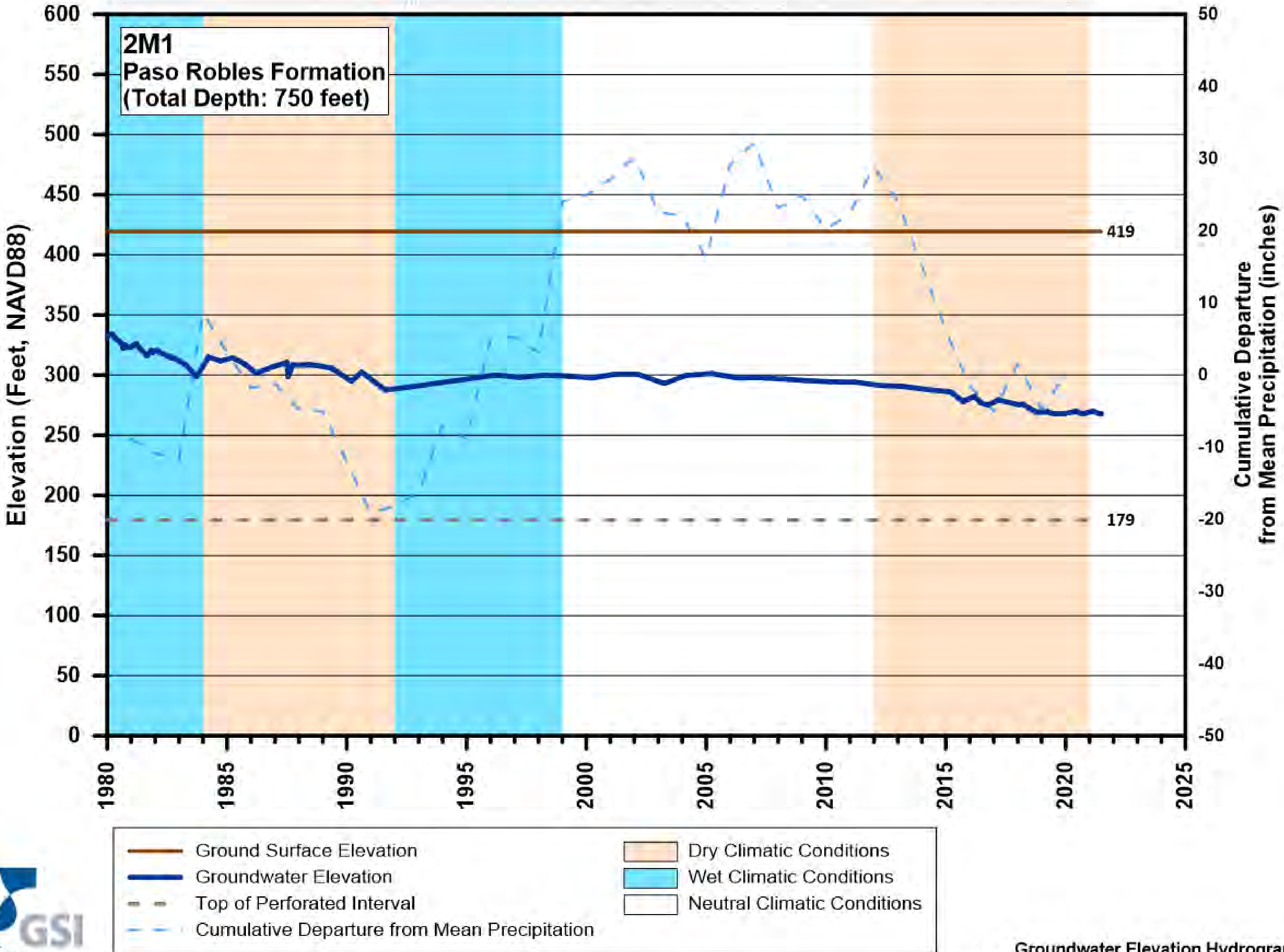
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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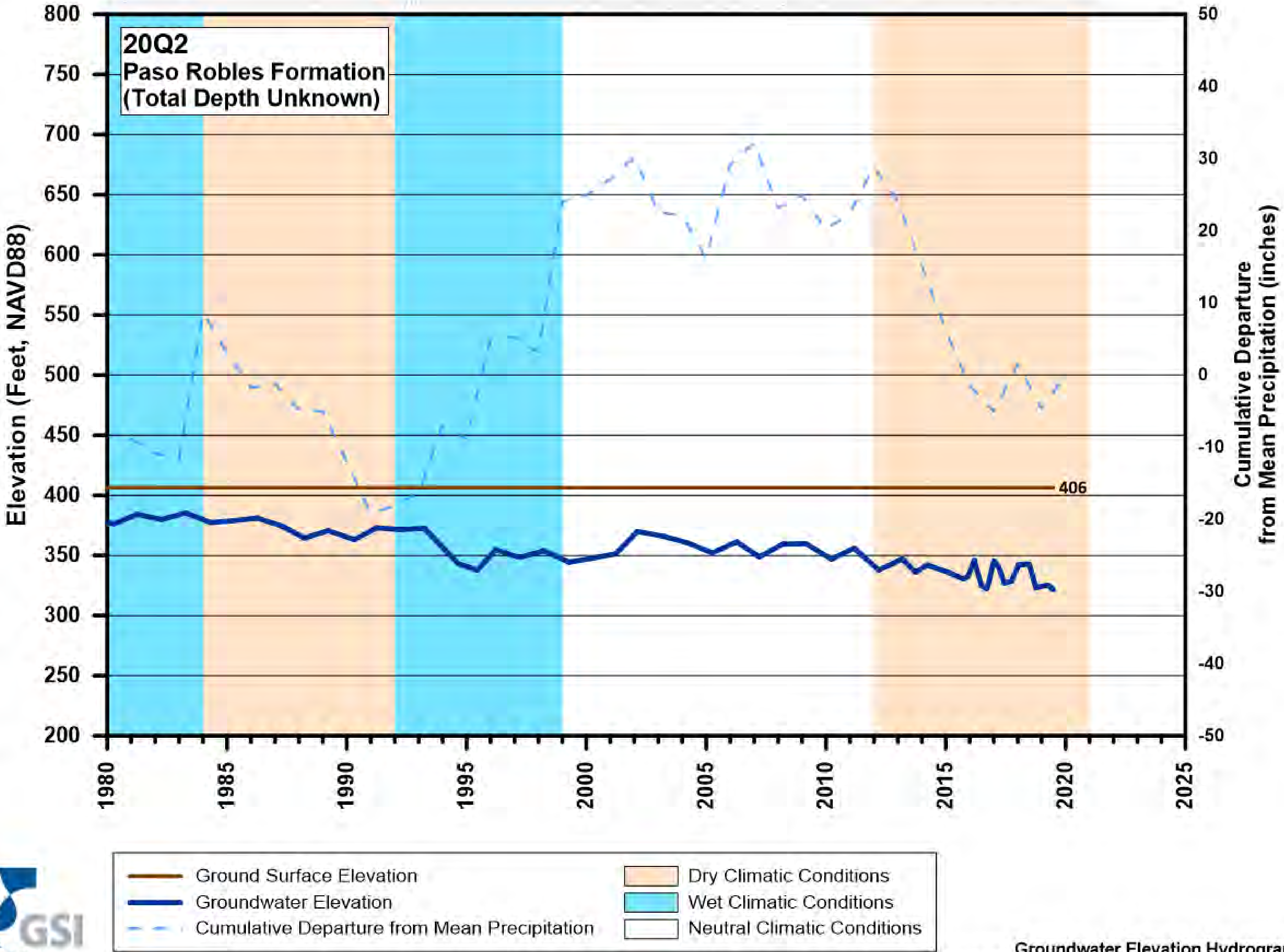
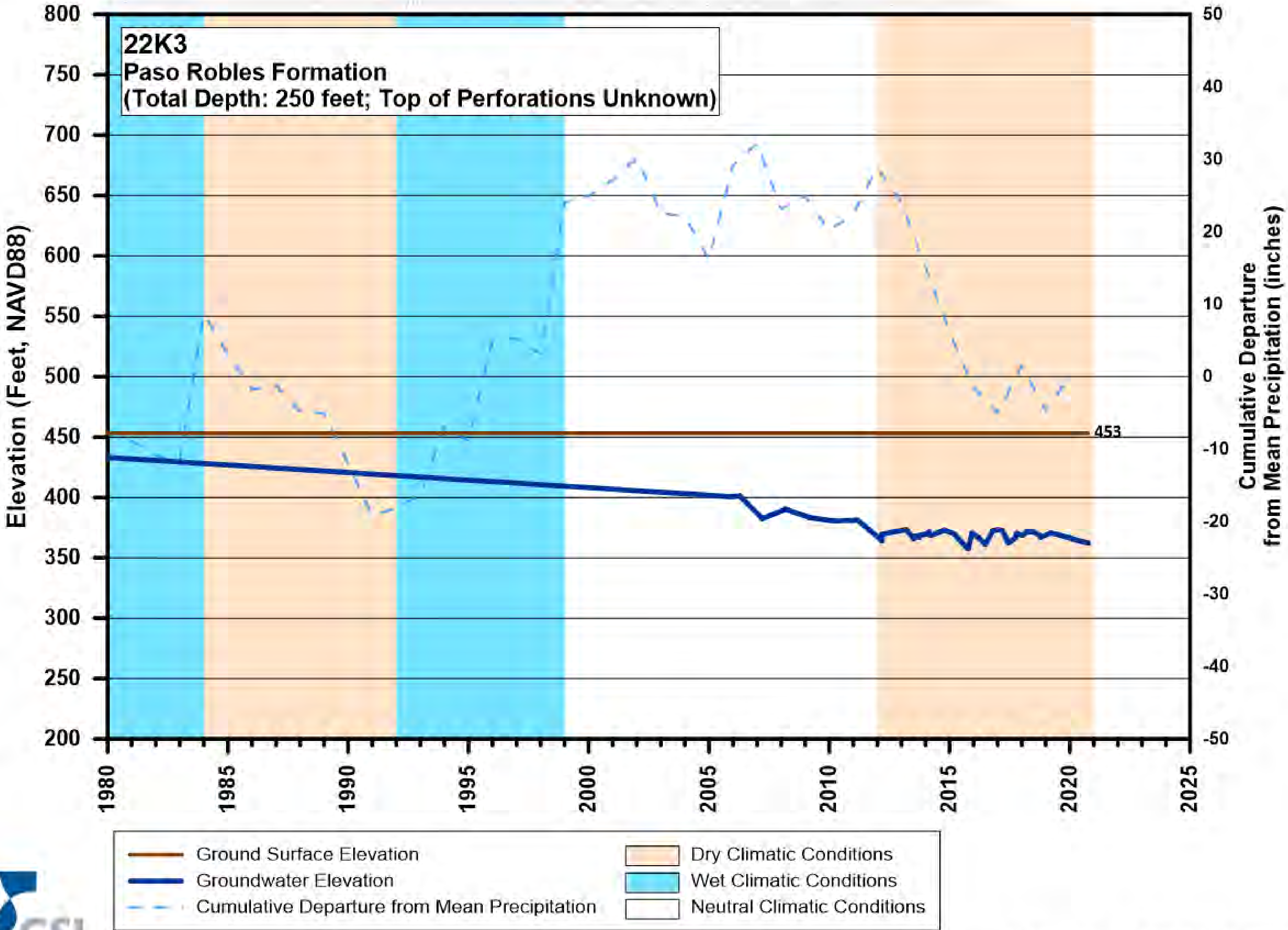
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



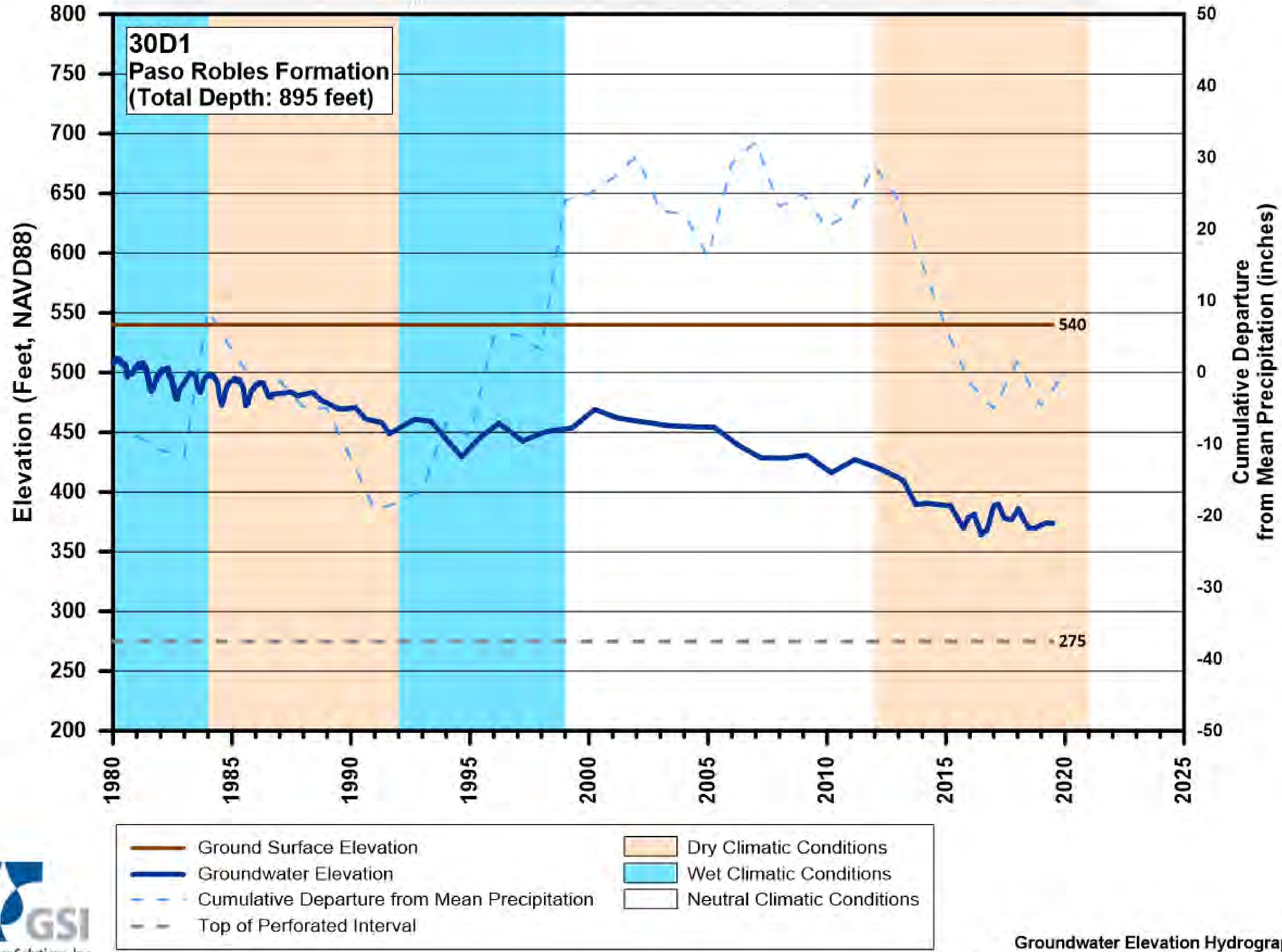
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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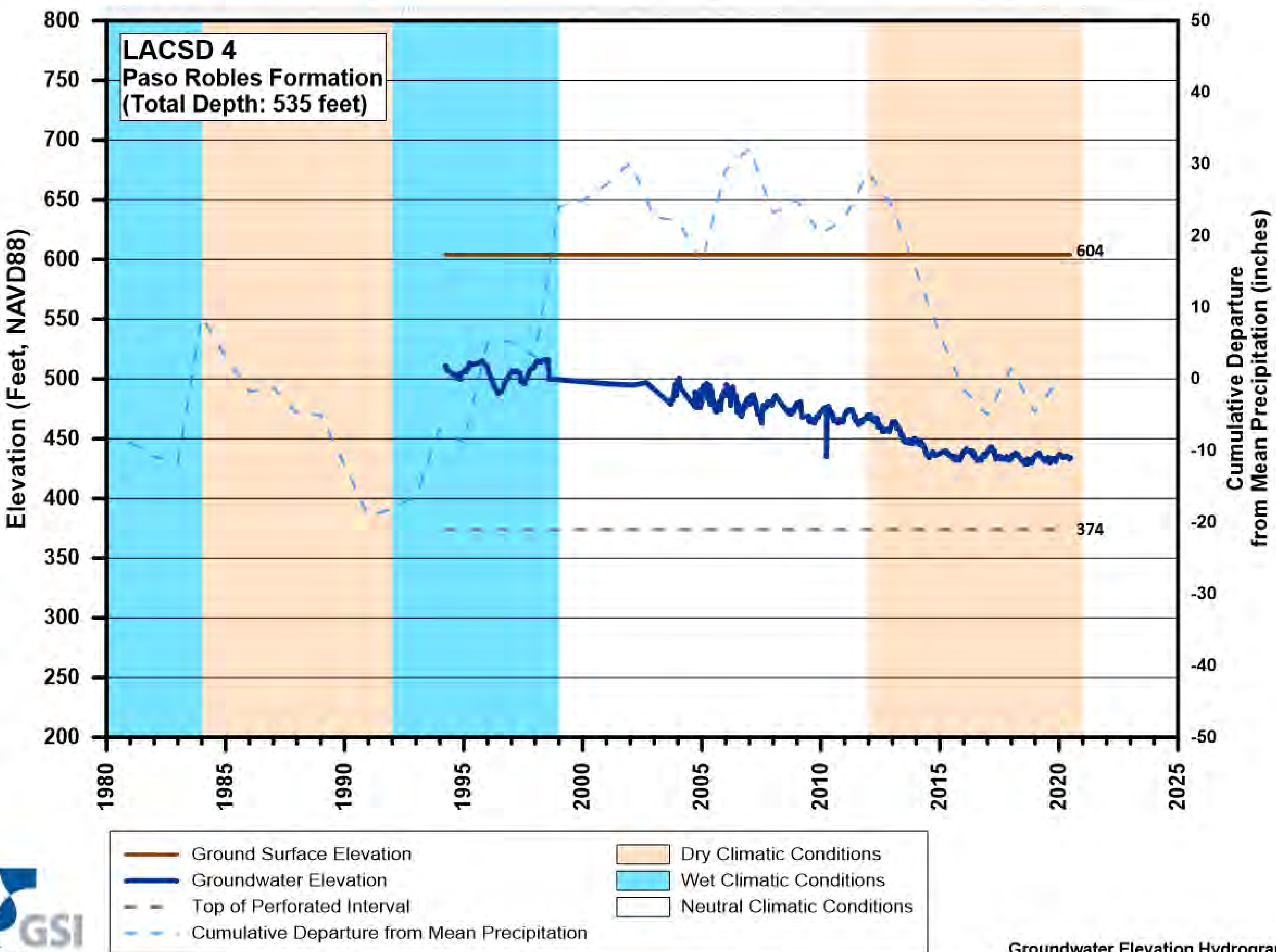
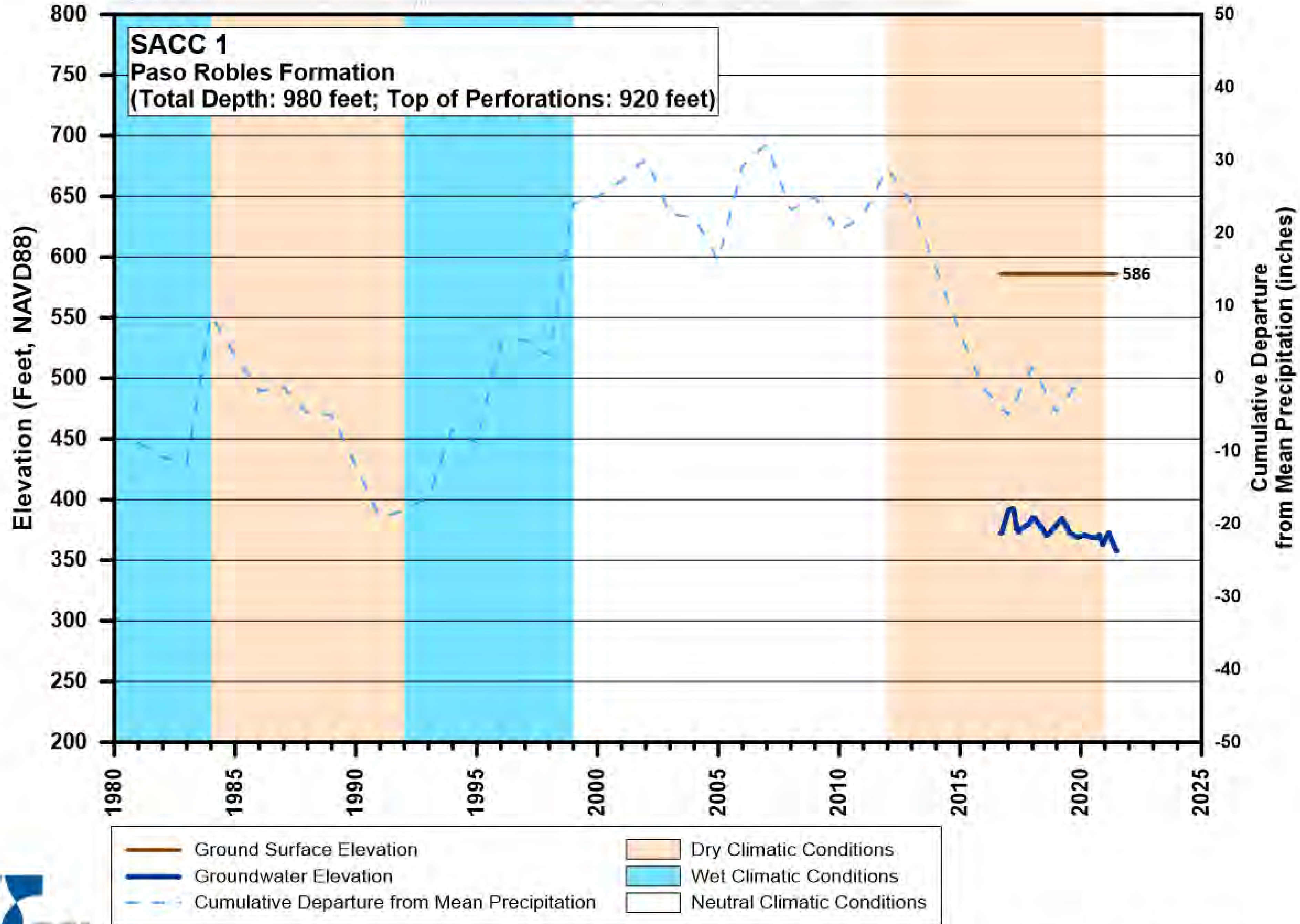
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



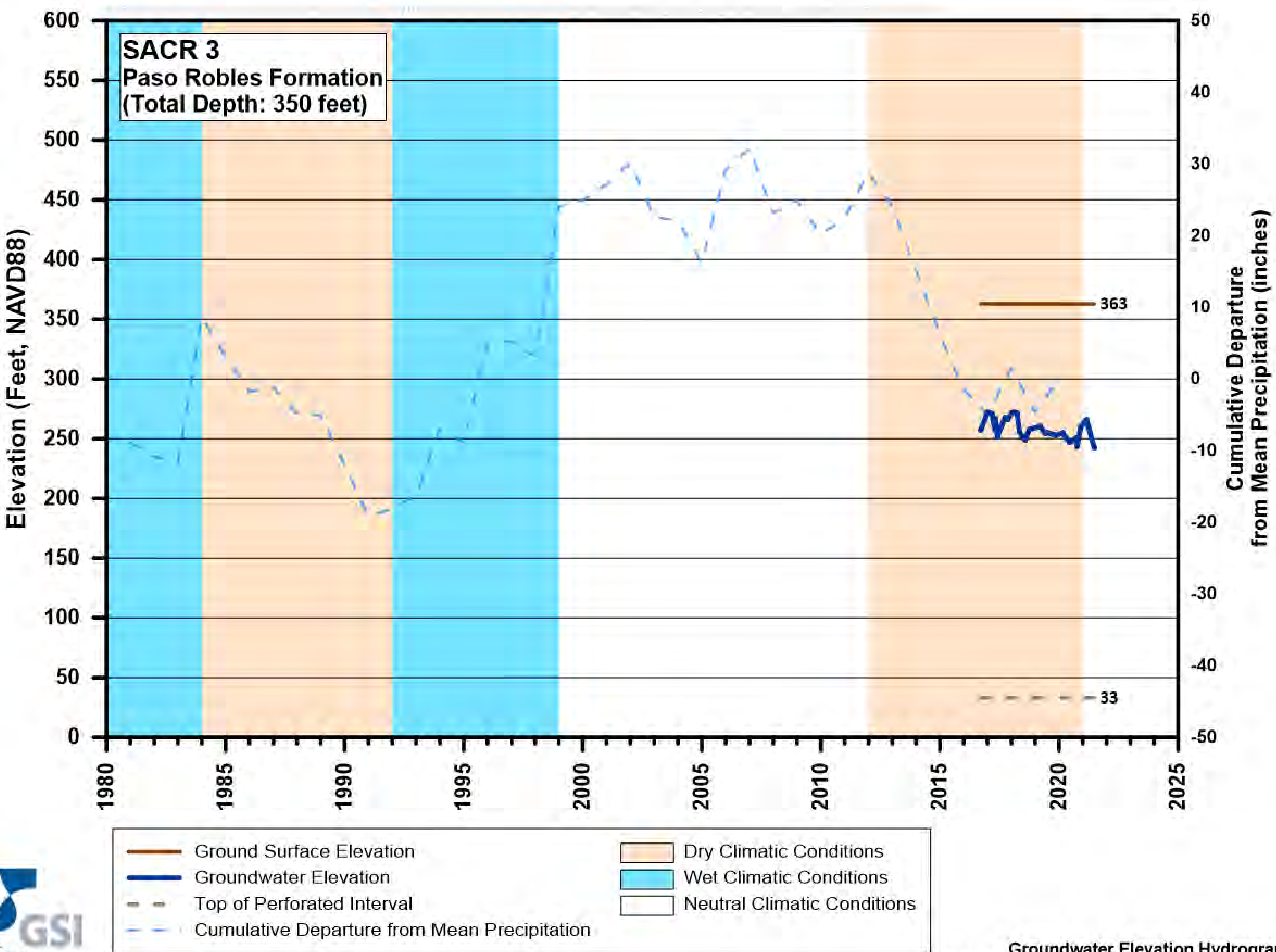
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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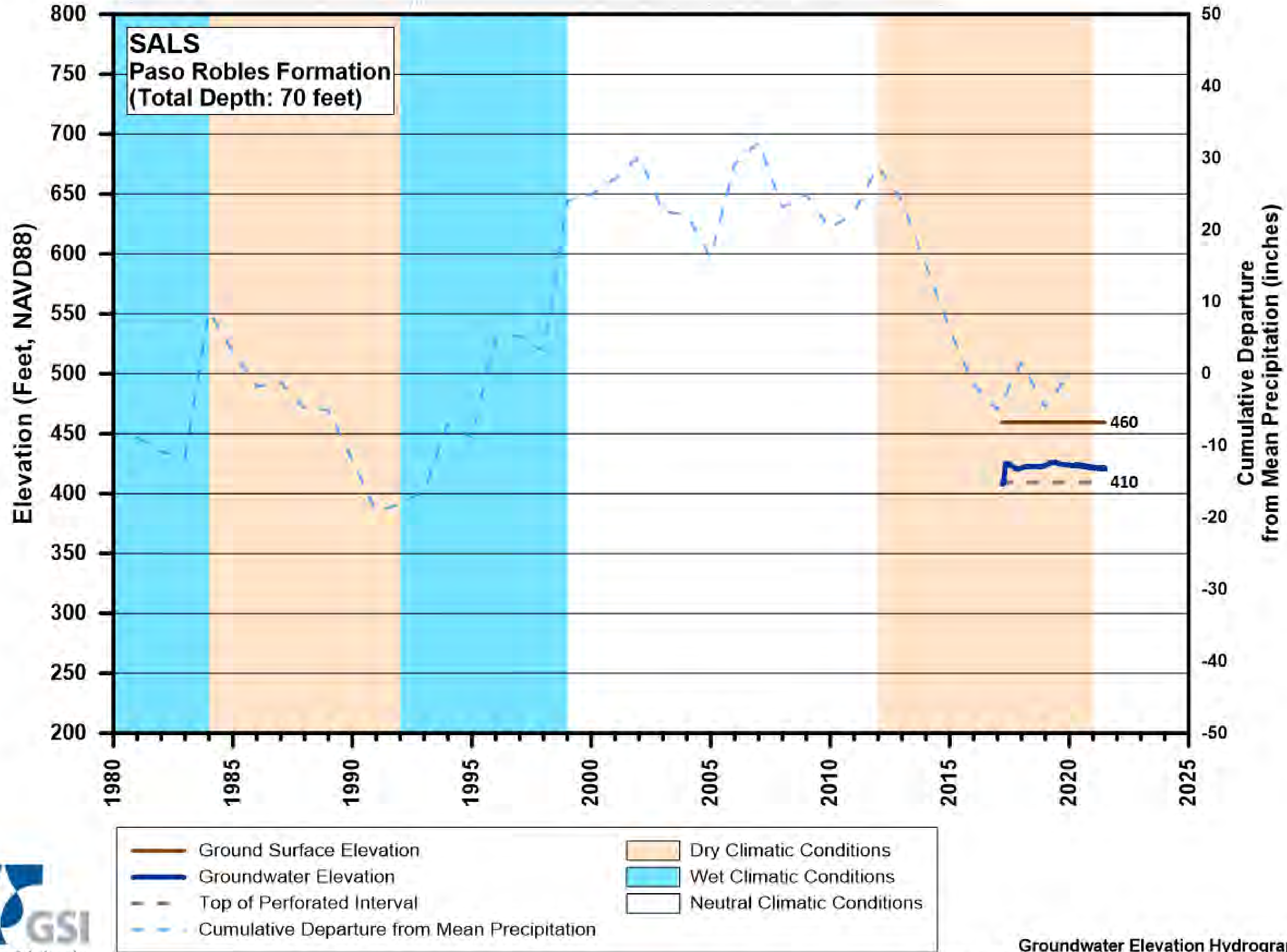
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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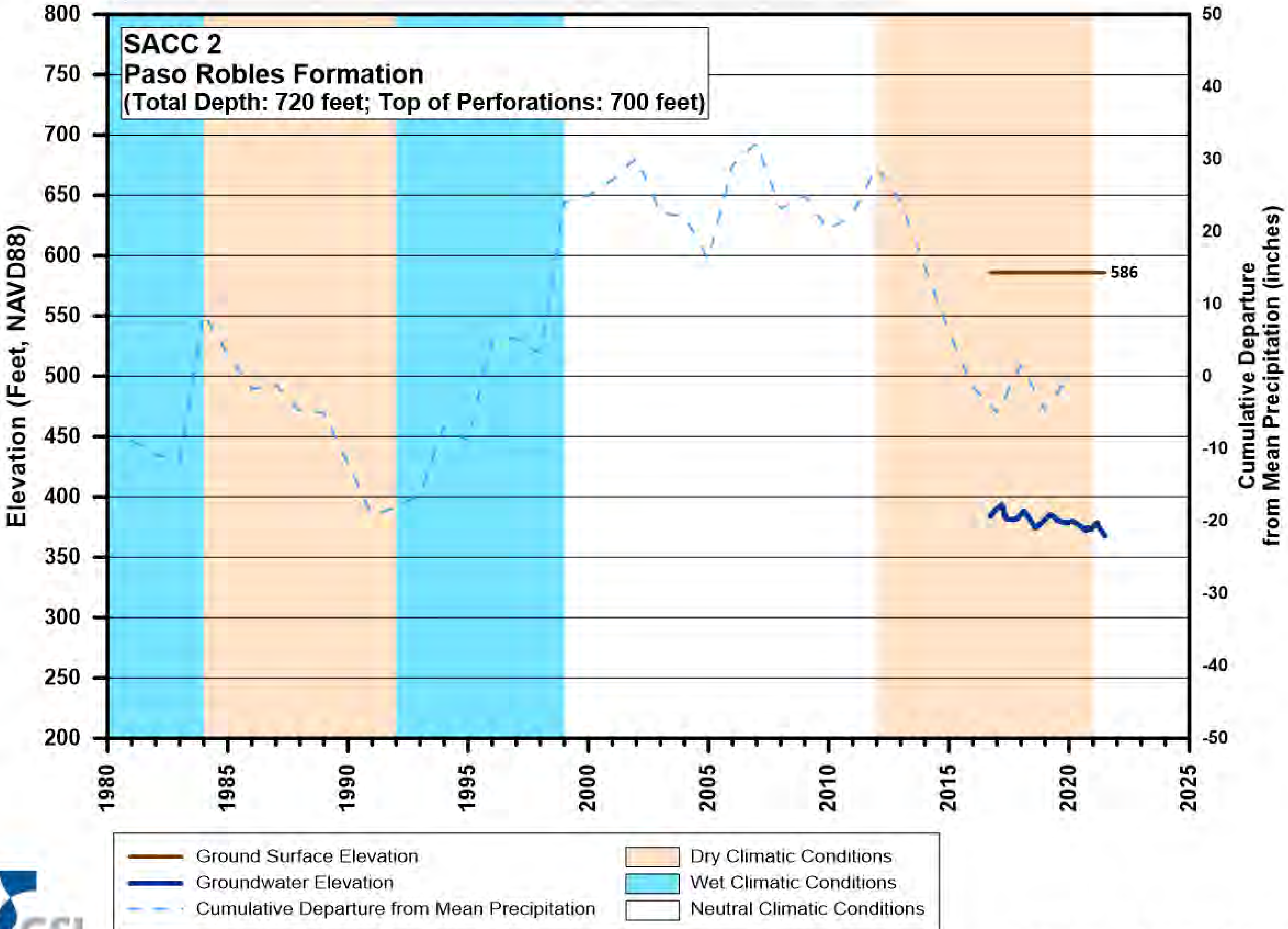
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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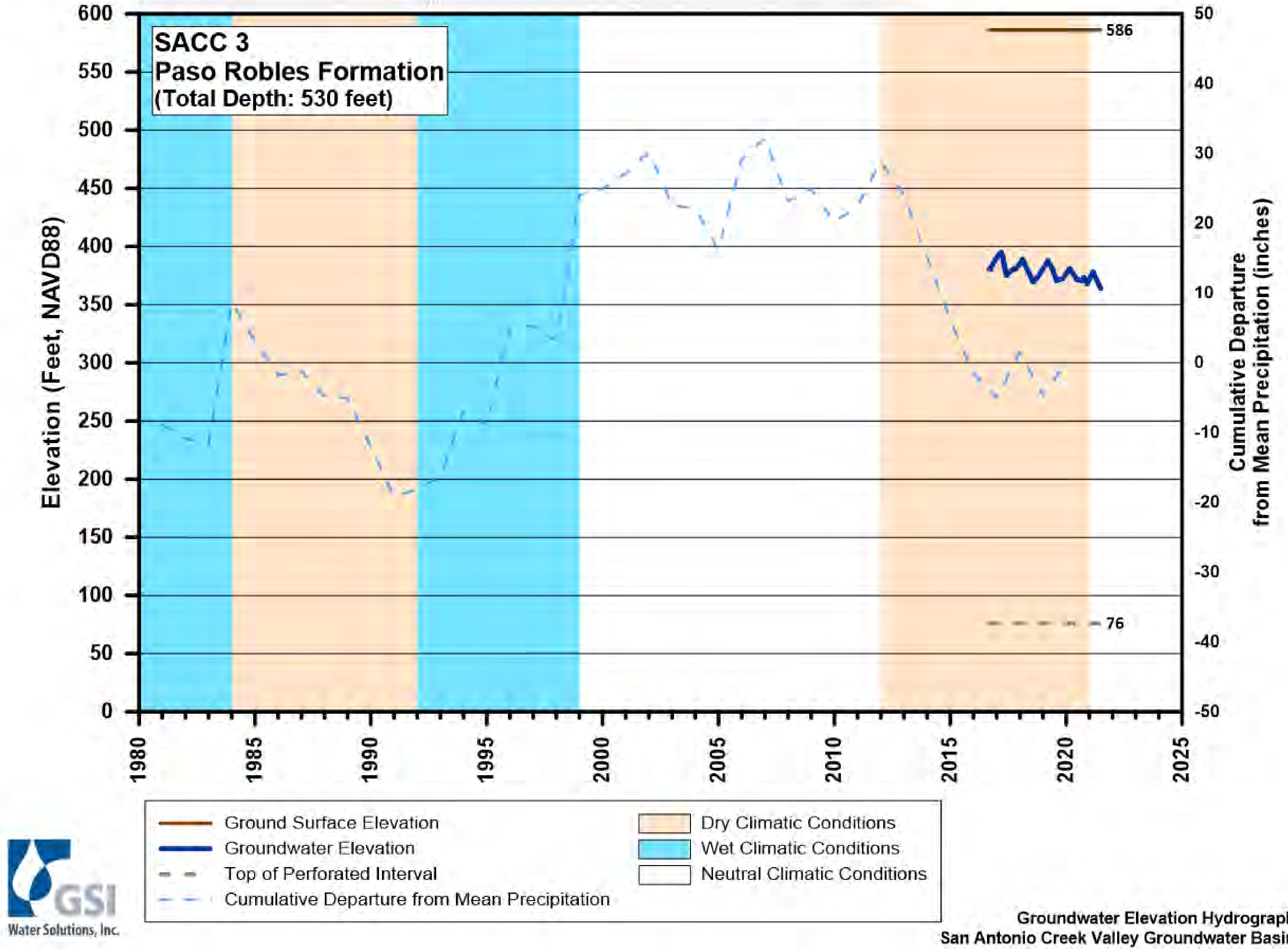
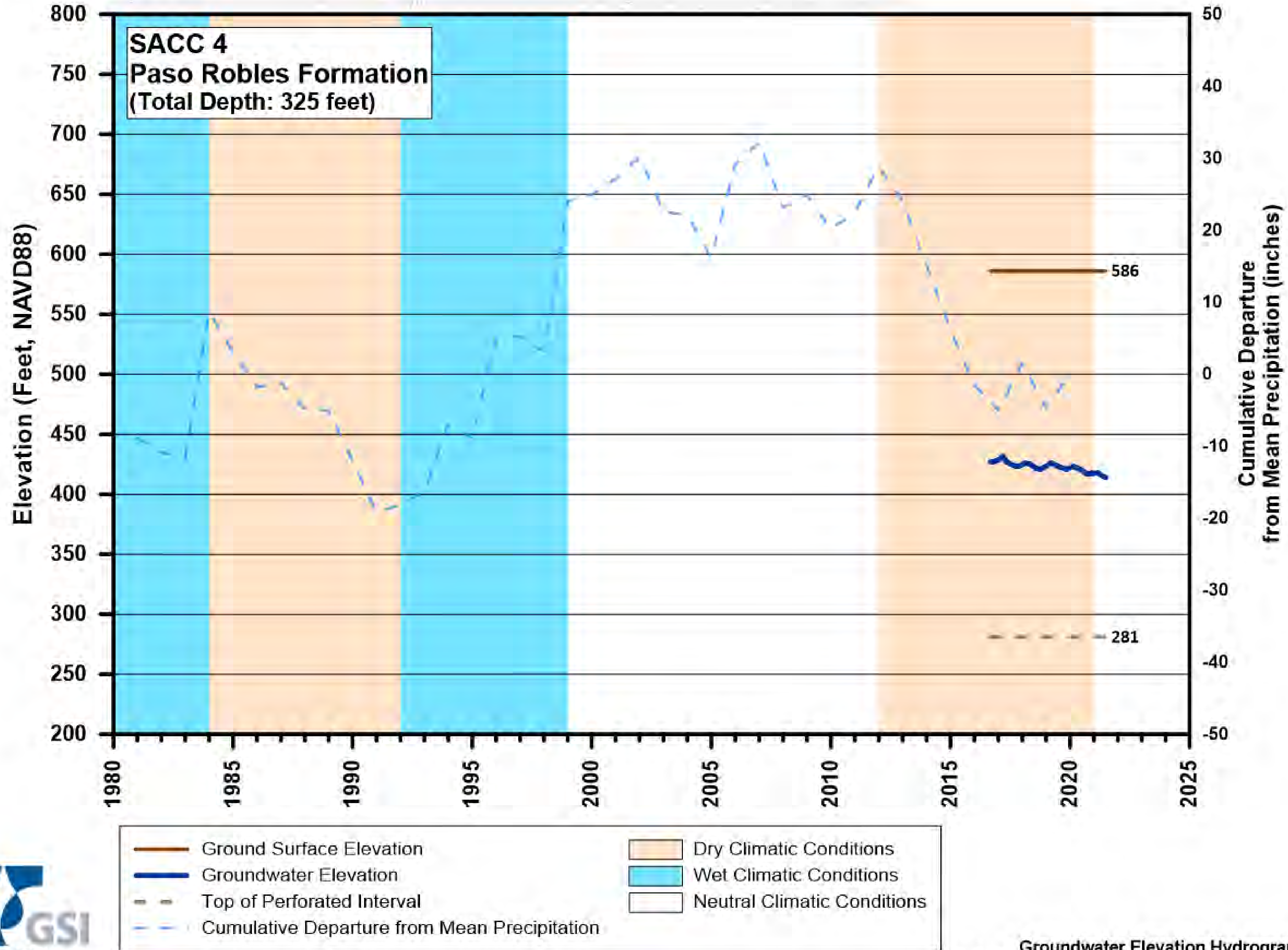
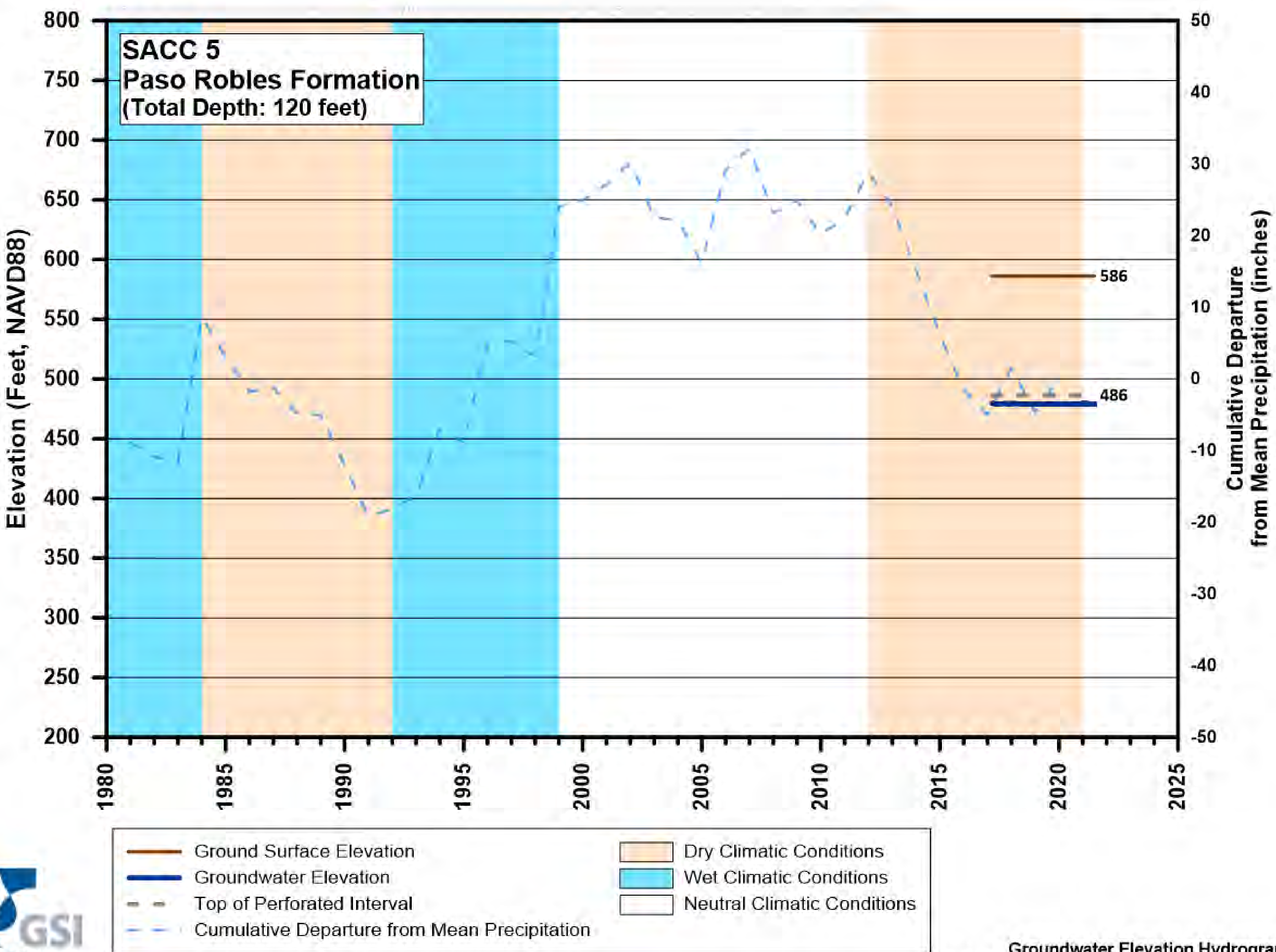
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

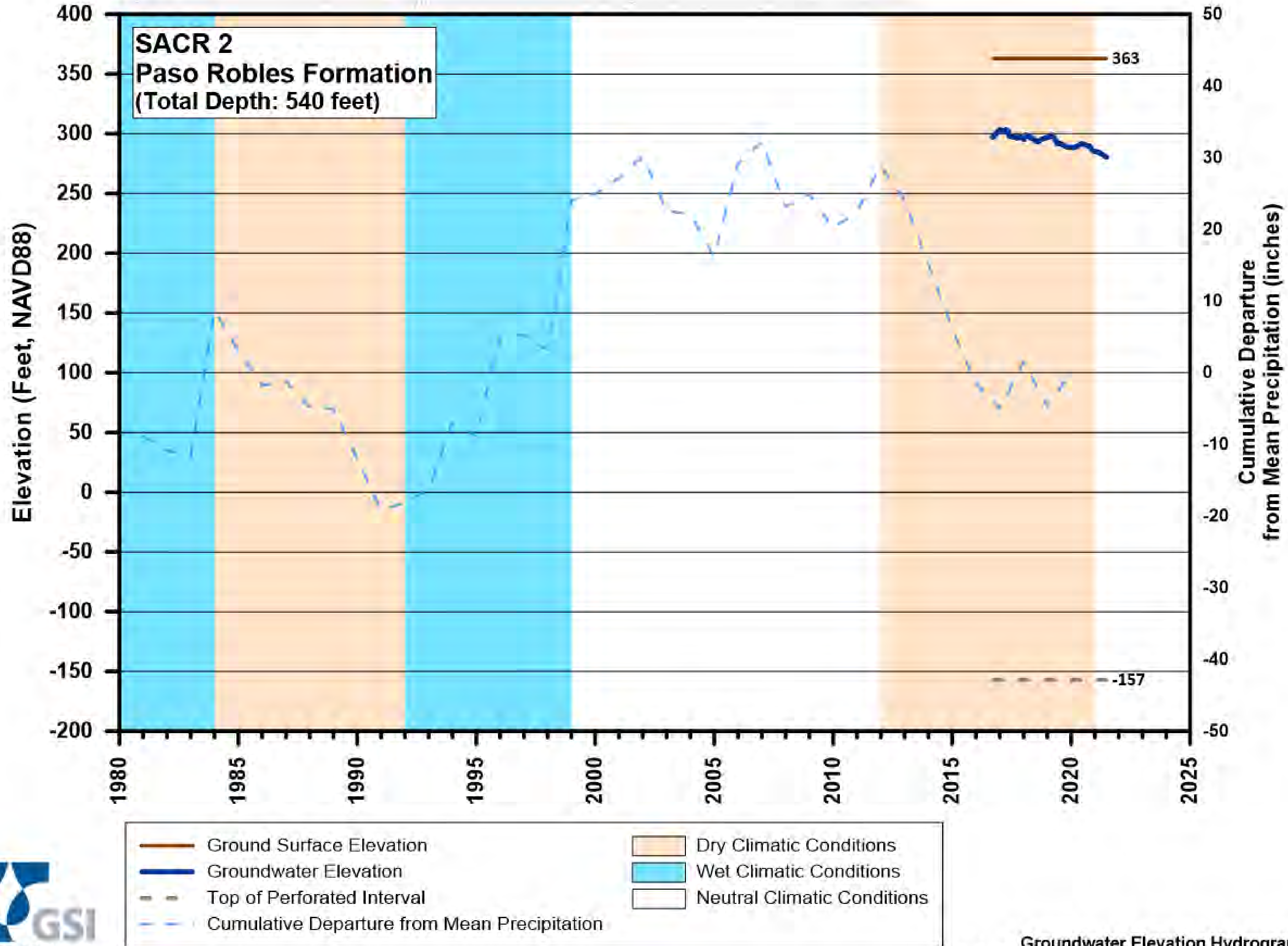


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



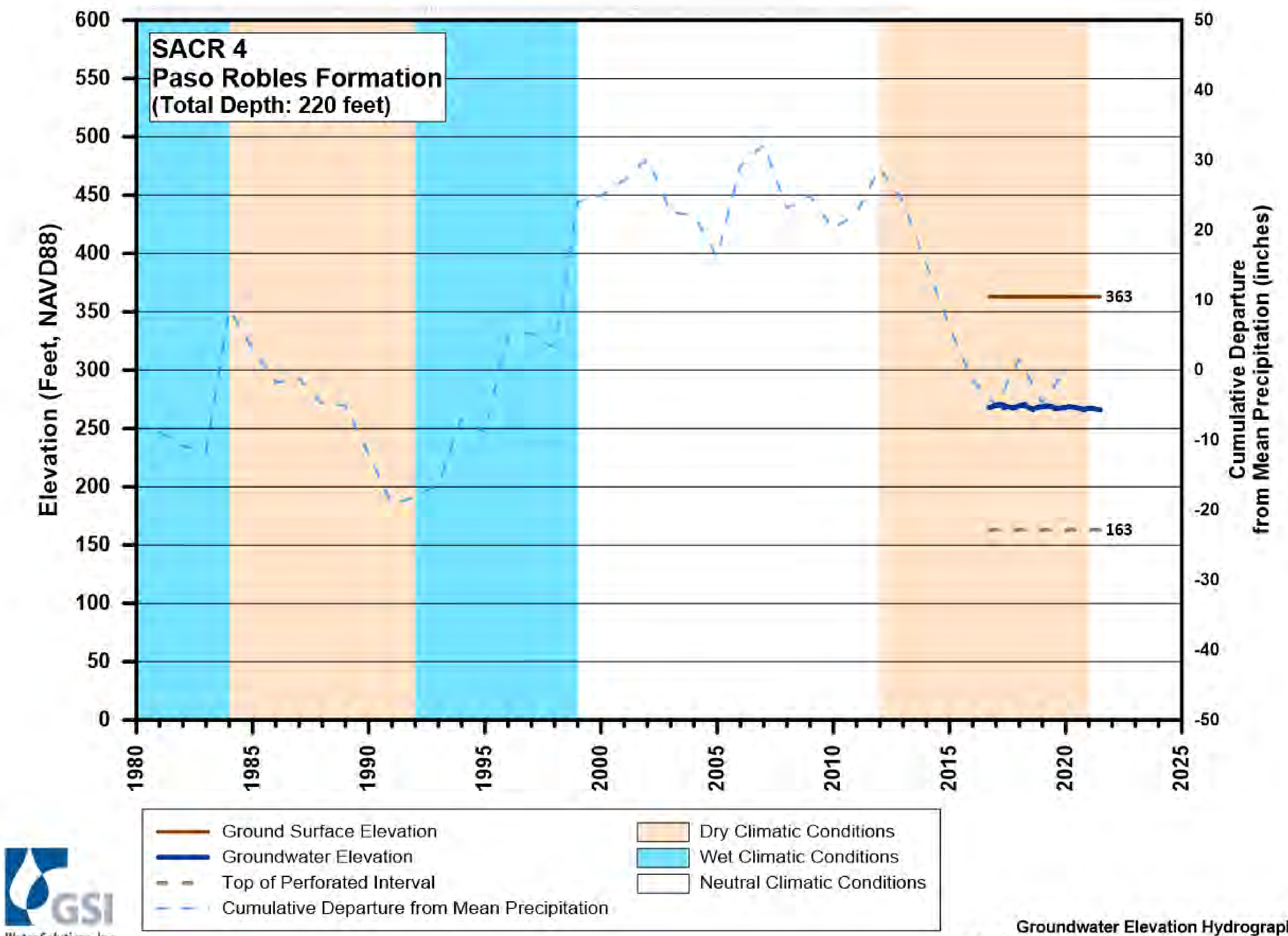
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

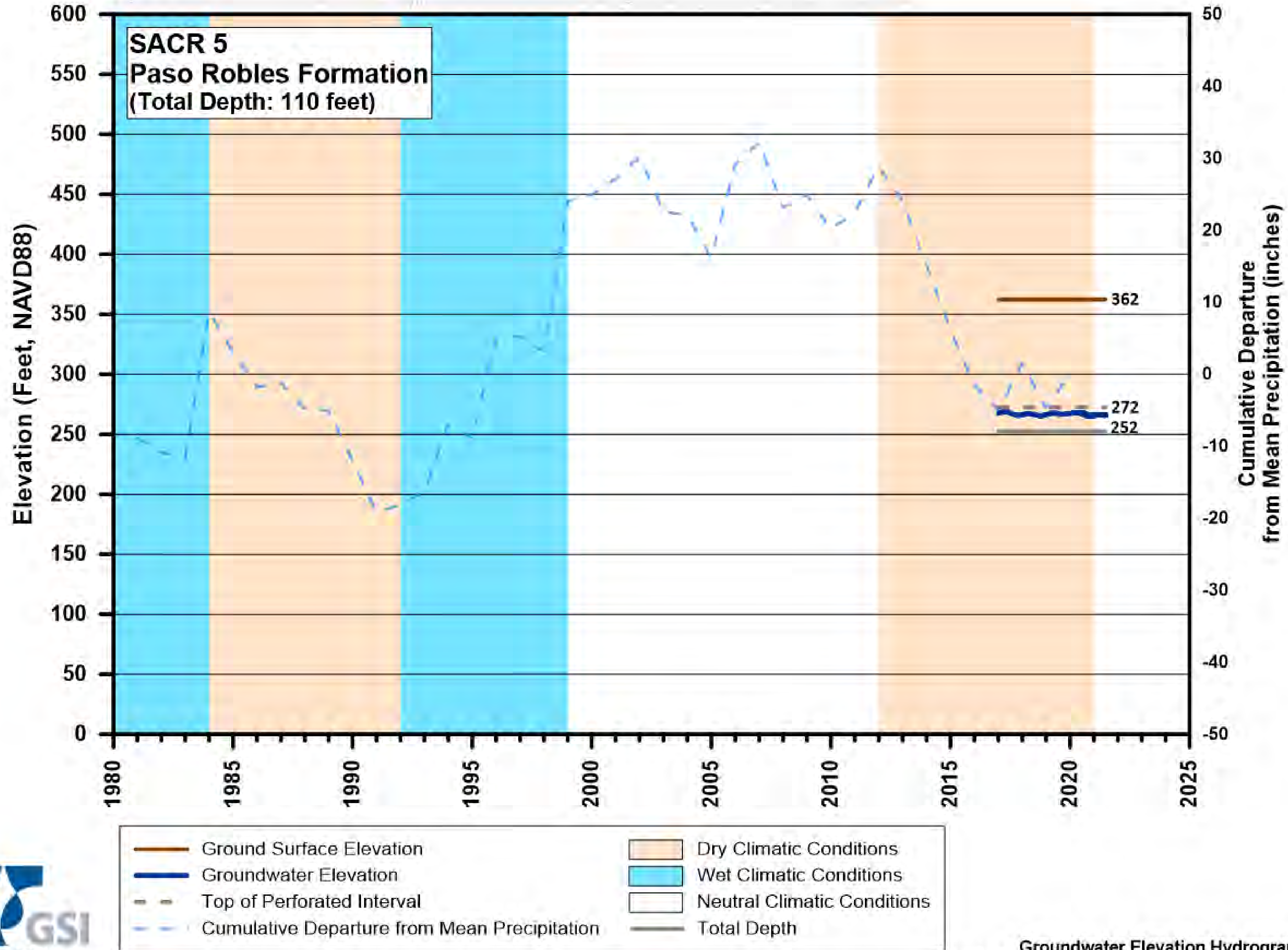


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

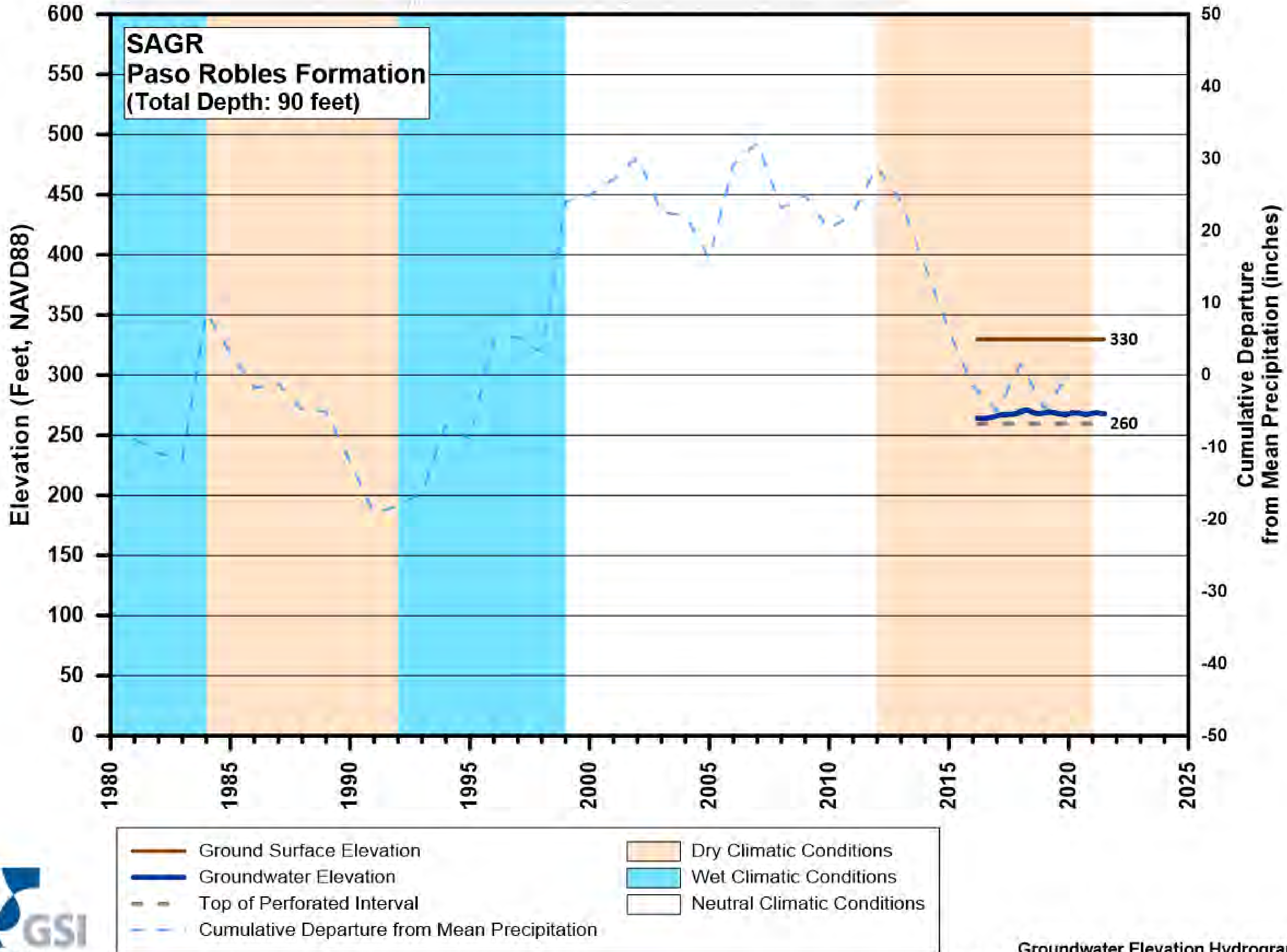


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



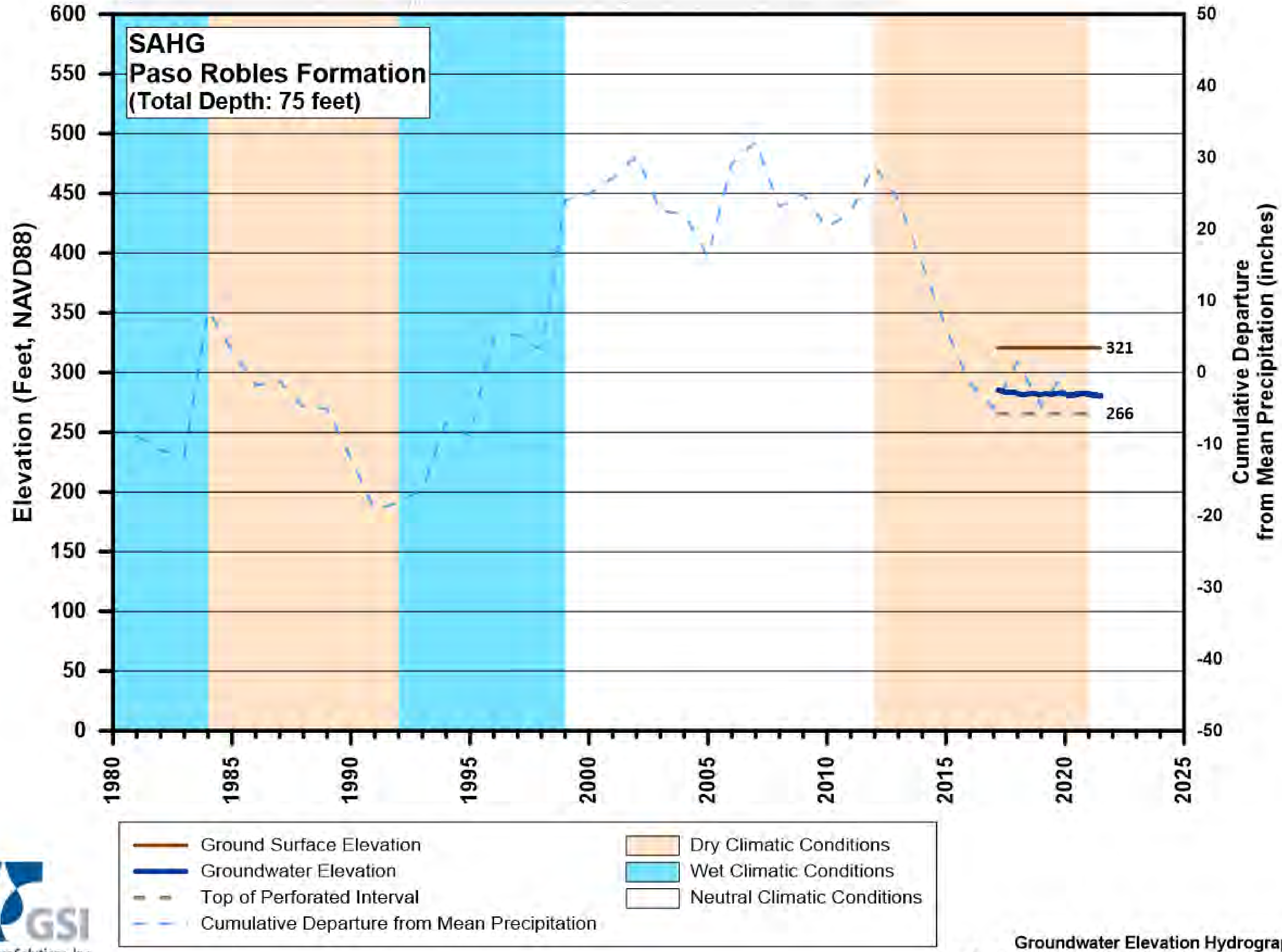
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



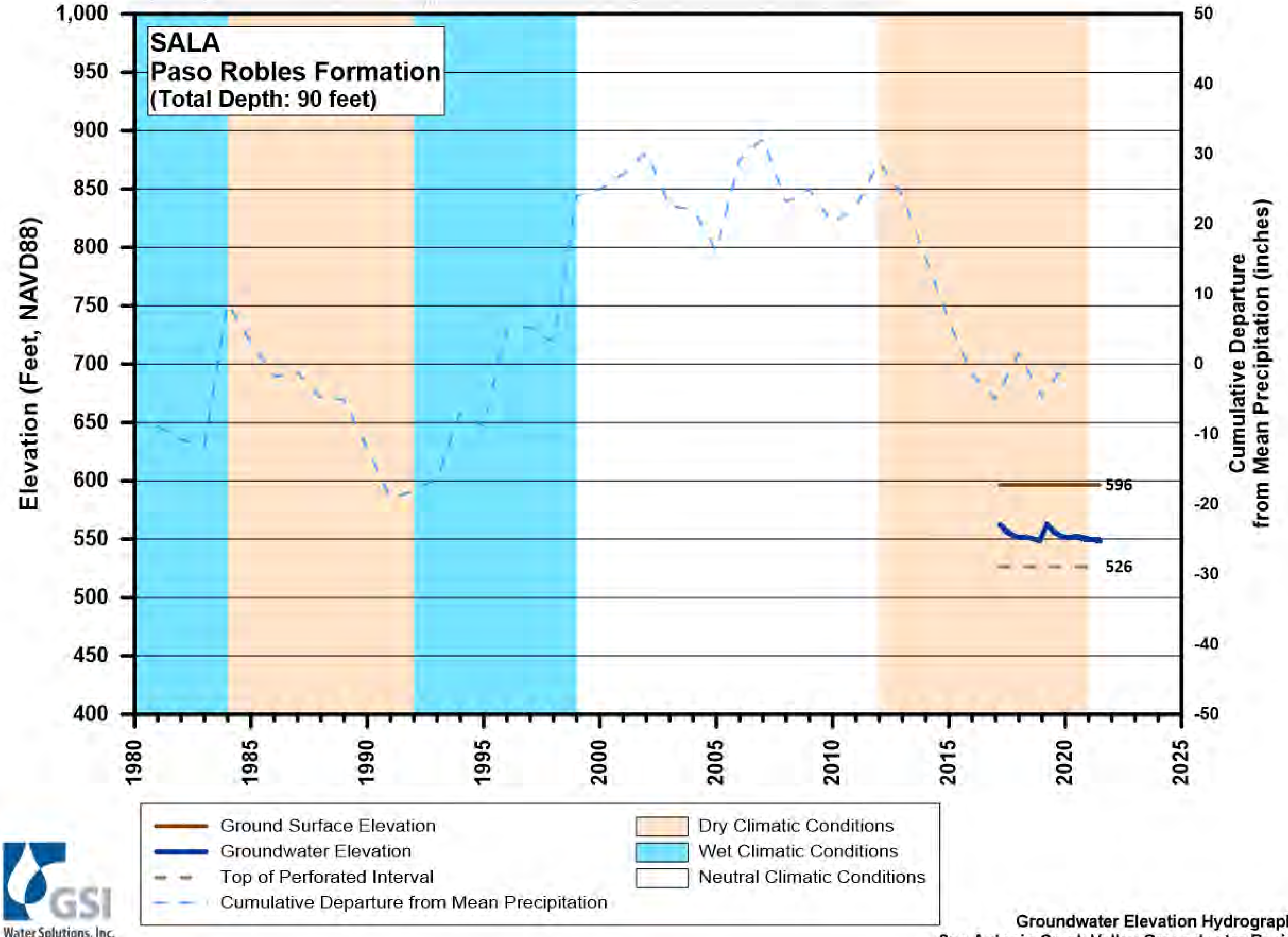
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

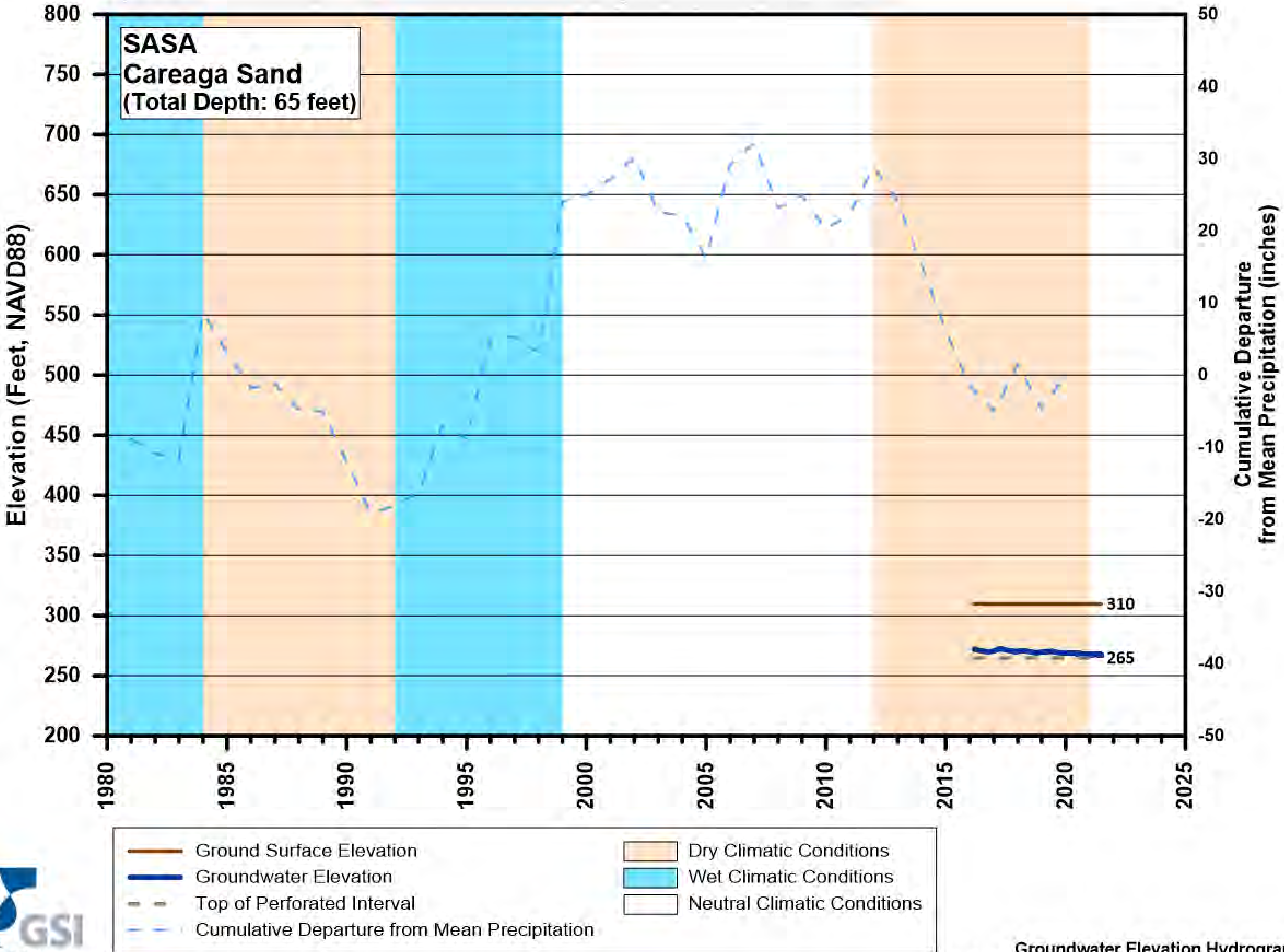


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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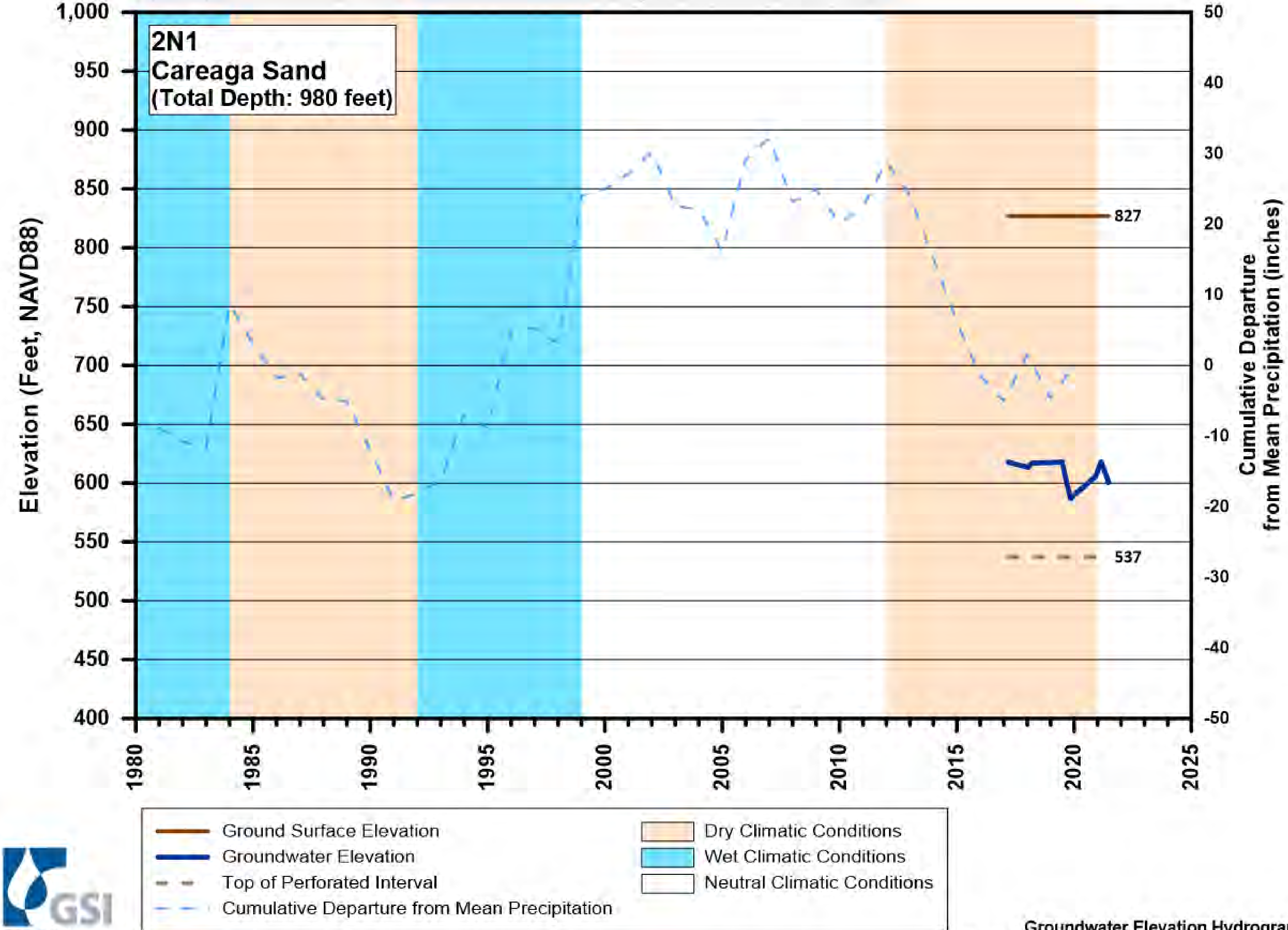
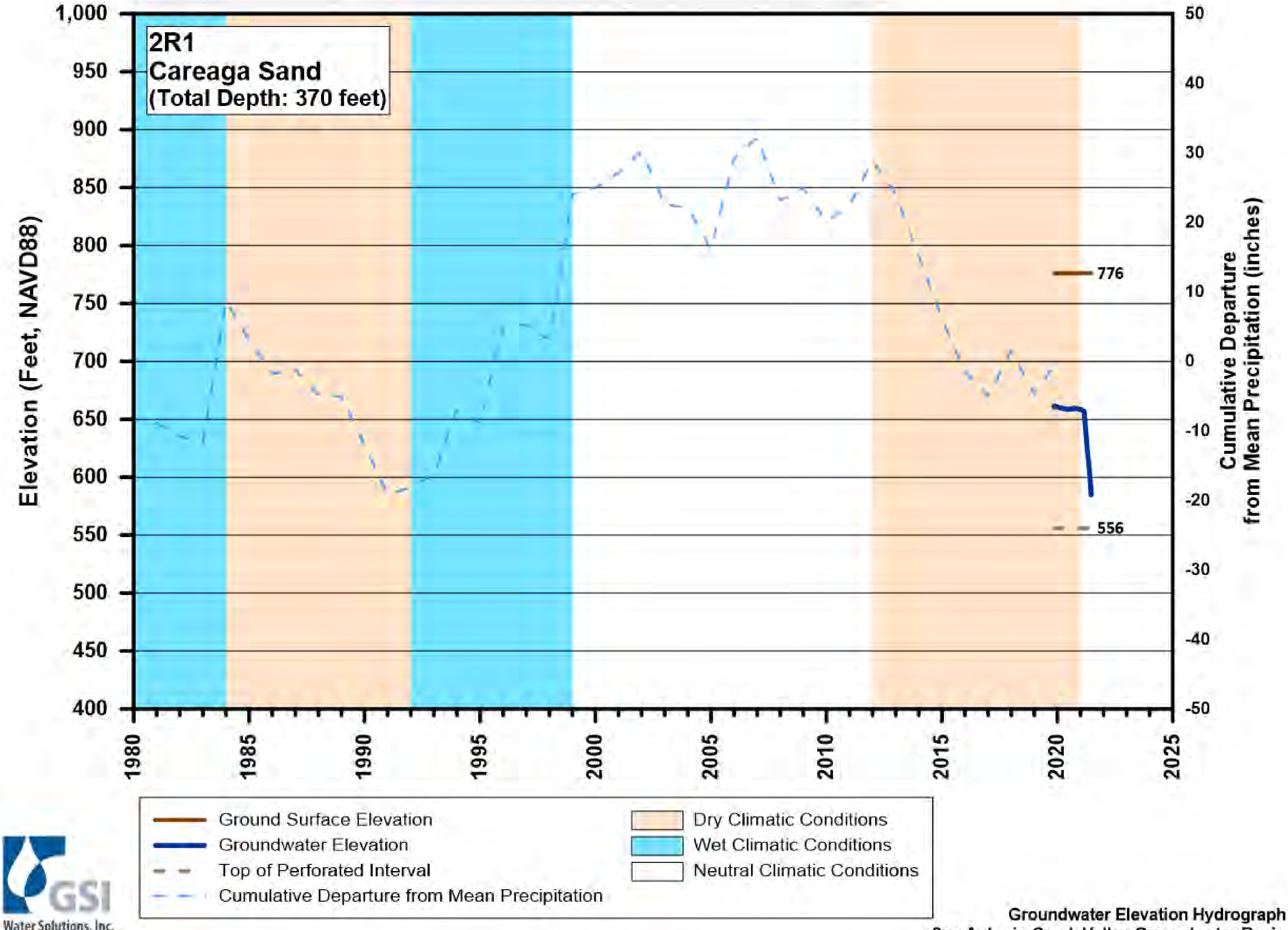
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

Careaga Sand

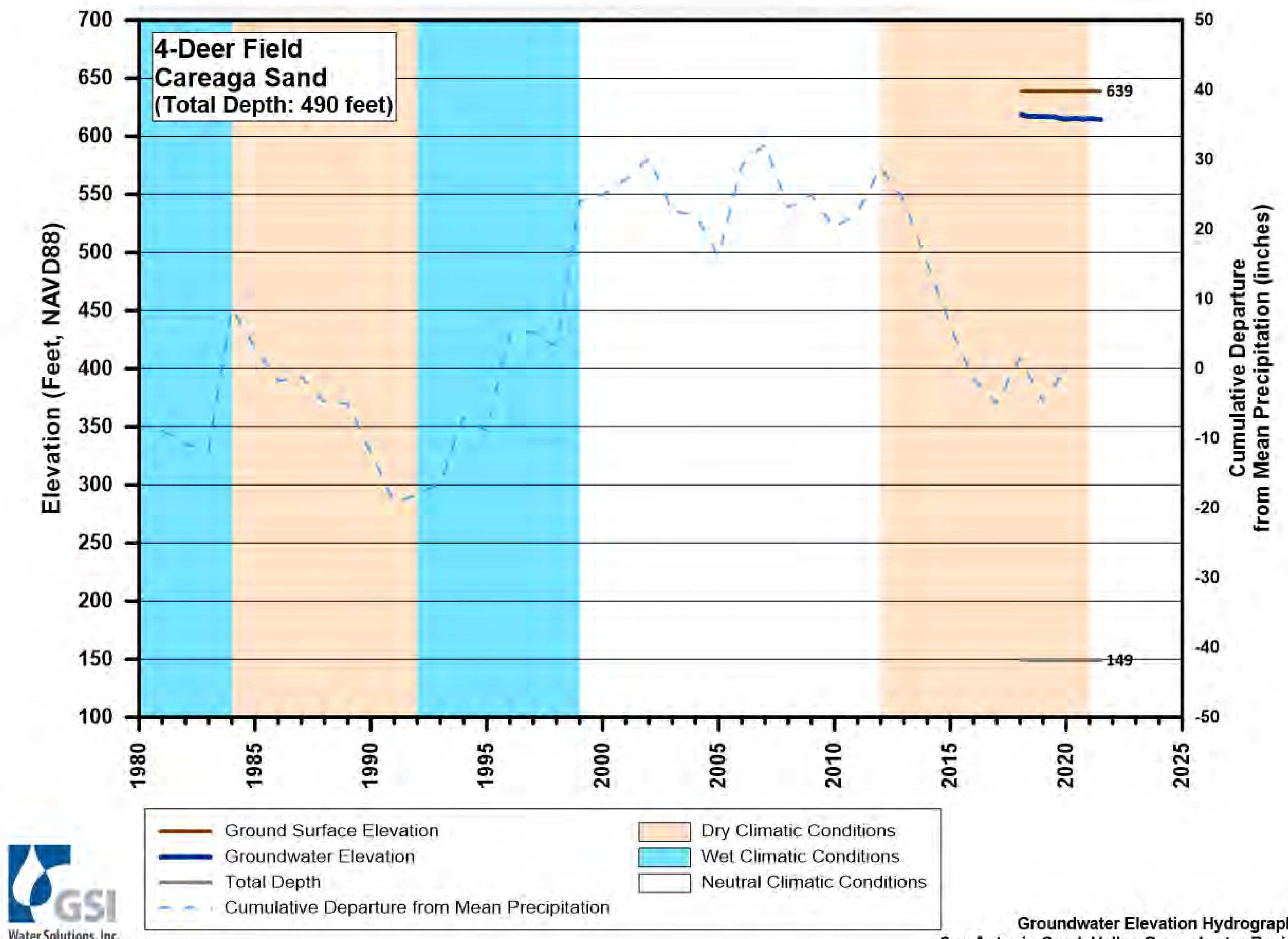


GSI Water Solutions, Inc.

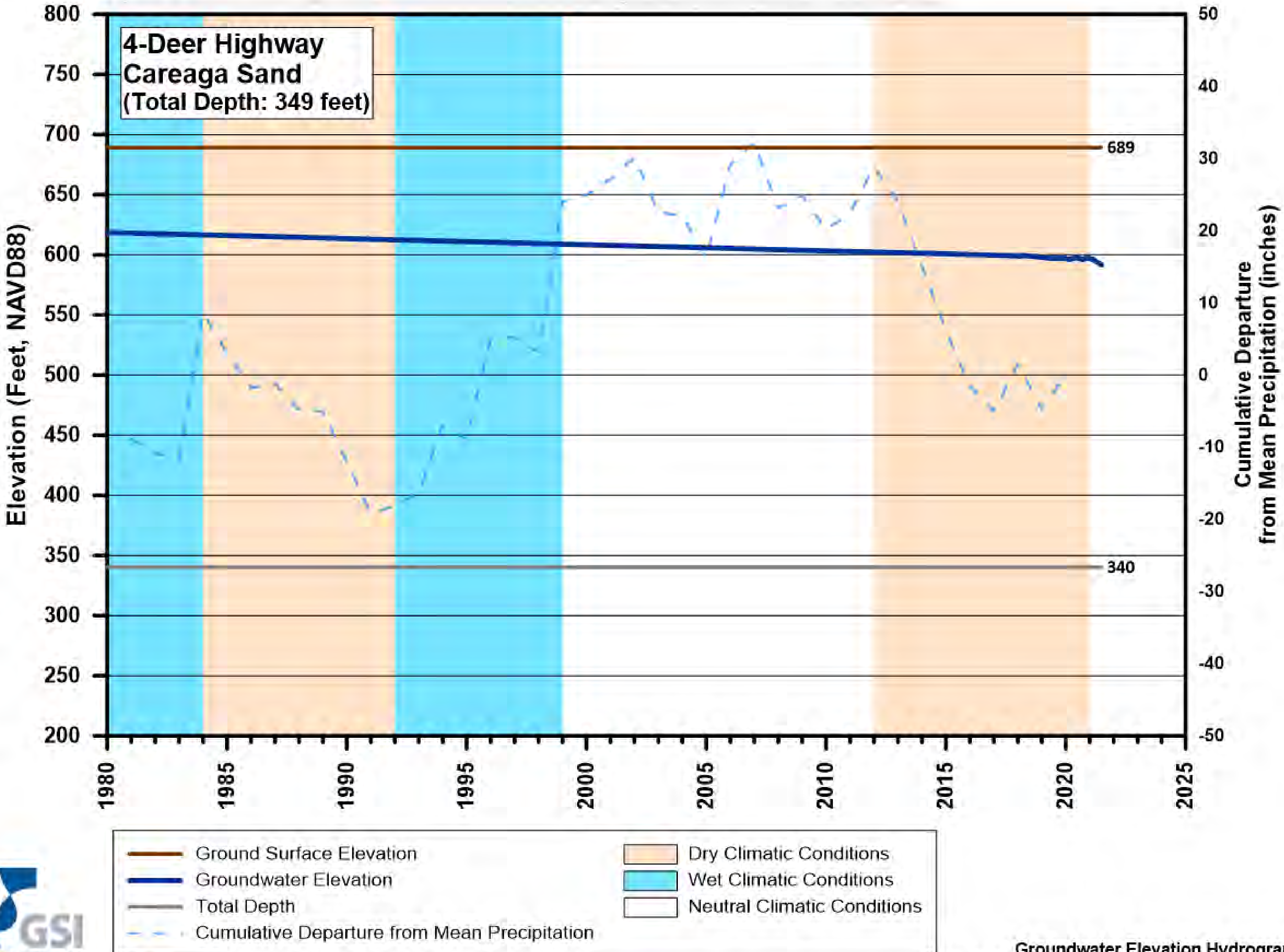
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

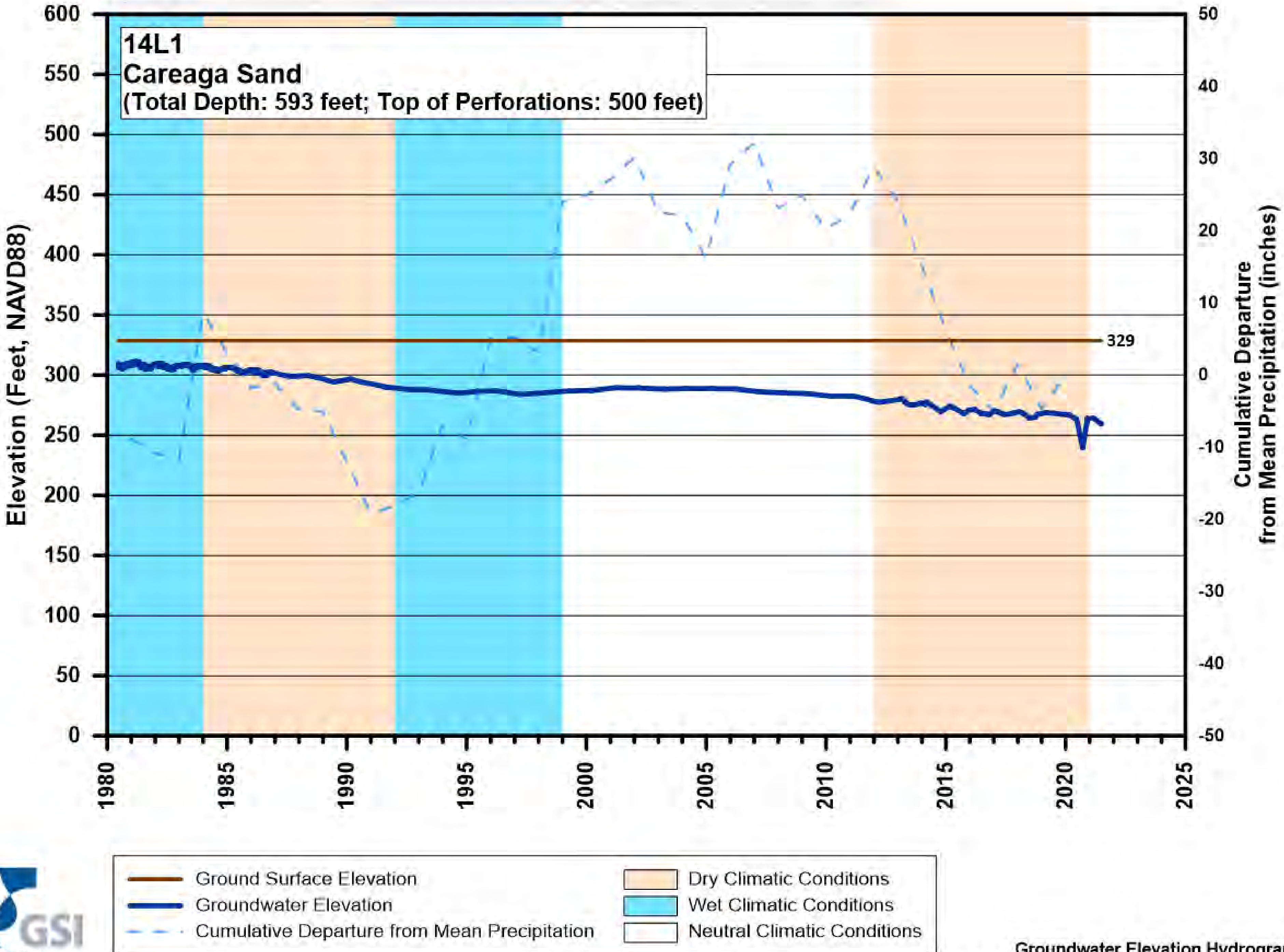


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



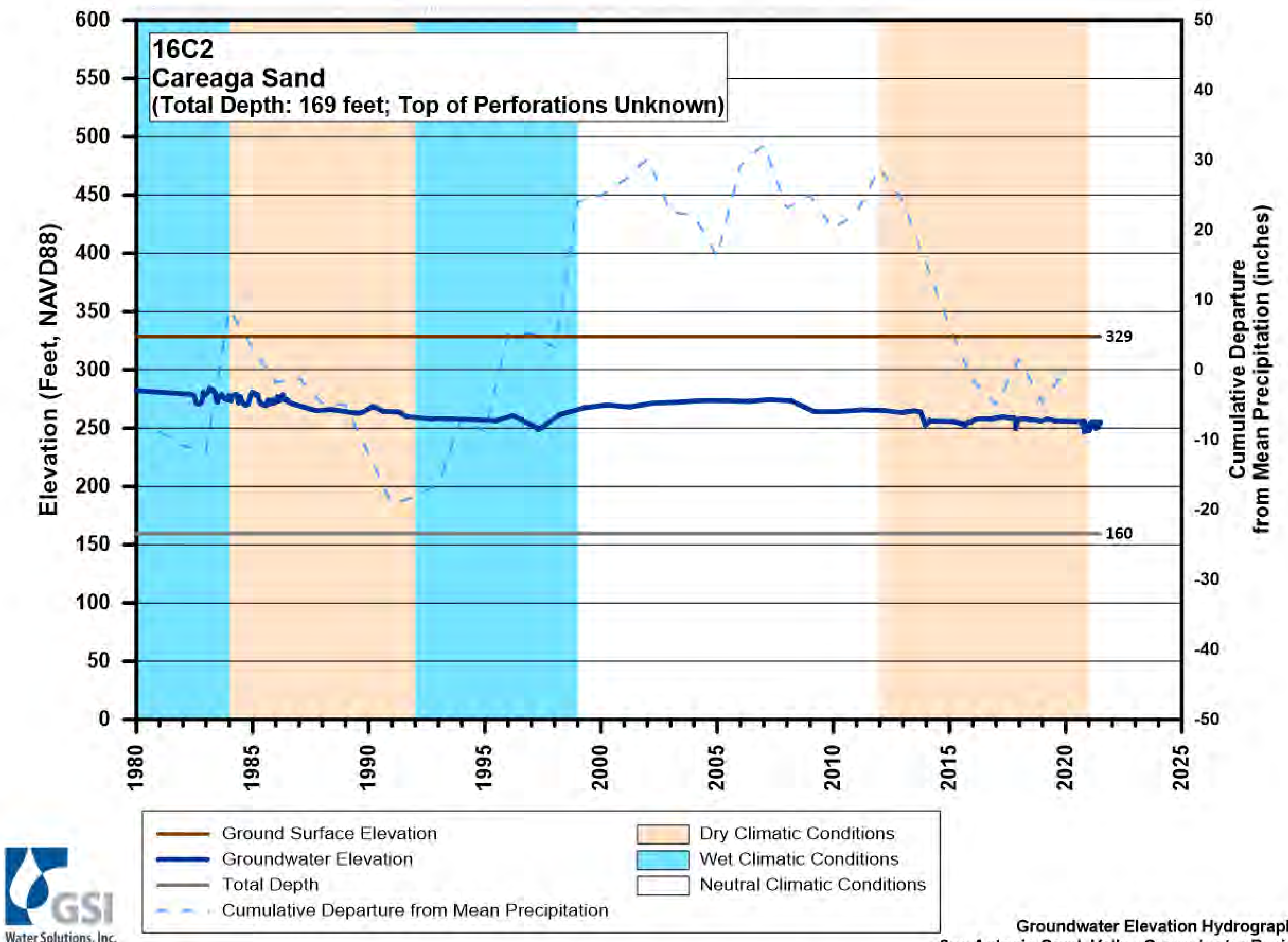
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

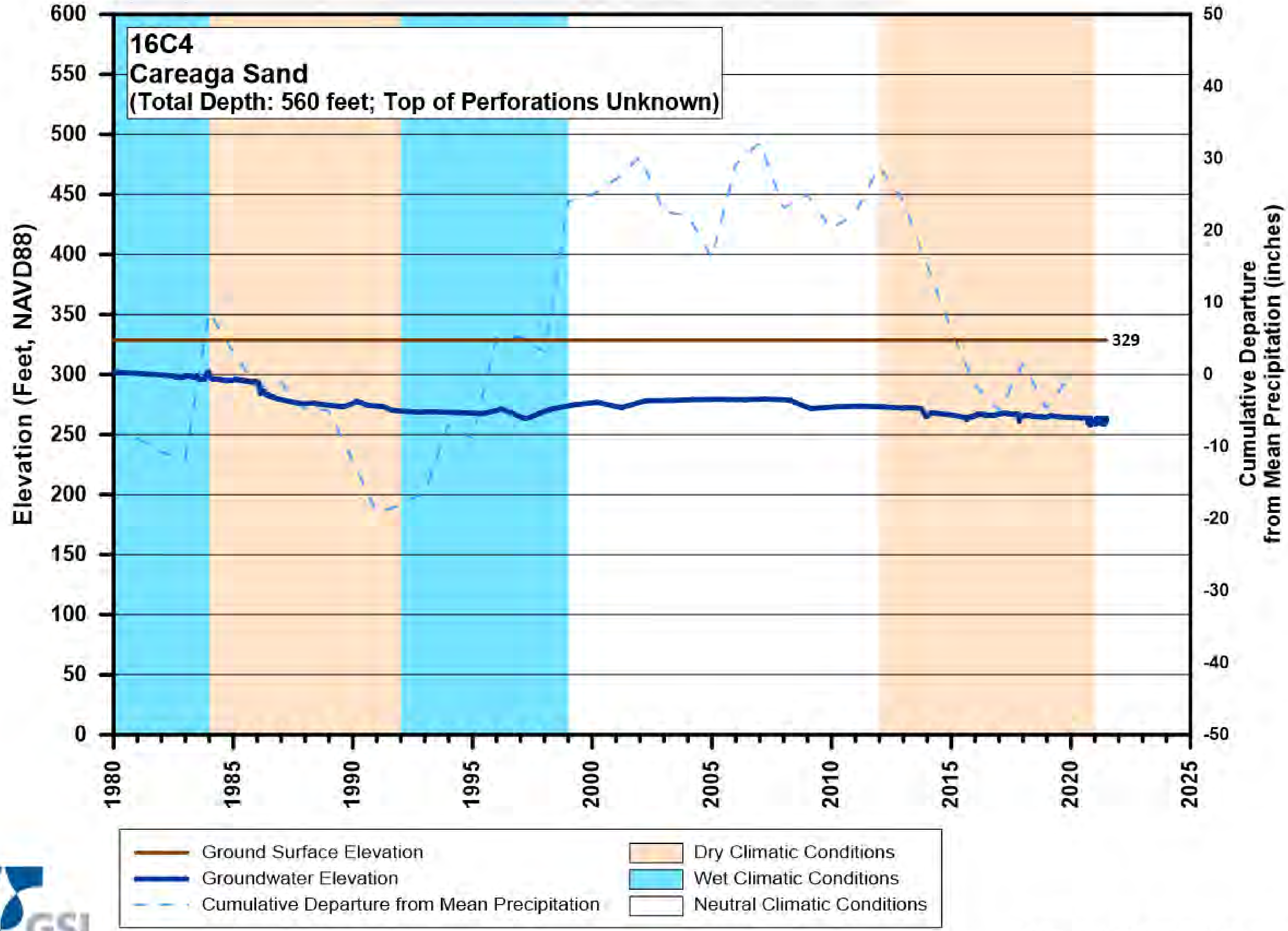


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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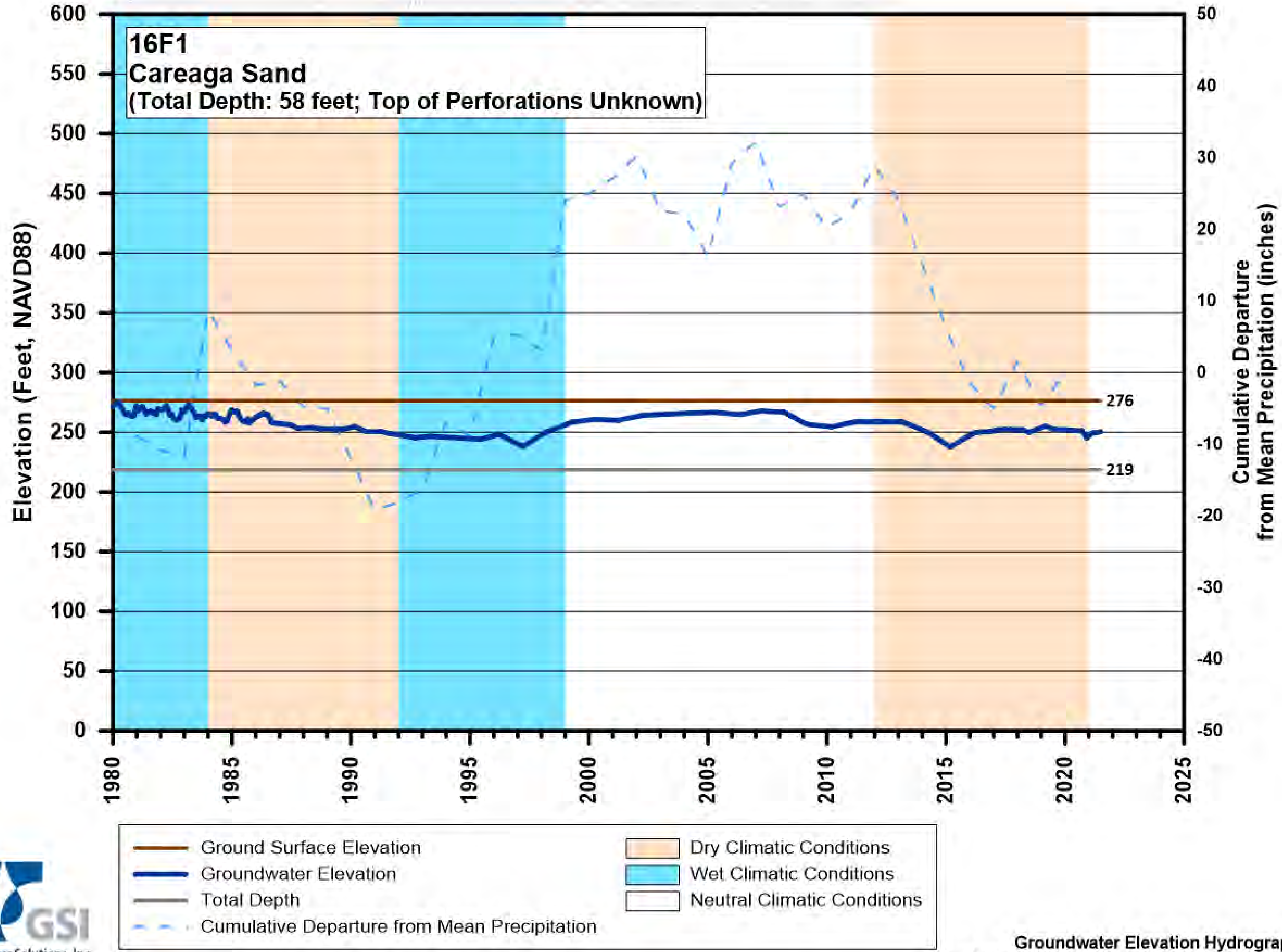
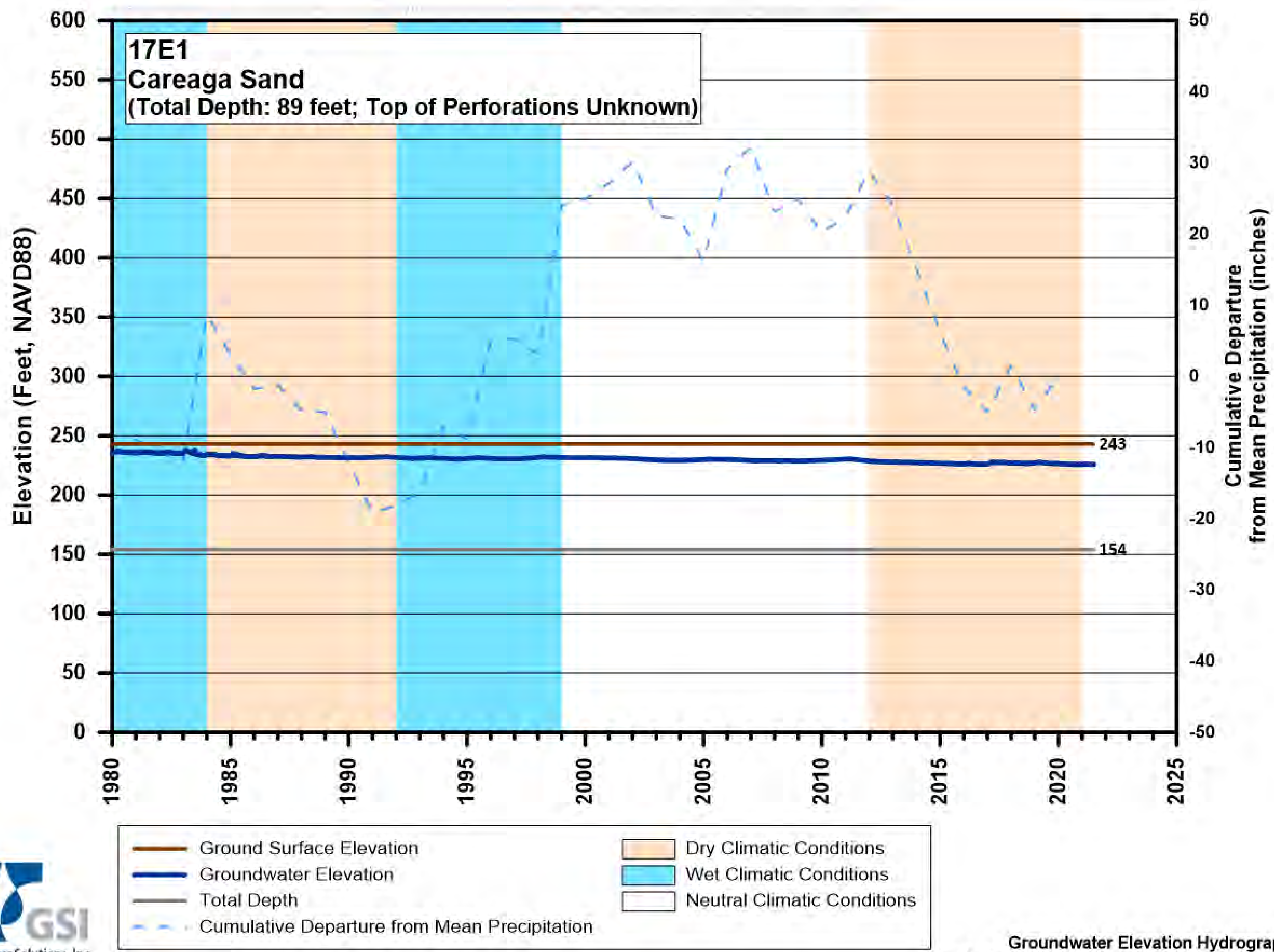
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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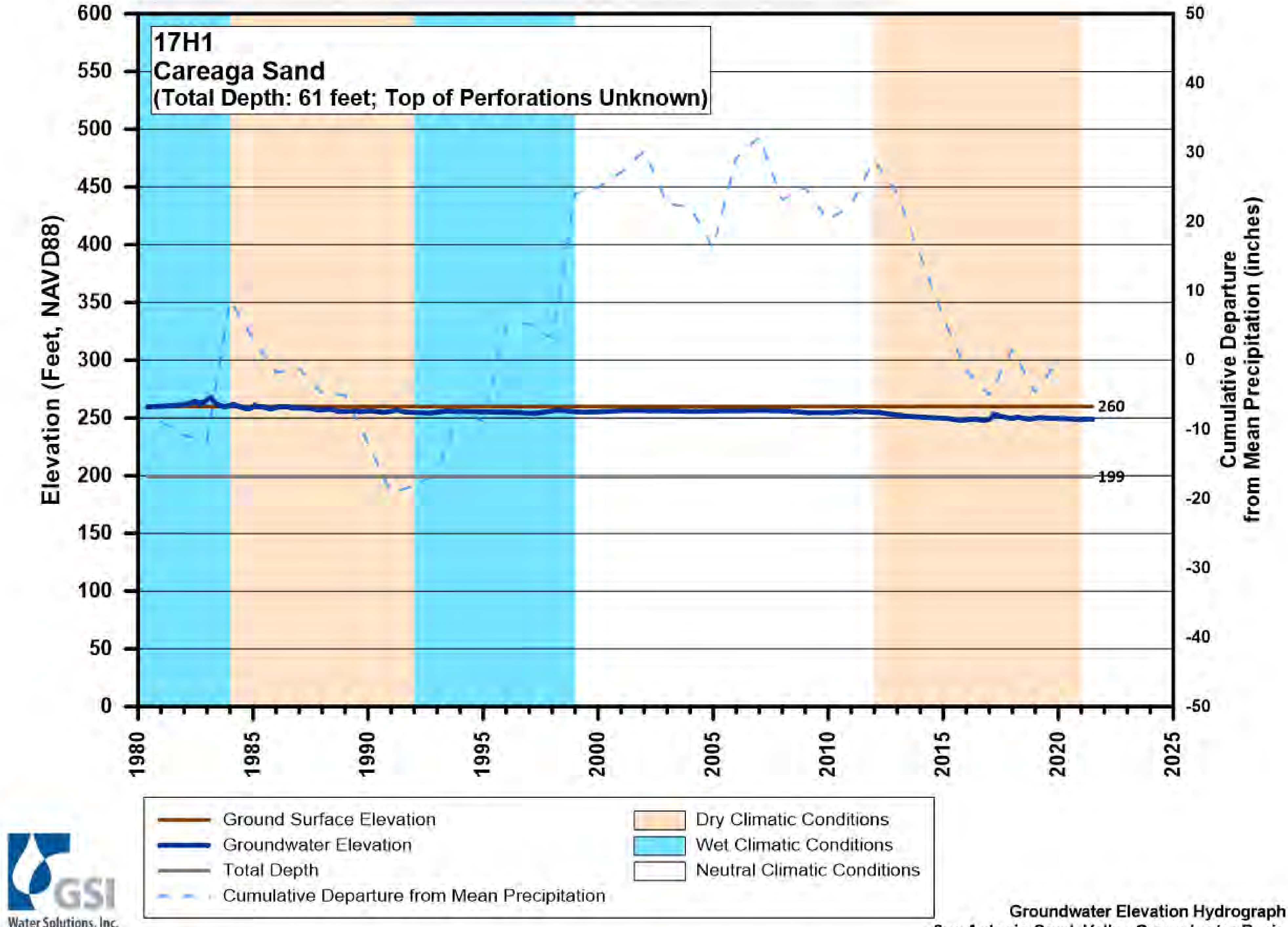
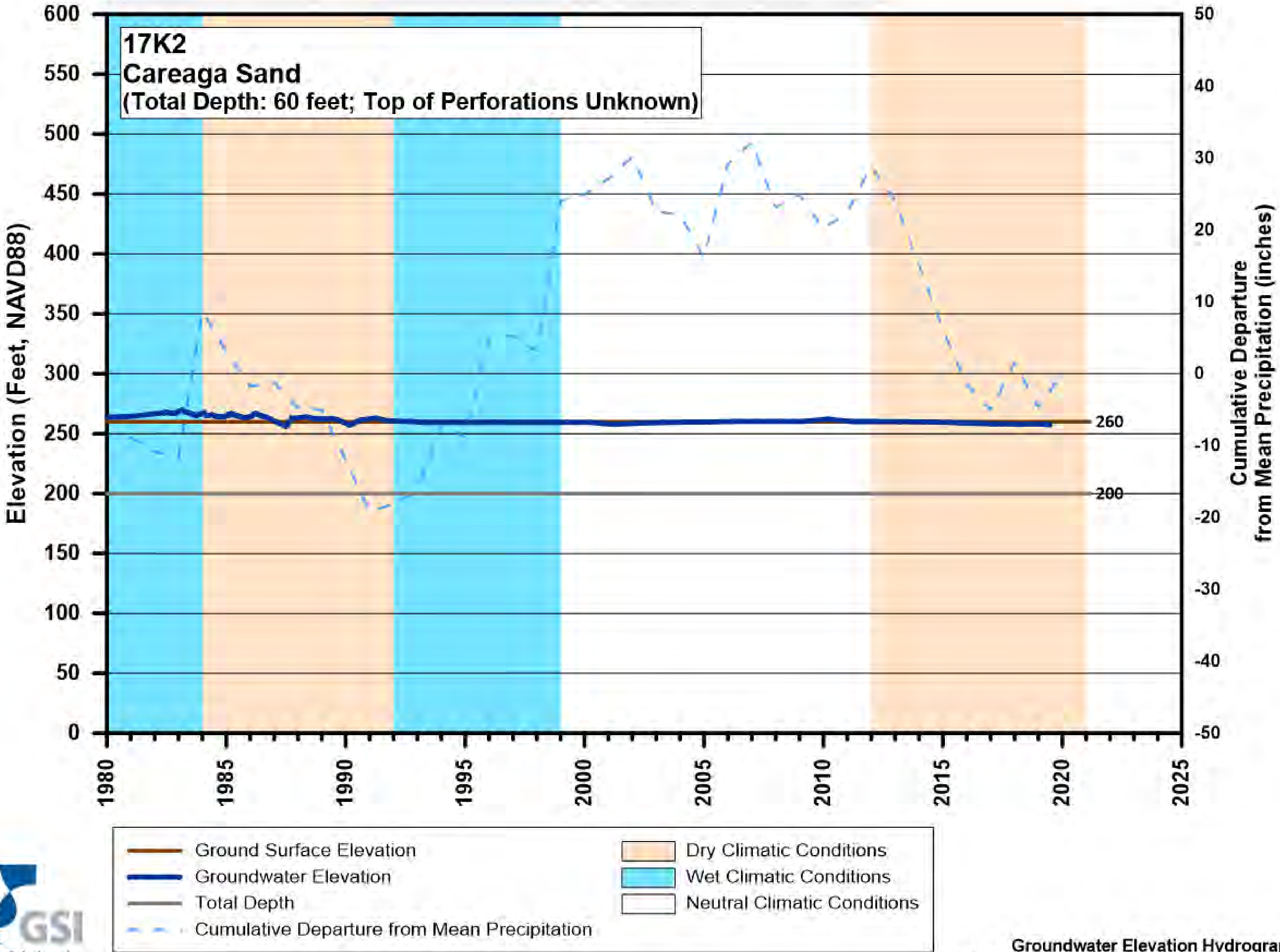
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



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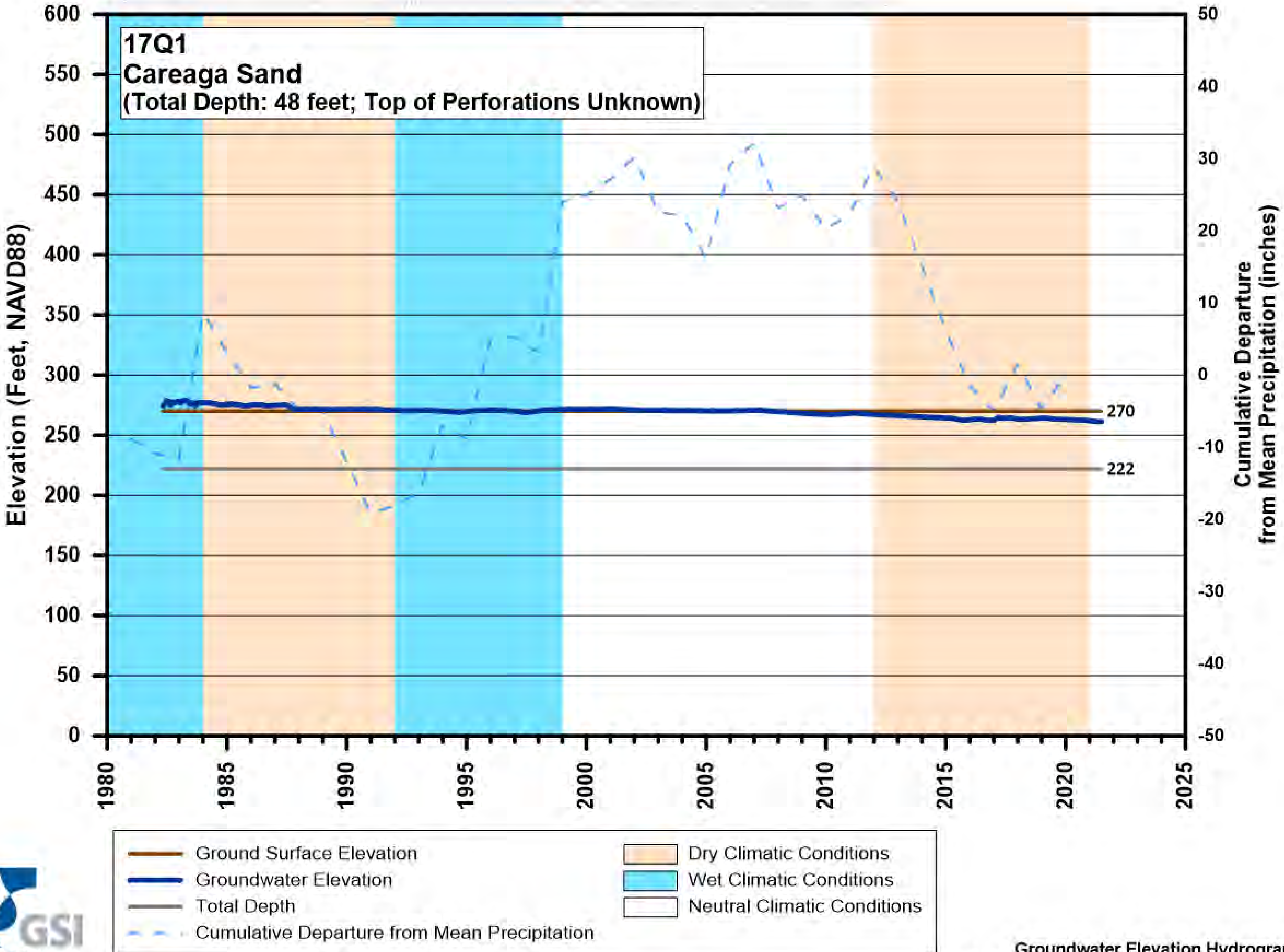
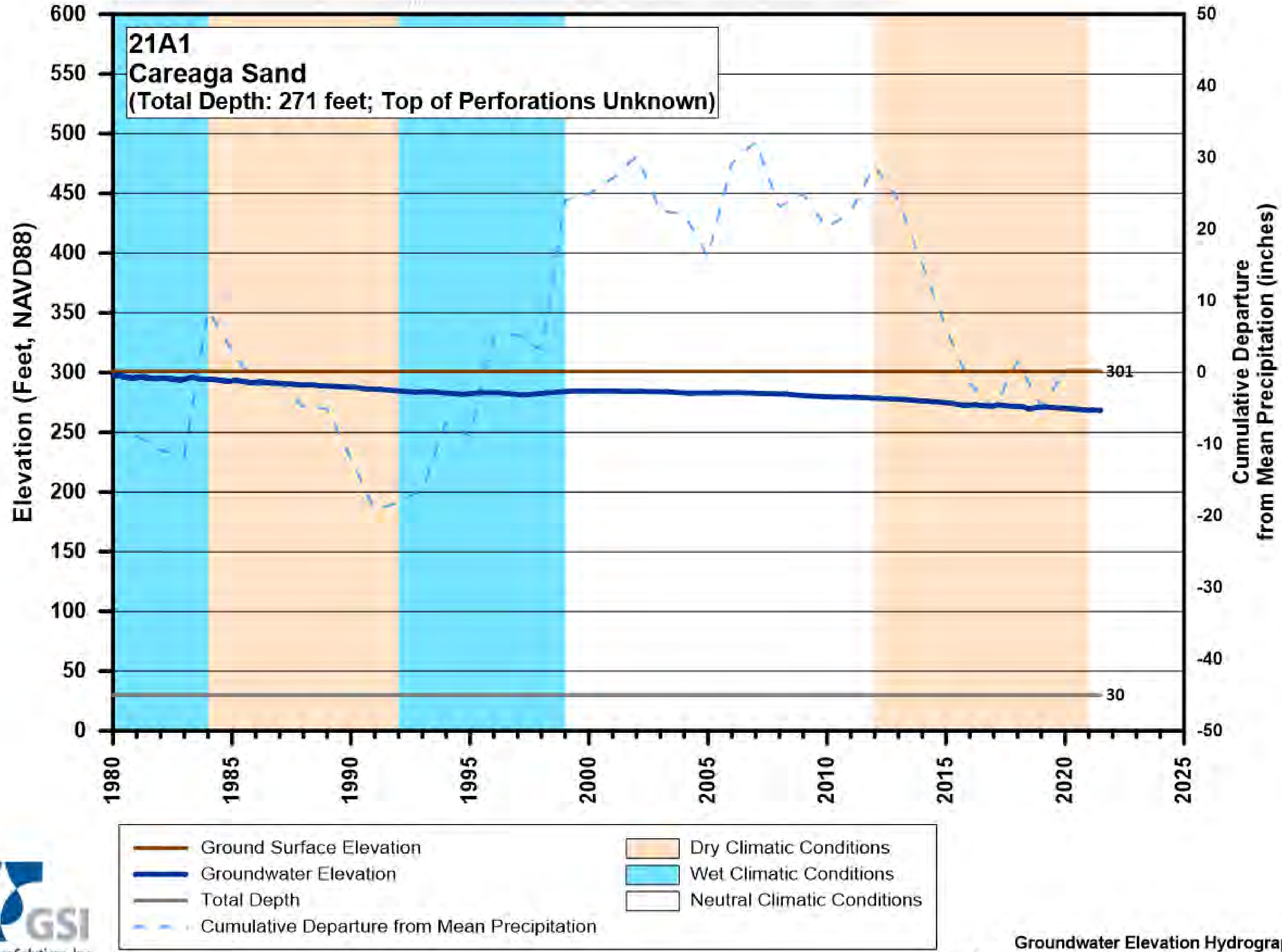
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



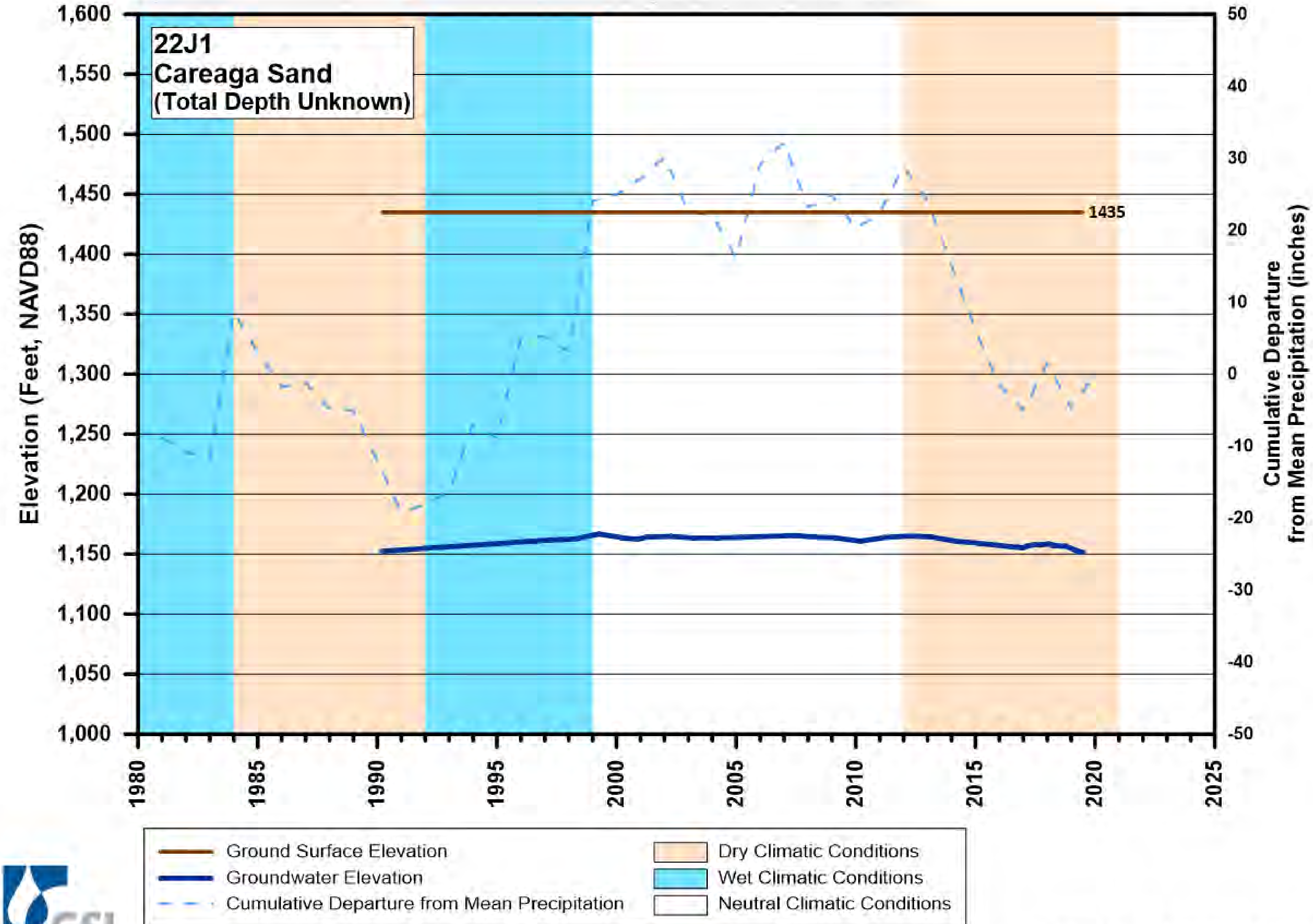
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



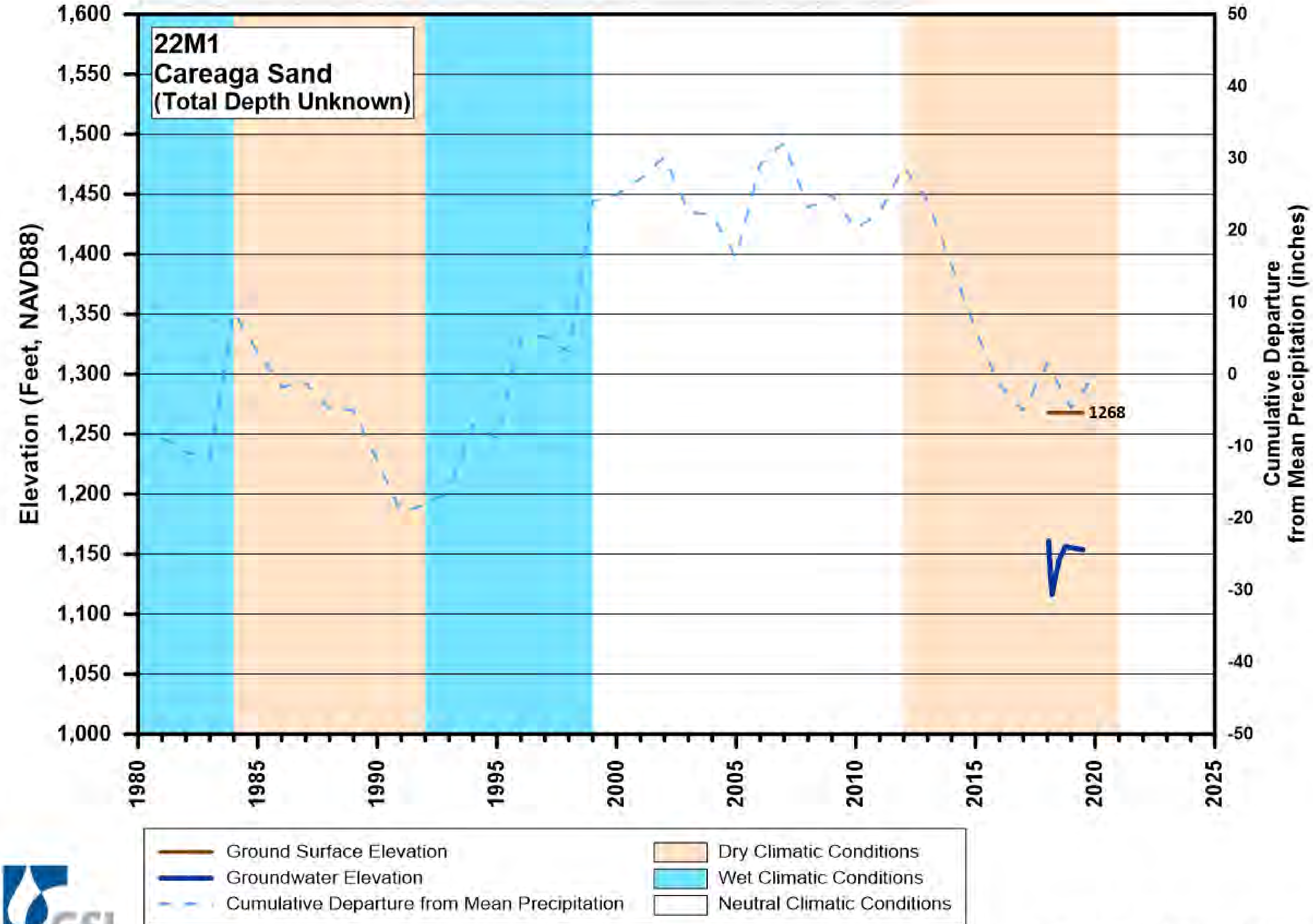
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



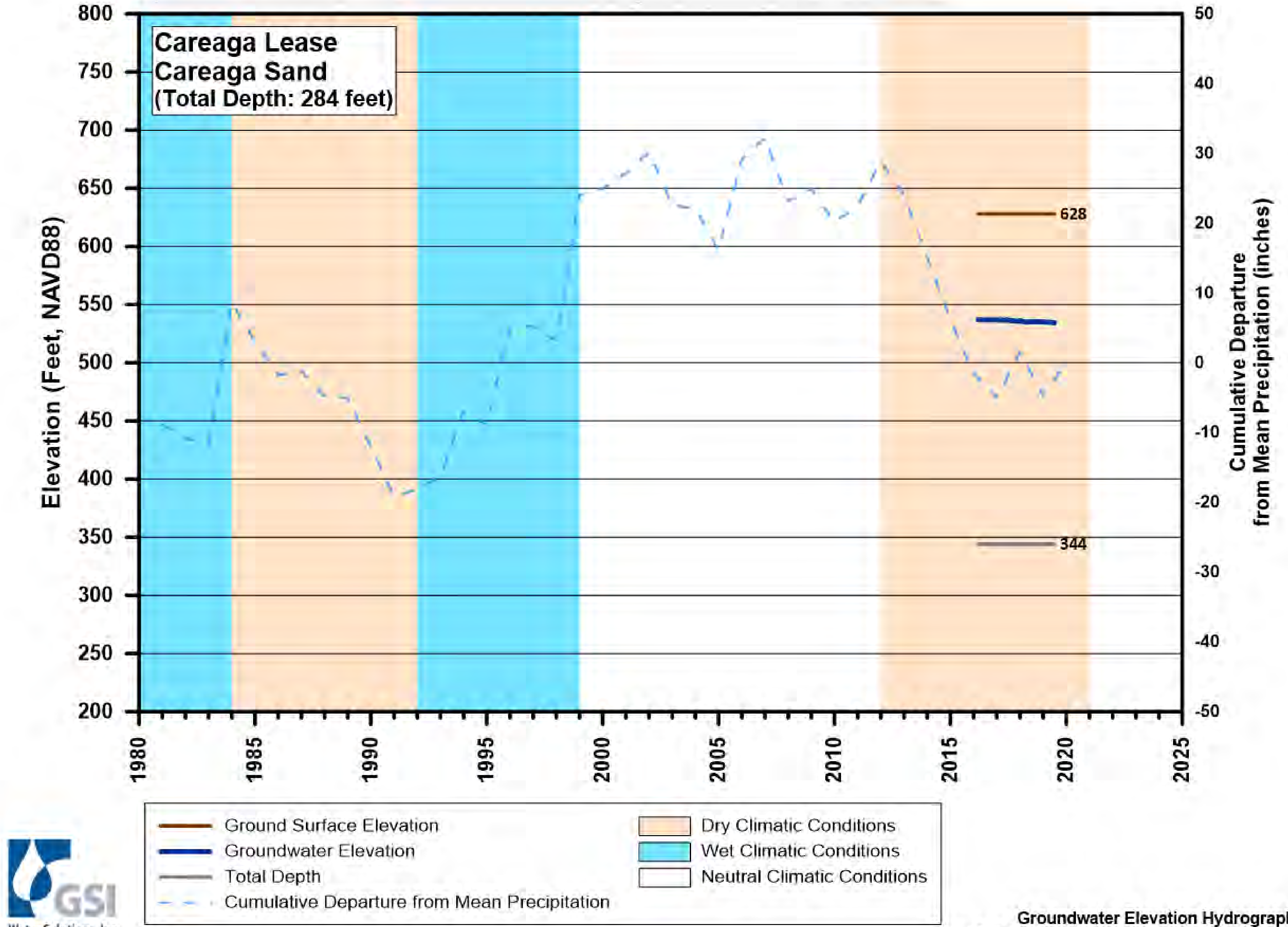
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

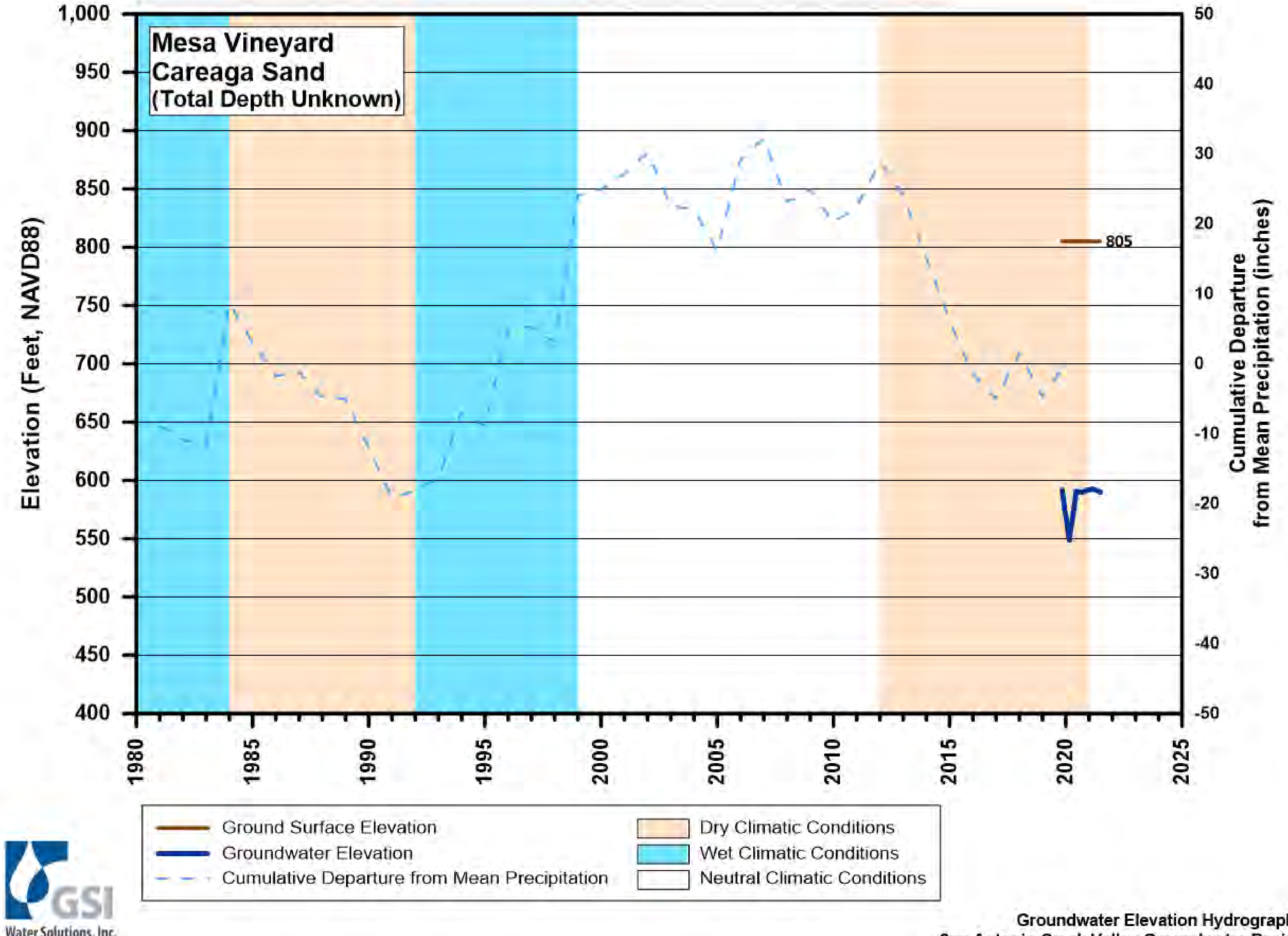


GSI Water Solutions, Inc.

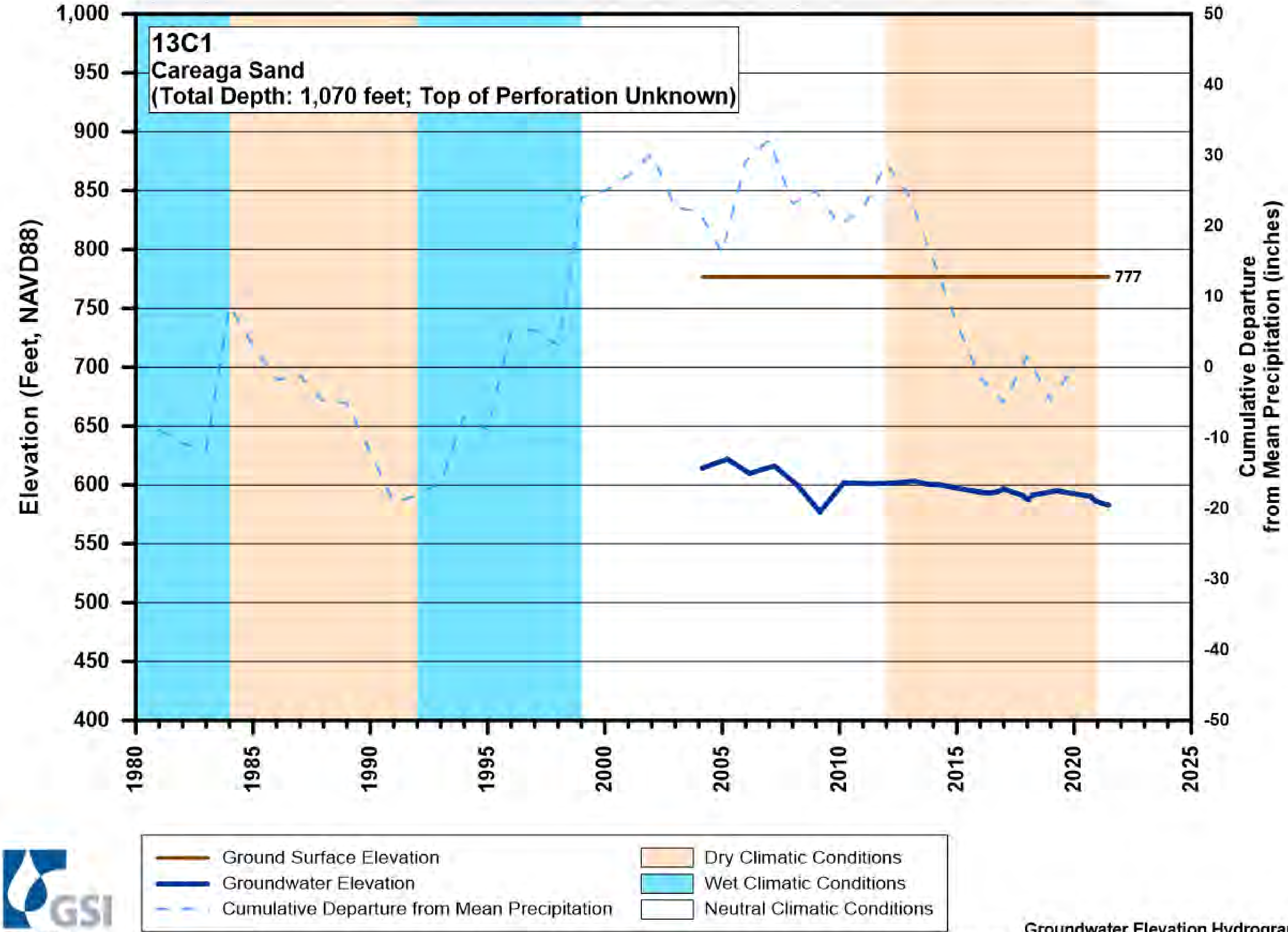
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

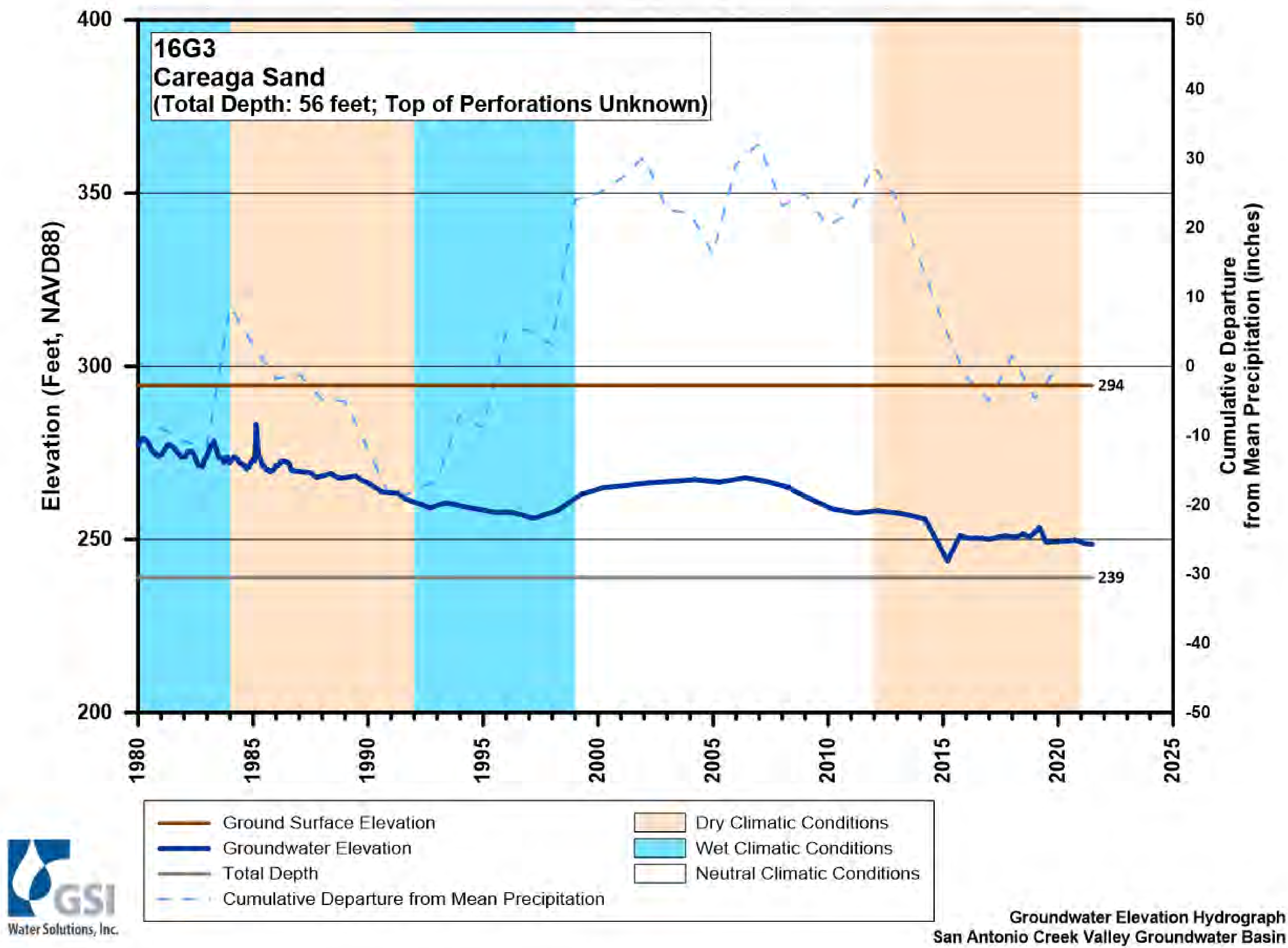


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

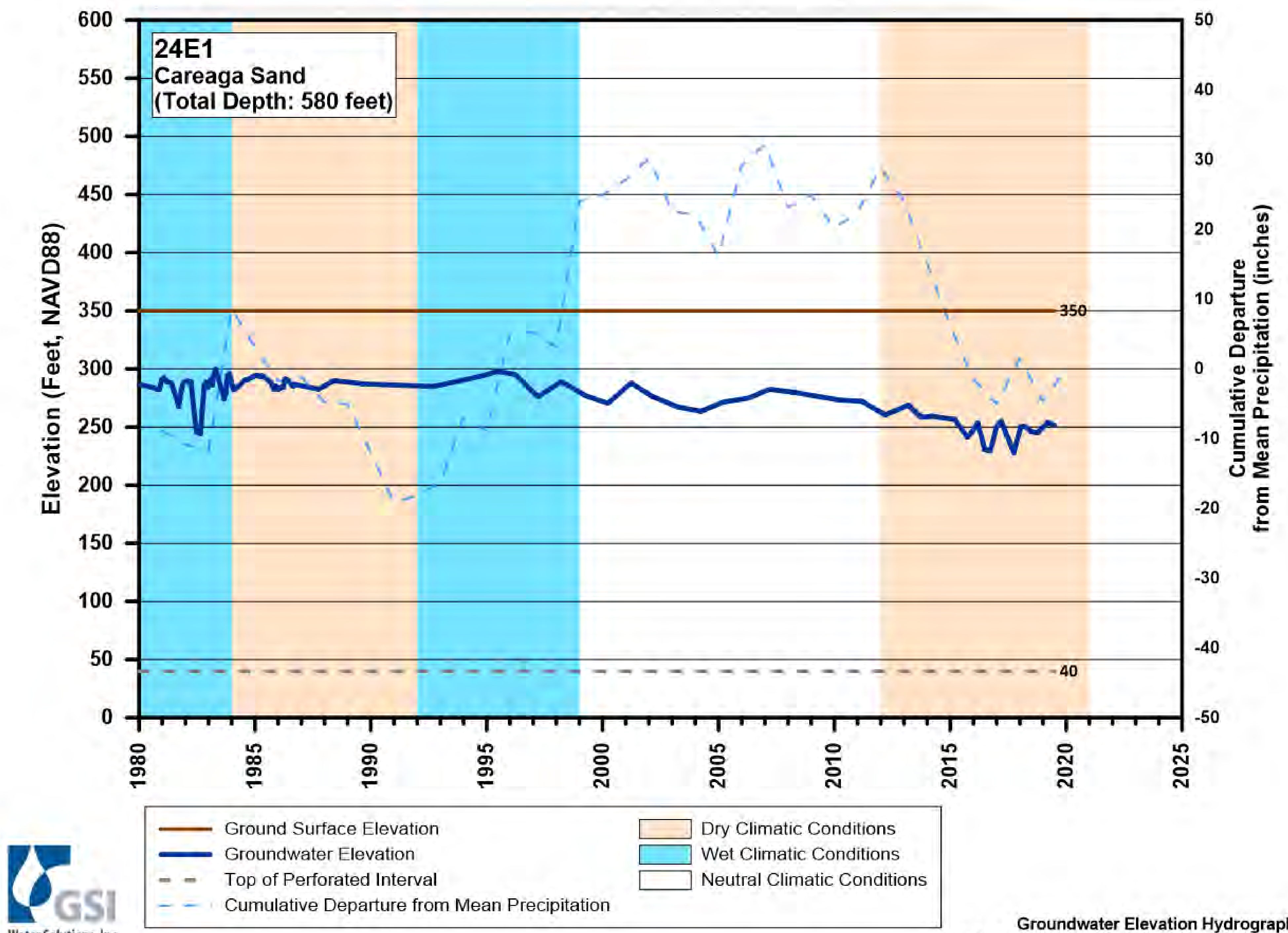


GSI Water Solutions, Inc.

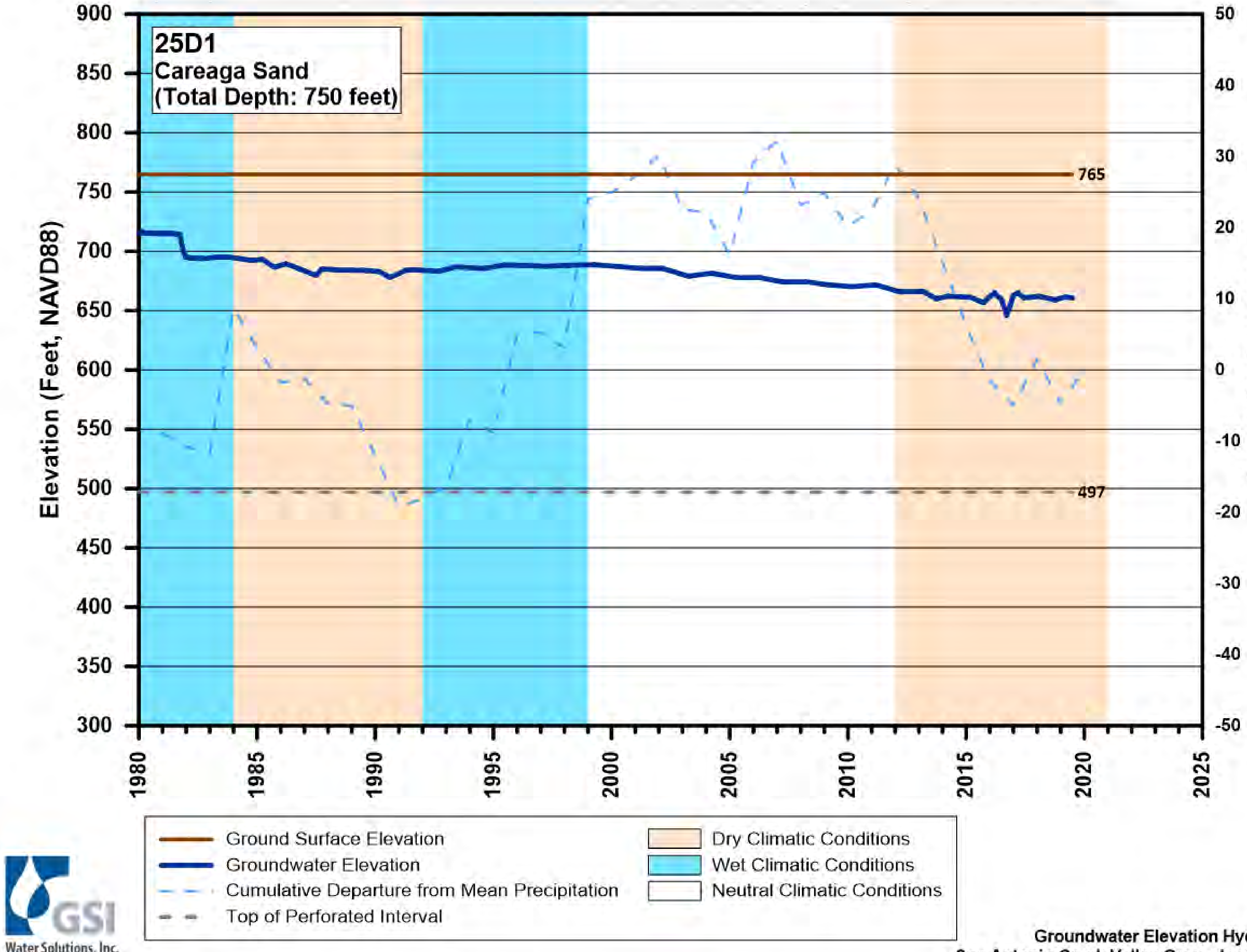
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



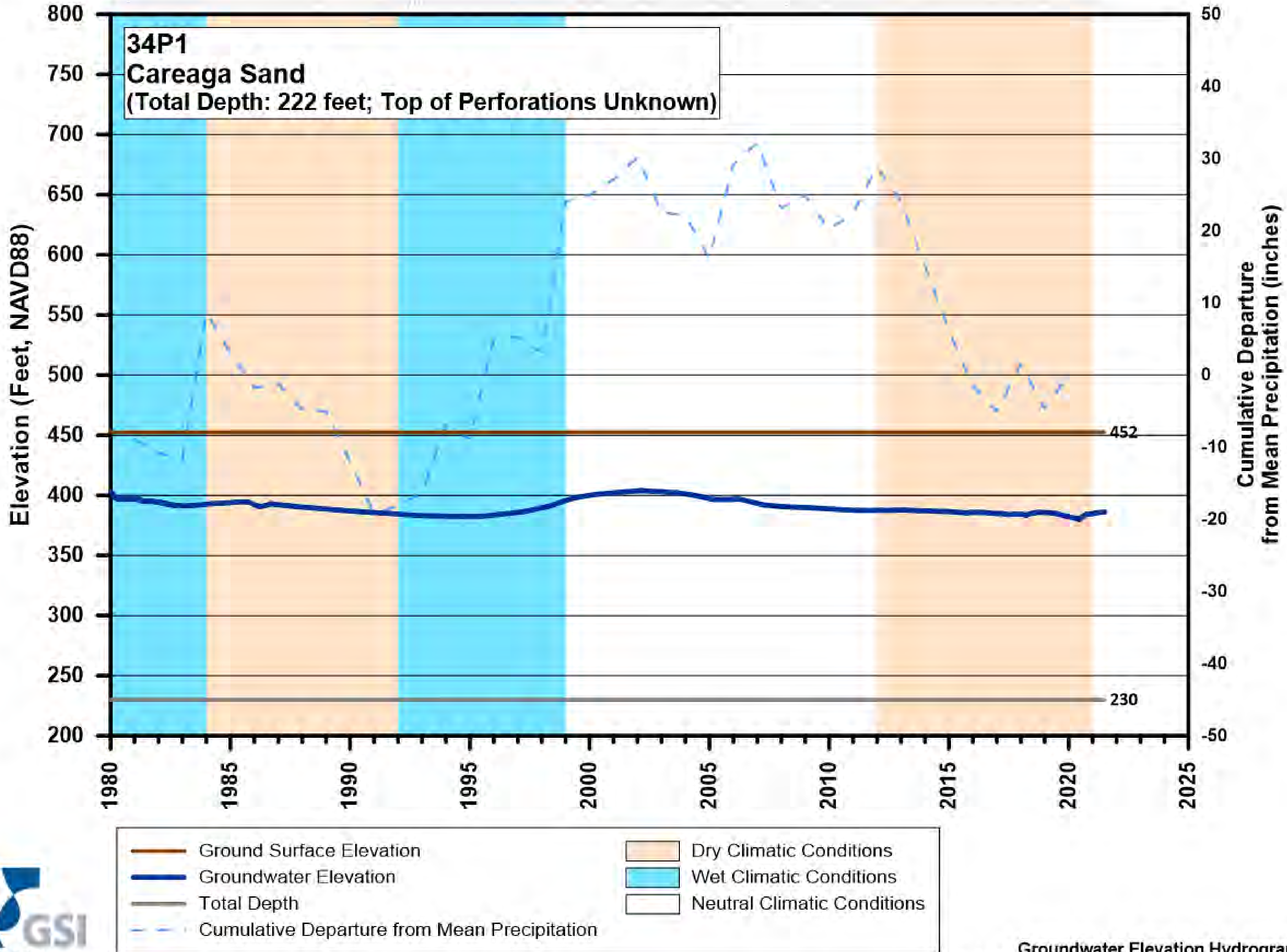
16G3
Careaga Sand
(Total Depth: 56 feet; Top of Perforations Unknown)
Elevation (Feet, NAVD88)
Cumulative Departure from Mean Precipitation (inches)
400
350
300
250
200
50
40
30
20
10
0
-10
-20
-30
-40
-50
294
239
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
Ground Surface Elevation
Groundwater Elevation
Total Depth
Cumulative Departure from Mean Precipitation
Dry Climatic Conditions
Wet Climatic Conditions
Neutral Climatic Conditions
GSI Water Solutions, Inc.
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

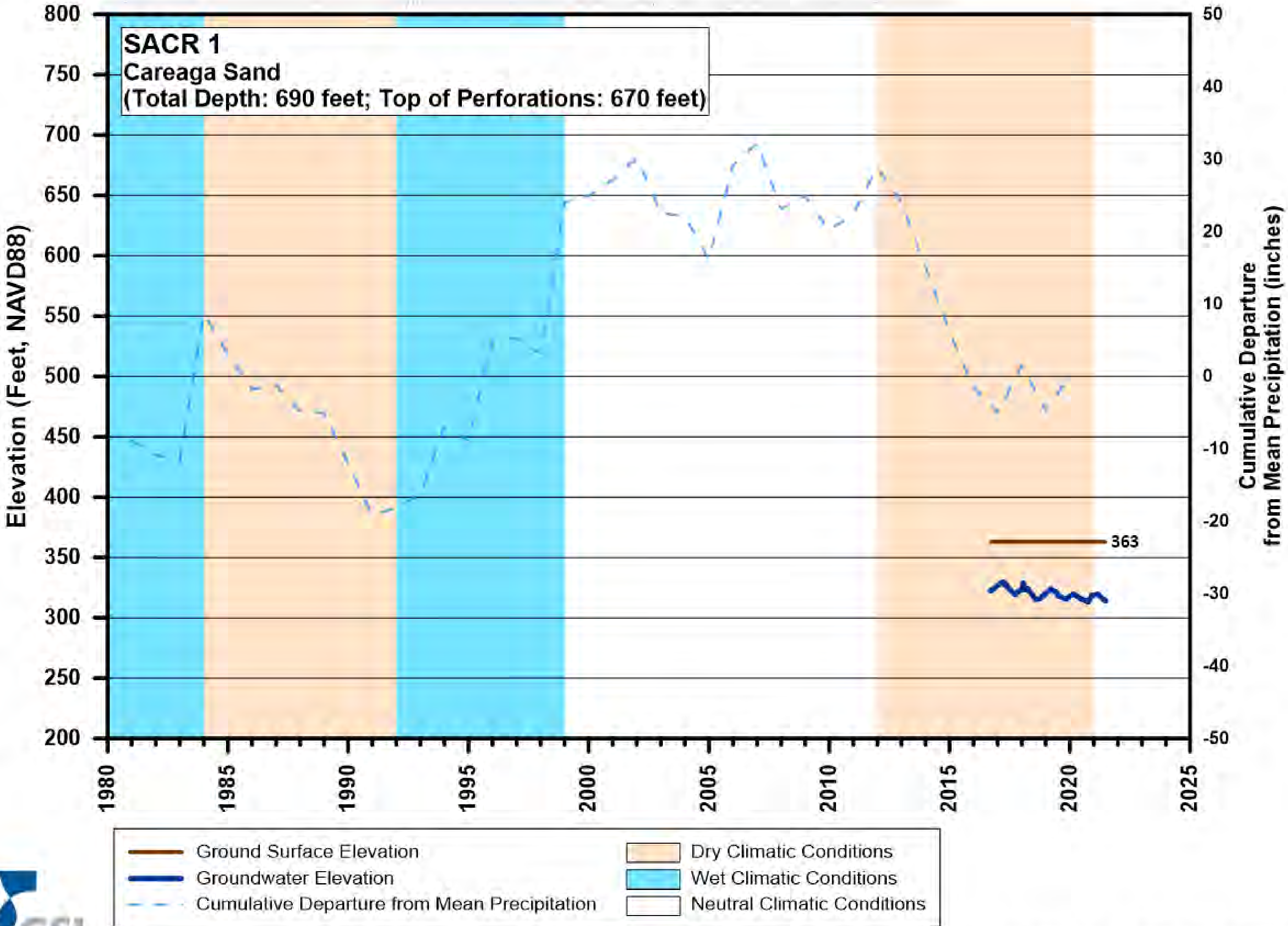


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



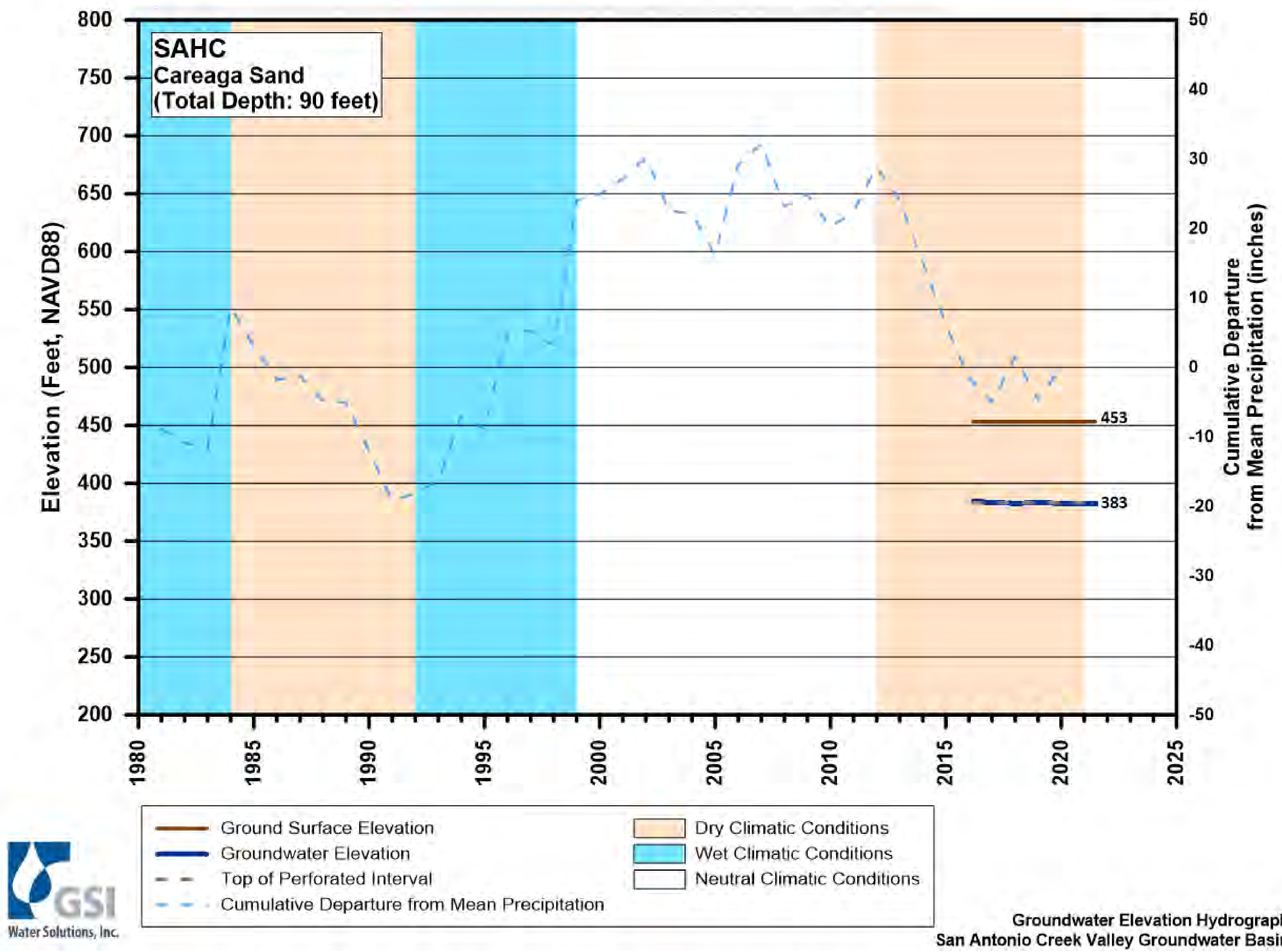
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

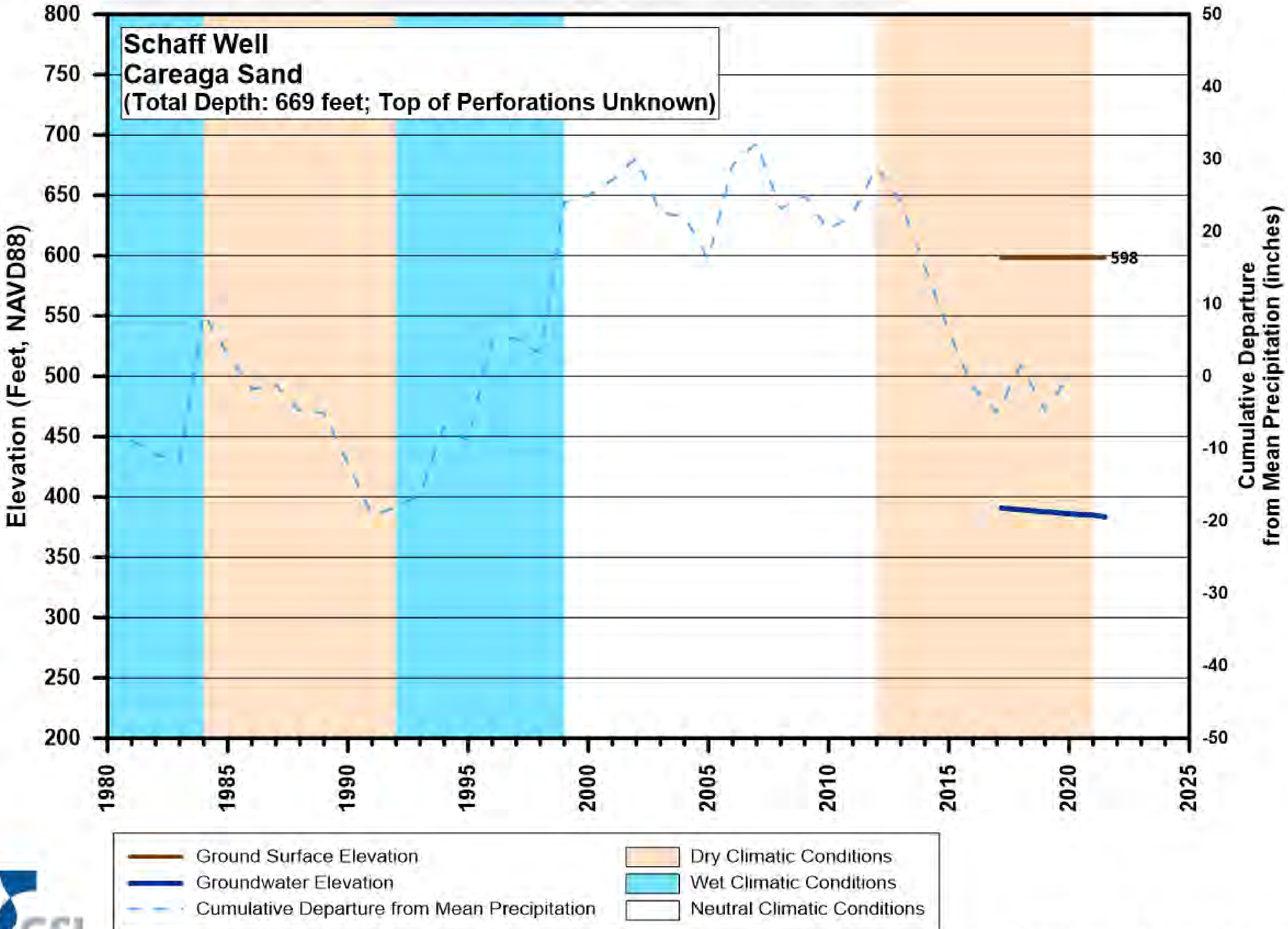


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

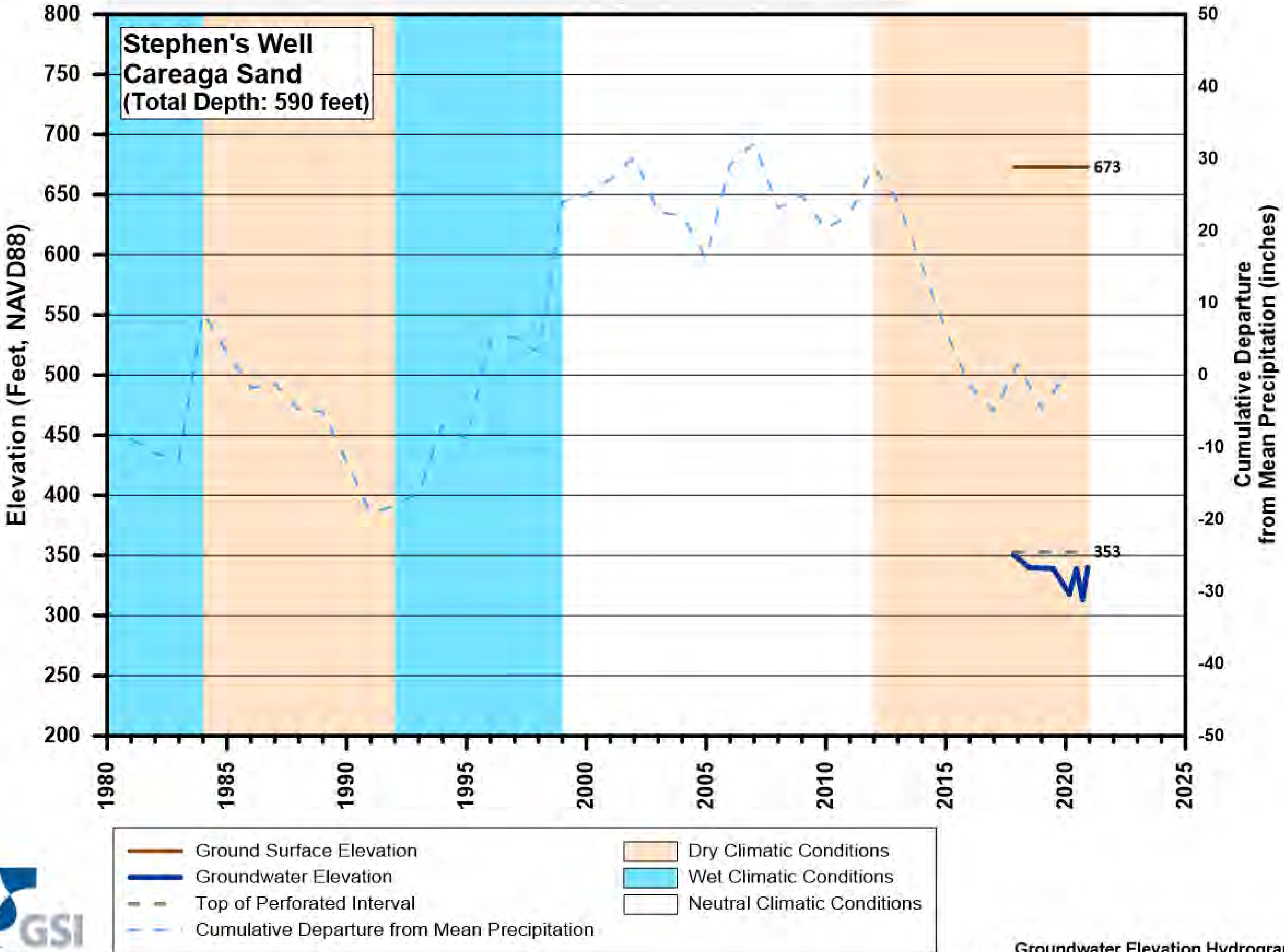


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



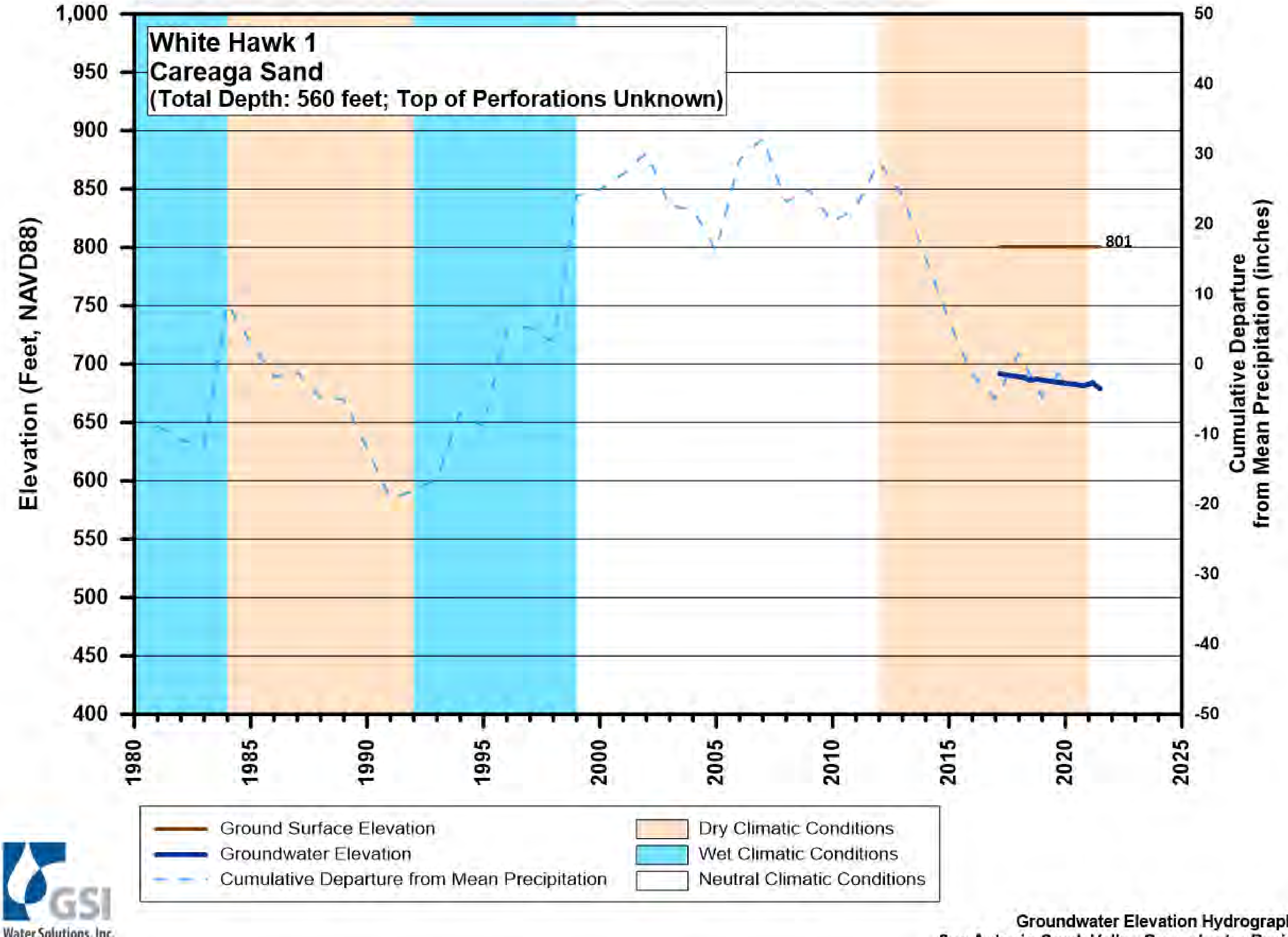
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

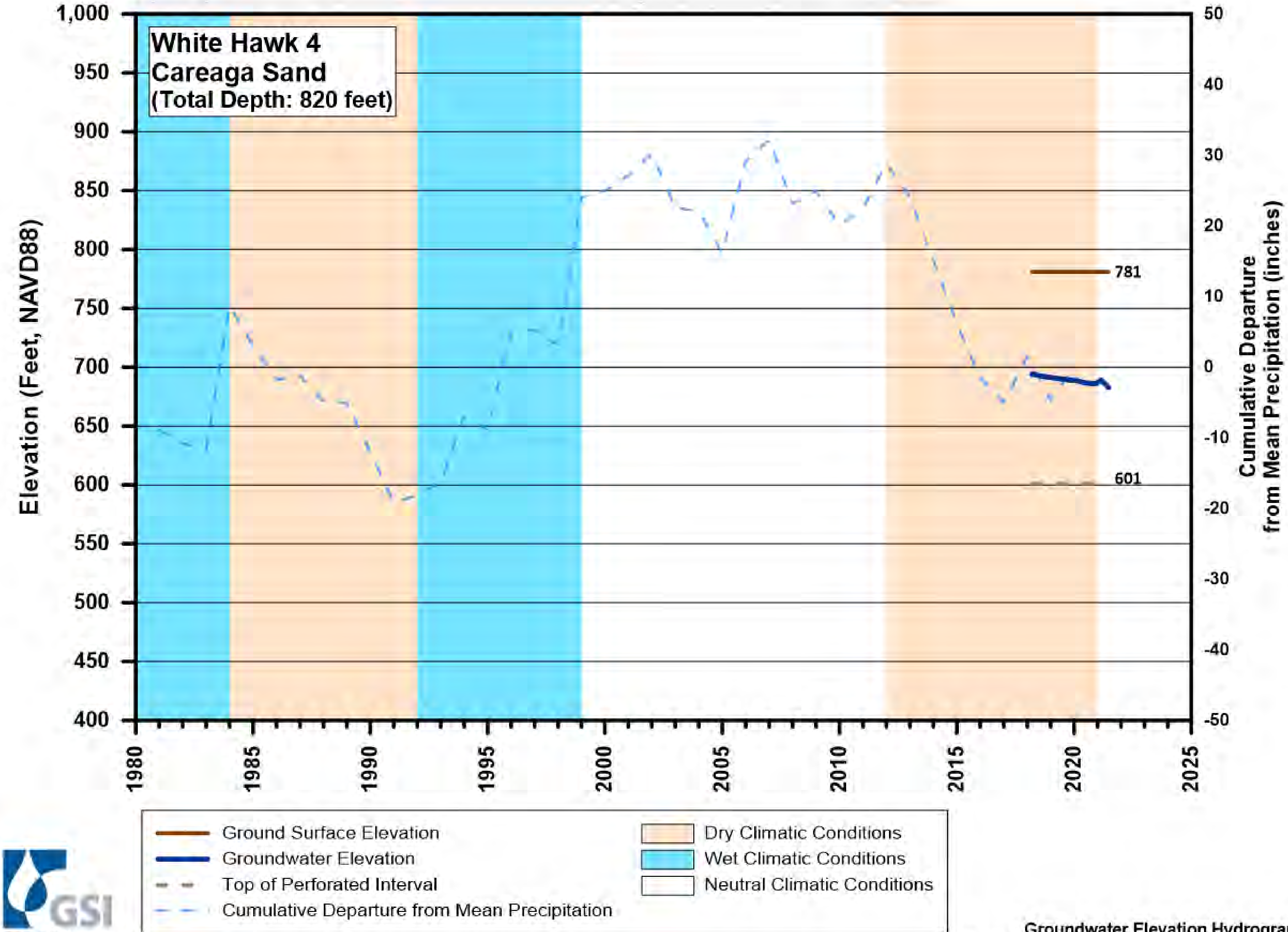


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

APPENDIX D-6

Preliminary Subsidence Evaluation, San Antonio Creek Basin GSP

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Technical Memorandum

To:	Mr. Jeff Barry, GSI Water Solutions, Inc.
From:	Michael Cornelius, PG Joseph de Larios, PE, GE Nicholas Paull, EIT
c:	
Date:	May 17, 2021
Re:	Preliminary Subsidence Evaluation San Antonio Creek Basin GSP Santa Barbara County, California GEI Project No. 2100279

As requested by GSI Water Solutions, Inc. (GSI), GEI Consultants, Inc. (GEI) performed a preliminary evaluation of potential subsidence within the San Antonio Creek Valley Groundwater Basin (SAB). The groundwater basin in located in northwestern Santa Barbara County, California.

The purpose of the preliminary evaluation is to assess the range of possible long-term ground surface elevation changes related to withdrawal of groundwater from the San Antonio Creek groundwater basin. GEI's evaluation of possible long-term subsidence is based on limited information and is therefore a screening-level study for the purpose of assessing relative risk. GEI's scope of services for the preliminary evaluation, which is described in the contract scope document dated January 6, 2021, included:

- Reviewing information regarding land surface elevations and indications that subsidence has occurred in the past.
- Reviewing subsurface geologic information and groundwater level data provided by GSI to assess the general susceptibility of the SAB to experience subsidence as a result of lowering groundwater levels below historical levels.
- Developing stratigraphic profiles from well logs provided by GSI and estimating ranges of possible long-term subsidence that might be expected in the future, based on a simple one-dimensional settlement model, assumed soil parameters, and professional judgement.

This technical memorandum (TM) describes the background, approach, and results of the preliminary subsidence evaluation.

OVERVIEW

Historically, subsidence of land in California has typically been related to excessive groundwater pumping. In sedimentary aquifers, groundwater is pumped from the pore spaces between sand and gravel grains, causing a lowering of pore-water pressure and a corresponding increase in the effective stress in the aquifer. The increased stresses can induce elastic (reversable) and inelastic (permanent) settlement of the ground surface, depending on a number of factors (including the magnitude and duration of groundwater elevation decline). Fine-grained soil materials (e.g., clays) within the aquifer tend to be much more compressible than the coarser-grained materials (sands and gravels). Consequently, the typical causes of land subsidence are related to compression of the finer-grained strata within a given aquifer.

The relationship between groundwater level decline-and-recovery and subsidence is complex. There are time-dependent and non-linear interactions between the various aspects of the aquifer system, such as the variable thicknesses of the soil strata within a given aquifer, time-dependent changes in effective stress (related to lowering and raising of groundwater levels), and variability in the rates and distribution of drainage from the different soil types within the aquifer. If the magnitude and duration of groundwater elevation decline is limited, land subsidence may be elastic (reversable). Otherwise, some inelastic (permanent) subsidence may be induced.

A check of the U.S. Geological Survey (USGS) land subsidence website (USGS, 2021) indicates that the San Antonio Creek Valley Groundwater Basin (SAB) is not in a mapped area of ongoing USGS subsidence studies.

The draft Groundwater Sustainability Plan prepared by GSI includes a summary of existing information for long-term changes in ground surface elevation within the groundwater basin (GSI, 2020). The available information is somewhat limited, with elevation data for a specific site within the basin (a monitoring station in the town of Los Alamos) going back to the year 2000 and relative elevation data for the overall basin going back to 2015. The limited UNAVCO CGPS data available within the SAB indicates that ground surface elevations are stable. In addition, in the data that we reviewed, GEI did not find any reports indicating observations of ground deformation attributed to subsidence within the SAB.

PRELIMINARY EVALUATION OF SUBSIDENCE POTENTIAL

The subsurface geologic information and groundwater level data provided by GSI to GEI was reviewed and the general susceptibility of the SAB to experience subsidence as a result of lowering groundwater levels below historical levels was assessed. The selection of data, the approached used for the first-order estimates of subsidence, and the limitations and uncertainties of the subsidence estimates are discussed below.

> *§354.16 Groundwater Conditions. Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following: (e) The extent, cumulative total, and annual rate of land subsidence, including maps depicting total subsidence, utilizing data available from the Department, as specified in Section 353.2, or the best available information.*

GEI performed a screening-level, preliminary evaluation of the potential for ground surface subsidence within the basin. Our preliminary evaluation included developing stratigraphic profiles from well logs provided by GSI and estimating ranges of possible long-term subsidence that might be expected in the future. There is limited data on the historic groundwater levels across the SAB (GSI, 2020). Most hydrographs (groundwater elevation data plots) made available to GEI extend back less than 10 years. In addition, there is limited information on the geotechnical conditions within the SAB aquifers (i.e., no site-specific data on the geotechnical properties or engineering parameters).

Our preliminary evaluation focused on two locations within the basin for which there are recorded groundwater elevations extending back several years. A map showing the locations of the wells and copies of the well logs are included in Attachment A. Locations analyzed:

Well ID	LACSD6	SACR 1-4
Coordinates:	34.7447083 -120.2797861	34.7588888 -120.39416666
Estimated Ground Surface Elevation (GSE), feet (estimated from Google Maps):	578	375
Source of Historic Water Level Data:	LACSD5 (2003 to 2018)	20Q2 (1965 to 2018)*

* Water levels from 20Q2 were adjusted to account for the GSE difference between 20Q2 and SACR 1-4 (405 feet and 375 feet, respectively).

The hydrograph from the first location (LACSD5) indicates that the groundwater level at that location has dropped about 55 feet since 2010. For the second location (SACR 1-4) the closest hydrograph is for well designated 20Q2, which indicates that groundwater levels in that area have dropped about 65 feet since the 1960s.

To estimate possible ranges of past and ongoing ground surface settlement, GEI used assumed geotechnical parameters (e.g., unit weights, compressibility, stress history), professional judgement, and classical consolidation theory developed by Terzaghi (Holtz et al., 2011):

$$\delta_c = \frac{C_r}{1+e_0} H \log\left(\frac{\sigma'_{zc}}{\sigma'_{z0}}\right) + \frac{C_c}{1+e_0} H \log\left(\frac{\sigma'_{zf}}{\sigma'_{zc}}\right)$$

Where:

δ_c = the settlement due to consolidation in a given stratum.
C_c = the compression index.
Cr = the recompression index.
e_0 = the initial void ratio.
H = the height of the compressible soil stratum.
σ_{zf} = the final vertical stress.
σ_{z0} = the initial vertical stress.
σ_{zc} = the preconsolidation stress of the soil.

The stratigraphy, assumed parameters, and the above equation were used to develop simple, one-dimensional settlement models for each of the two sites. First-order estimates of the soil parameters were based on a range of possible values. The estimates from these models are considered first-order estimates and are subject to confirmation through additional investigations.

An important factor and key limitation in assessing the magnitude of potential settlement is the stress history within the soil column (including long-term groundwater levels prior to the available hydrographs). The sediments in the groundwater basin were assumed to be "unconsolidated" from a geologic perspective, but to be near-normally consolidated from a geotechnical perspective. The estimated ranges of possible consolidation settlement were based on model consolidation curves, which were in-turn based on assumed over-consolidation ratio (OCR) values ranging from 1.2 to 2.0 and Janbu's tangent modulus approach (Holtz et al. 2011).

Other key assumptions included:

- Soil layer discretization was based on the well logs.
- Settlement of soil strata assumed to be predominantly coarse-grained (i.e., material retained on the No. 200 sieve) was considered to be negligible.
- All soil properties (unit weights, compressibility, etc.) were assumed based on soil types indicated on well logs.
- Individual soil layers assumed uniform.
- Any layer with clay indicated in the well log was assumed to have clay behavior (i.e., compressible).
- No settlement assumed below the materials listed in the well logs.
- Unit weights were assumed to be constant, with clay assumed to be 120 pounds per cubic foot (pcf), sand unit weight assumed to be 125 pcf, and gravel unit weight assumed to be 140 pcf.
- All calculations estimate the ultimate consolidation settlement (time rate effects are not included; assumes groundwater levels do not recover).

The models produced similar subsidence estimates for the two locations, with estimated potential subsidence on the order of 1 to 2 feet resulting from the changes in groundwater elevation reported in the hydrographs. This estimated range assumes that the sediments in the SAB remain at or above the "normally consolidated" stress state (i.e., the current stresses on the soils are less than the maximum those soils have previously been subjected to over geologic time). If the present or future stresses on the soils exceed the maximum past pressure, the potential long-term subsidence could be several times the estimated range.

Historic subsidence on the order of 1 to 2 feet appears relatively consistent with the estimated subsidence rate of 0.5 inches per year reported for the UNAVCO CGPS Station located in the town of Los Alamos (Section 3.2.4.2 of GSI, 2020), which is in the general area of Well ID LACSD6.

DISCUSSION AND CONCLUSIONS

As noted above, ground subsidence is a complex, time-dependent phenomenon. There is commonly significant time-lag between the lowering of groundwater levels and observed subsidence. Figures 1 and 2 include descriptions of the mechanisms, three-dimensional effects, and time-dependent aspects of ground subsidence.

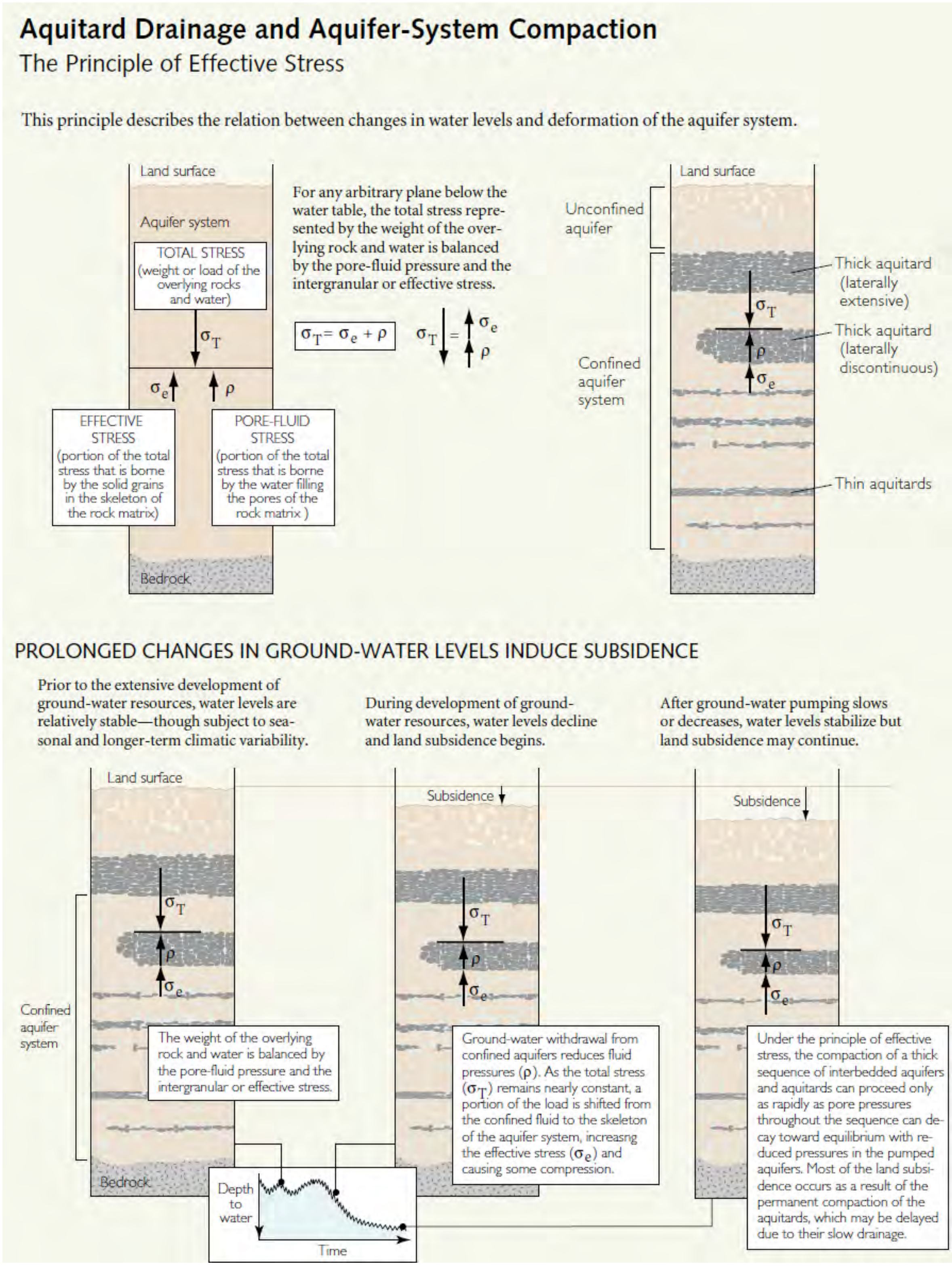


Figure 1: Schematic diagram of land subsidence due to groundwater withdrawal (from Galloway et al., 1999).

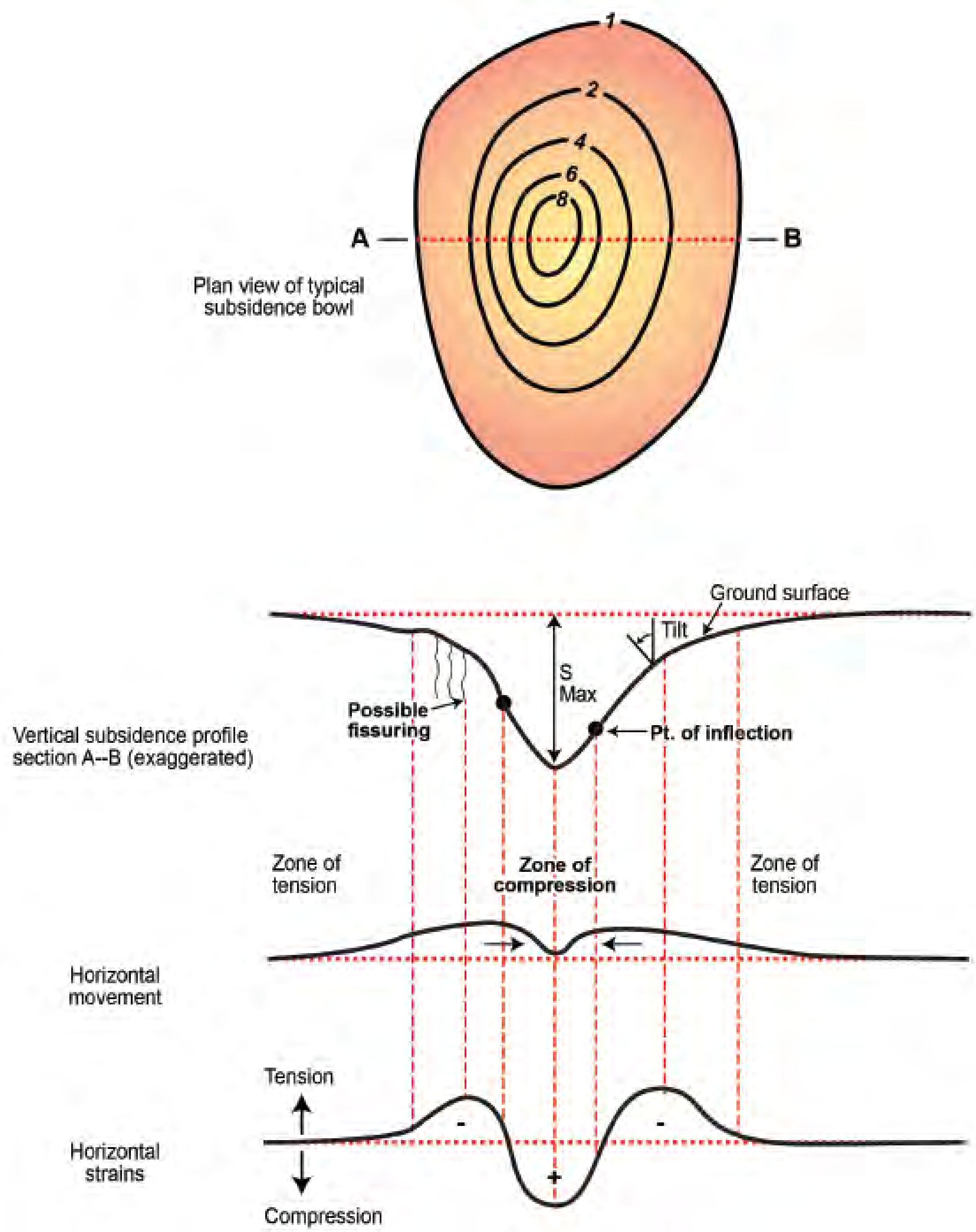


Figure 2: Schematic diagram of land-surface movements associated with subsidence bowls (from Lowe, 2012, modified from Viets and others, 1979). S max is maximum vertical subsidence.

It is important to note that while settlement of the ground surface may have adverse effects on constructed facilities, the relative impact is dependent on the specific facility and the magnitude of settlement (both total and differential). The greatest potential for damage is along linear surface features, including pipelines, canals, levees, railroad tracks, highways. There may be localized impacts at bridges or building foundations. It is likely that limited amounts of subsidence will not adversely affect the performance of surface improvements and infrastructure.

Groundwater Management Perspective

From a groundwater management perspective, we are interested in the magnitude of subsidence that may take place as a result of removal of groundwater from the aquifer system. In California much of the land subsidence resulting from groundwater extraction has occurred in the San Joaquin Valley where the Corcoran Clay is present. As ground water levels in the aquifers beneath the Corcoran Clay are lowered, the water no longer provides the buoyancy to help support the above soil column, so the sediments may compress.

Consolidation of sediments typically takes a relatively long time, often tens of years before it becomes evident at the ground surface. Once the mechanism to initiate subsidence has been started, it may persist for years after groundwater levels have returned above e the threshold which triggered it. Also, compressed sediments cannot be “uncompressed” by adding water to the system. Even if groundwater levels are returned to the “original” elevation, subsidence may continue for some period of time (as the system comes to the new equilibrium).

In the San Antonio Basin (SAB) there has been no reported historical or anecdotal information regarding land subsidence as a result of groundwater extractions. There may be, and likely has been some subsidence as a result for groundwater extraction, but to date has not been documented to impact surface features. With groundwater declines of as much as 70 to 90 feet in the SAB, some subsidence may have occurred prior to the initiation of SGMA, but there is not readily available information to document that. We do not know how much has occurred, or how it relates to the maximum amount that may occur based on the geotechnical analysis based on the limited data available.

Recommendations

Future declines in groundwater levels may result in land subsidence, but we are not able to accurately estimate those with the available data. If subsidence is a threat to the groundwater basin, more rigorous investigation and analysis can be conducted to estimate the amount of compaction that has taken place to allow to estimate the maximum amount of compression that may be experienced at a specific location. In order to avoid the potential for additional subsidence from groundwater extraction, groundwater levels should be maintained at or above the historic lows.

During planning and defining of groundwater management goals for the SAB, the need for additional studies should be assessed. Studies could include performing reconnaissance or inspection of critical infrastructure and other facilities to assess whether signs of deformation or subsidence can be observed. If additional ground surface data becomes available, it may be beneficial to evaluate the estimated basin storage and compare it to the measured subsidence.

As a minimum, we recommend that the ground surface elevations within the San Antonio Basin continue to be periodically surveyed and apparent changes in elevation be assessed. If total and differential settlements across the basin are of concern, additional measures should be developed to fill data gaps and allow for more-detailed evaluation. If a more-detailed evaluation of potential subsidence is desired, a plan should be developed to investigate the geotechnical parameters and stress history within the aquifer materials, which could include in situ and laboratory testing of soil samples.

Limitations

In the performance of its professional services, GEI Consultants, Inc., its employees, and its agents comply with the standards of care and skill ordinarily exercised by members of our profession practicing in similar localities. The analyses, conclusions, and recommendations discussed in this memorandum are based on limited information about the sites evaluated. Subsurface conditions may vary from those assumed for the purposes of this study.

No warranty, either express or implied, is made or intended in connection with the services performed by us, or by the proposal for consulting or other services, or by the furnishing of oral or written reports or findings. In the event conclusions or recommendations based on information in this memorandum are made by others, such conclusions and recommendations are not our responsibility unless we have been given an opportunity to review and concur with such conclusions or recommendations in writing.

REFERENCES

Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., Editors, 1999, Land subsidence in the United States: U.S. Geological Survey Circular 1182 (https://pubs.usgs.gov/circ/circ1182/#pdf).

GSI Water Solutions, Inc. (GSI), 2020. DRAFT San Antonio Creek Valley Basin Groundwater Sustainability Plan, prepared for San Antonio Basin Groundwater Sustainability Agency, October 26.

Hoffmann, Jörn, Leake, S.A., Galloway, D.L., and Wilson, Alicia M., 2003. MODFLOW-2000 Ground-Water Model—User Guide to the Subsidence and Aquifer-System Compaction (SUB) Package, U.S. Geological Survey Ground-Water Resources Program, Open-File Report 03-233.

Holtz, R. D., Kovacs, W. D., and Sheahan, T. C., 2011. An Introduction to Geotechnical Engineering, Second Ed., Pearson Education Inc. Upper Saddle River, NJ.

Lowe, M., 2012. Subsidence in Sedimentary Basins Due to Groundwater Withdrawal for Geothermal Energy Development, Utah Geological Survey Open-File Report 601, (https://ugspub.nr.utah.gov/publications/open_file_reports/OFR-601.pdf).

Poland, J.F., Editor, 1984. Guidebook to Studies of Land Subsidence Due to Ground-Water Withdrawal (https://wwwrcamnl.wr.usgs.gov/rgws/Unesco/), prepared for the International Hydrological Programme, Working Group 8.4., United Nations Educational, Scientific and Cultural Organization (UNESCO).

U.S. Geological Survey (USGS), 2021. "Areas of Land Subsidence in California," https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html, accessed February 23.

ATTACHMENT A

Well Locations, Stratigraphic Information, and Hydrographs Used in Analyses (well logs and excerpts from GSI Water Solutions, Inc., 2020)

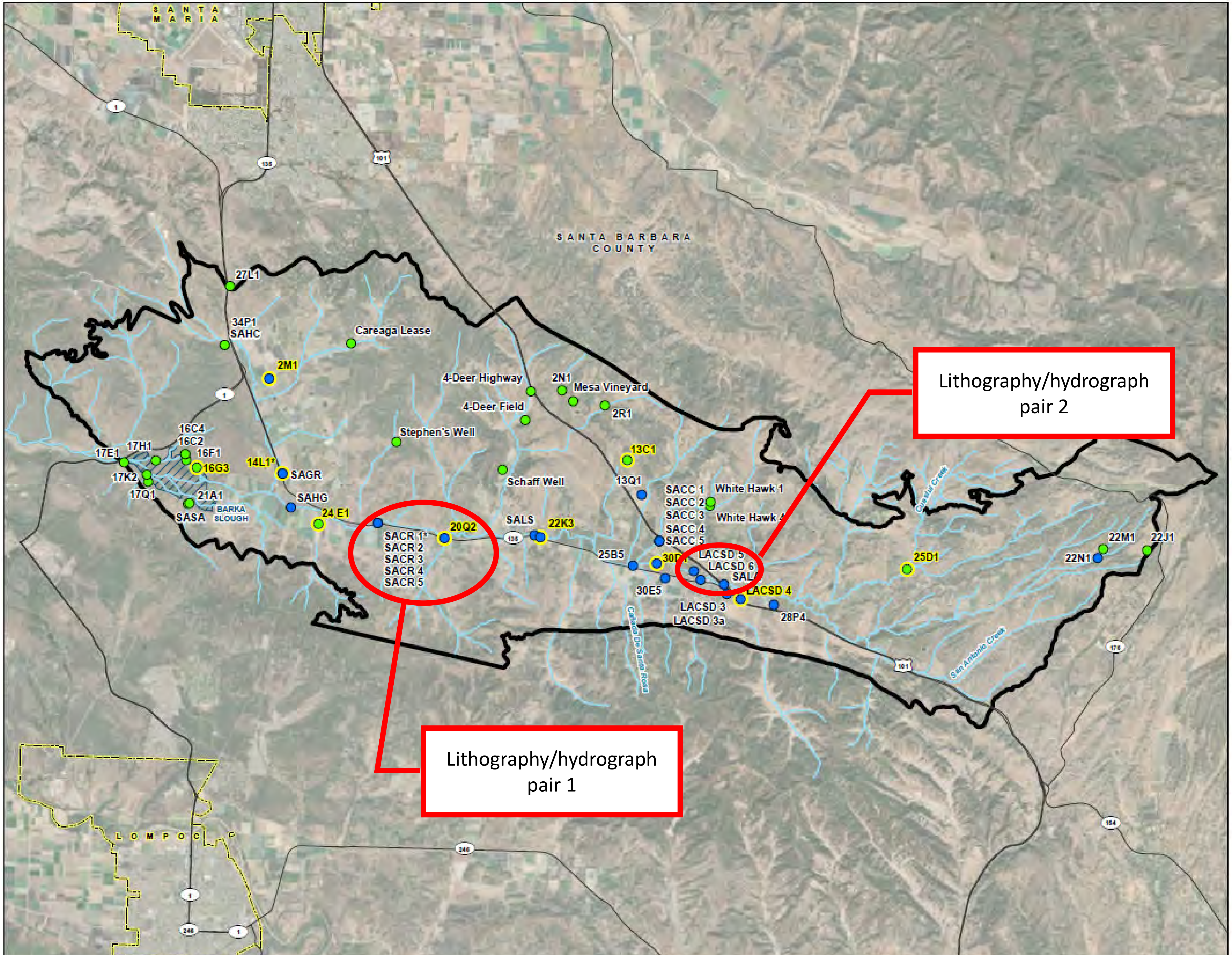


FIGURE 3-12

Wells Included in the San Antonio Creek Valley Groundwater Basin Groundwater Monitoring Program

Groundwater Sustainability Plan
San Antonio Creek Valley Groundwater Basin

LEGEND

Representative Well

Wells (by screened aquifer)

Paso Robles Formation

Careaga Sand Formation

All Other Features

San Antonio Creek or Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Formation aquifer.
San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

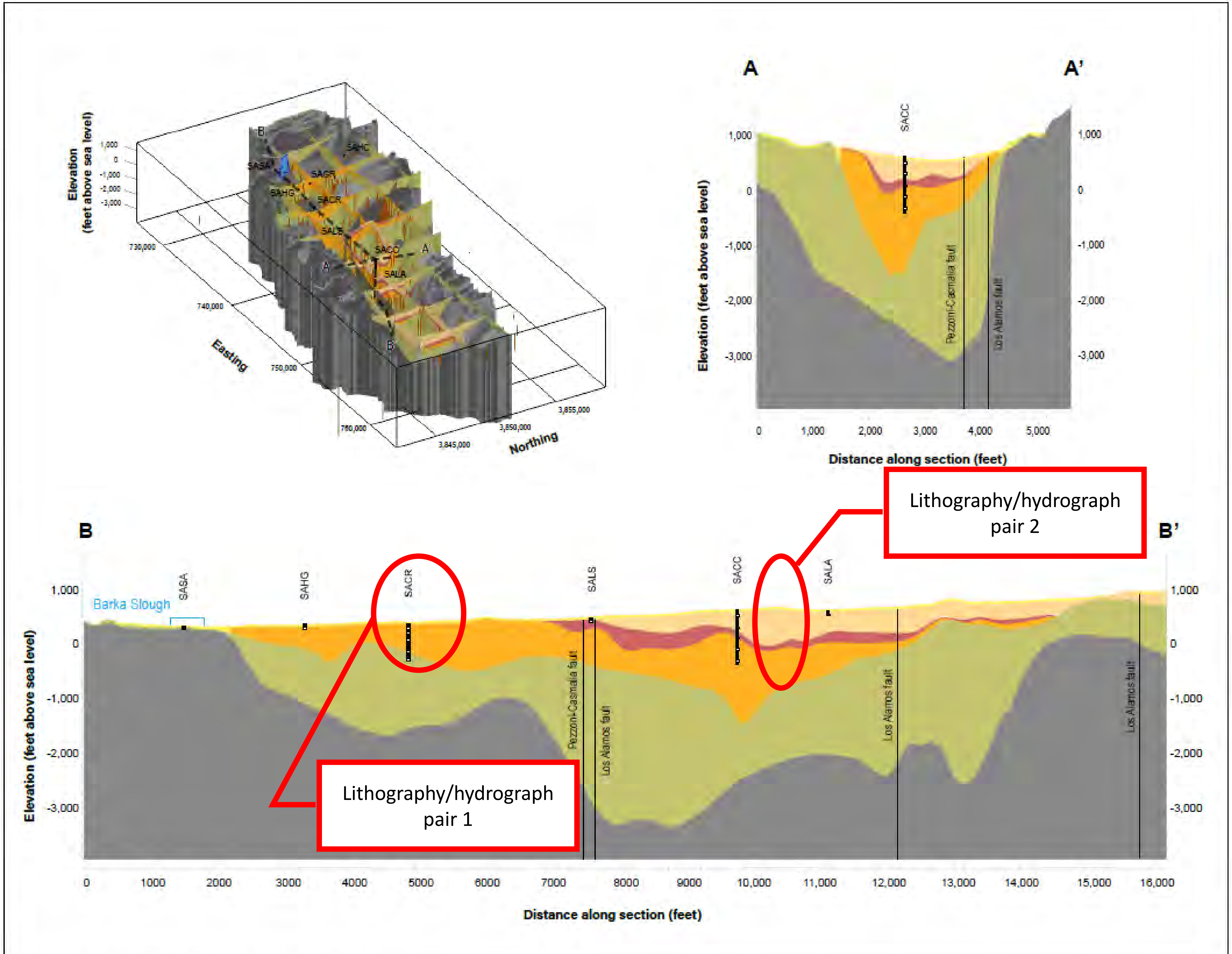
0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: October 21, 2020
Data Sources: USGS, ESRI, CADWR

FIGURE 3-5
Geological Cross Sections San Antonio Creek Valley Groundwater Basin

Groundwater Sustainability Plan San Antonio Creek Valley Groundwater Basin



LEGEND

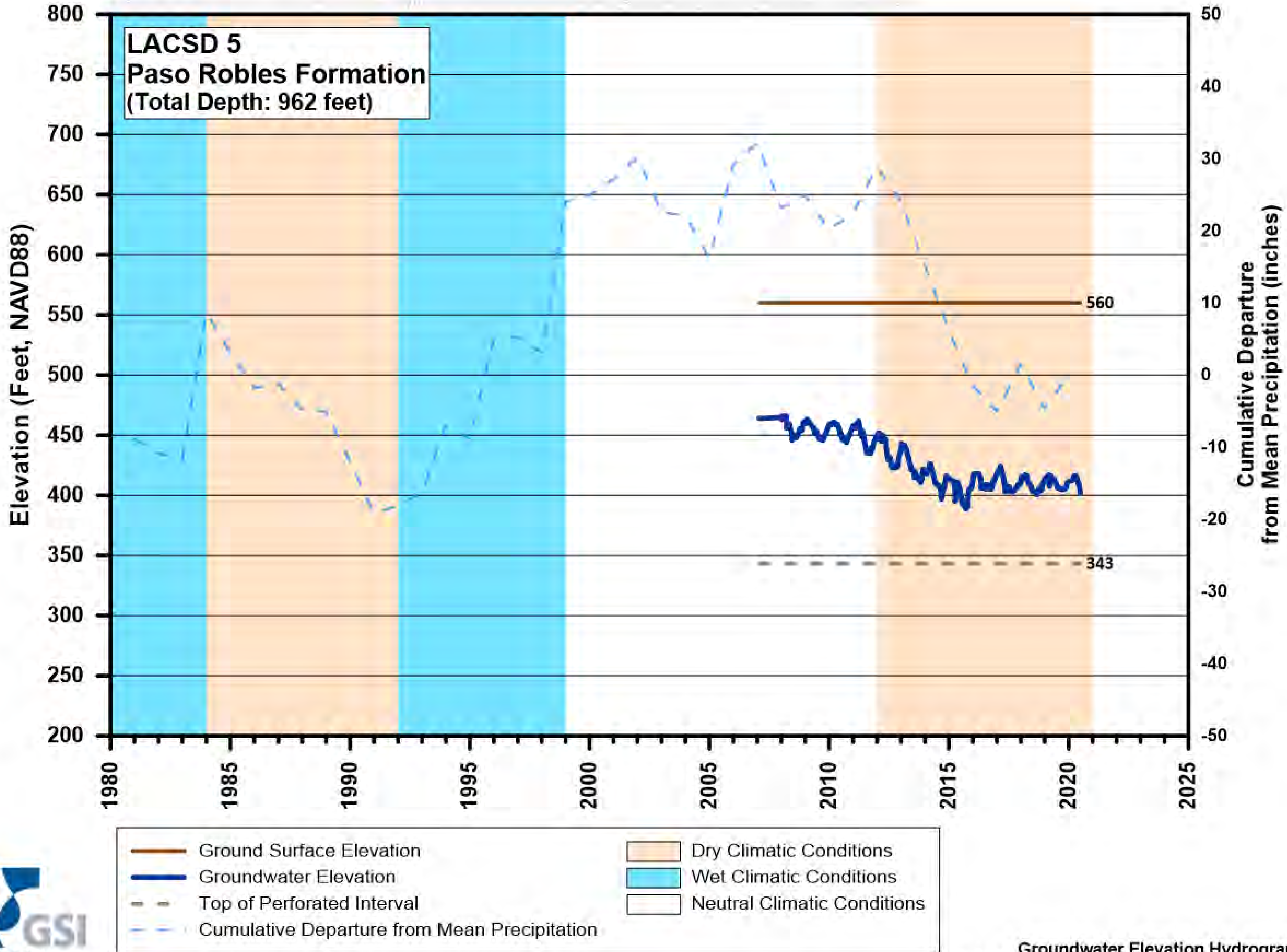
- Channel Alluvium
- Upper member - Paso Robles Formation
- Middle member - Paso Robles Formation
- Lower member - Paso Robles Formation
- Careaga Sandstone
- Consolidated bedrock

WELL LEGEND

- Screen

NOTE:
Geologic cross sections shown on Figure 3-4.
Date: September 24, 2020
Data Sources: (USGS, 2020).

GSI Water Solutions, Inc.



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

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File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752

DWR Use Only – Do Not Fill In

State Well Number/Site Number

N | W

Latitude | Longitude

APN/TRS/Other

Page 1 of 2

Owner's Well Number Well No 5

Date Work Began 10-4-06 Date Work Ended 11-18-06

Local Permit Agency Los Alamos Comm. Serv. Dist

Permit Number N.A Permit Date N.A

Geologic Log

Orientation ☒ Vertical ○ Horizontal ○ Angle Specify ____

Drilling Method ____ Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)
0	90	Brown Sand
90	110	Gravel and Sand
110	230	Clay w, Sand and Gravel
230	360	Brown Sand Clay
360	500	Hard Brown Clay
500	700	Brown Gravelly Clay and Sand
700	800	Brown Clay w/ Sand
800	900	Sandy Clay
900	970	Brown Gravelly Sand
970	1010	Hard Grey Clay

Total Depth of Boring 1010 Feet

Total Depth of Completed Well 962 Feet

Well Owner

Name Los Alamos Comm. Serv. District

Mailing Address 82 North St. Joseph St

City Los Alamos State CA Zip 93440

Well Location

Address 33 St Joseph St

City Los Alamos County Santa Barbra

Latitude ____ Deg. Min. Sec. N Longitude ____ Deg. Min. Sec. W

Datum ____ Decimal Lat. ____ Decimal Long. ____

APN Book 101 Page 110 Parcel 035

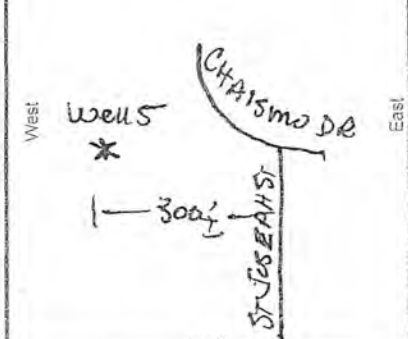
Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North

West



East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

☒ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

☒ Water Supply

☐ Domestic ☒ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

○ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7-06

Estimated Yield* 800 (GPM) Test Type Constant

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	60	36	Cond	Steel	5/16	28		
+2	210	24	Blank	Steel	1/4	12 3/4		
210	212	"	Mechical Connector			12 3/4		
212	217	"	Blank	T304 SS	1/4	12 3/4		
217	352	"	Screen	T304 SS		12 3/4	WW	
352	502	"	Blank	T304 SS	1/4	12 3/4		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	60	Cement	10.5 SK
60	120	Cement	10.5 SK
120	1010	Gravel	RMC #3

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name Best Drilling and Pump, Inc

Person, Firm or Corporation

2950 Oleta Lane Highland CA 92346

Address City State Zip

Signed [signature] 12-7-06 826672

C-57 Licensed Water Well Contractor Date Signed C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752 CONT.

Page 2 of 2

Owner's Well Number Well 5

Date Work Began ________ Date Work Ended ________

Local Permit Agency ________

Permit Number ________ Permit Date ________

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ○ Vertical ○ Horizontal ○ Angle Specify ________

Drilling Method ________ Drilling Fluid ________

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc.)

Total Depth of Boring ________ Feet

Total Depth of Completed Well ________ Feet

Well Owner

Name ________

Mailing Address ________

City ________ State ____ Zip ____

Well Location

Address ________

City ________ County ________

Latitude ___ ___ ___ N Longitude ___ ___ ___ W (Deg. Min. Sec.)

Datum ____ Decimal Lat. ____ Decimal Long. ____

APN Book ____ Page ____ Parcel ____

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

○ New Well

○ Modification/Repair

○ Deepen

○ Other ____

○ Destroy

Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

☒ Water Supply

☐ Domestic ☒ Public

☐ Irrigation ☐ Industrial

○ Cathodic Protection

○ Dewatering

○ Heat Exchange

○ Injection

○ Monitoring

○ Remediation

○ Sparging

○ Test Well

○ Vapor Extraction

○ Other ____

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7

Estimated Yield* 800 (GPM) Test Type CONSTANT

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
502	702	24	Screen	T304 SS		12 3/4	WW	.040
702	792	24	Blank	T304 SS	1/4	12 3/4		
792	952	24	Screen	T304 SS		12 3/4	WW	.040
952	962	24	Blank	T304 SS	1/4	12 3/4		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

☐ Geologic Log

☐ Well Construction Diagram

☐ Geophysical Log(s)

☐ Soil/Water Chemical Analyses

☐ Other ________

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name ________ (Person, Firm or Corporation)

________ Address ________ City CA State ________ Zip

Signed ________ C-57 Licensed Water Well Contractor ________ Date Signed ________ C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well Log
St. Joseph Street Well (Well #5)
Los Alamos Community Services District

Well ID: St. Joseph Street Well (Well #5)
Date: October 5 to October 14, 2006
Location: Saint Joseph Street, north of San Antonio Creek
Elevation: 560.20 ft above sea level (from survey)
Geologists: D. Williams, and D. Burke, Cleath & Associates.
Drilling Company: Best Drilling and Pump, Inc.
Drilling Method: reverse rotary
Total depth: 1,010 feet

Lithologic Log
Depth to top and bottom in feet

Top	Bottom	Thickness	Description
0	7	7	**Sandy Silt;** trace gravel; dark yellowish brown (10YR 4/4); fine to medium grained sand, gravel to 3", subrounded shale gravel; damp.
7	8	1	**Sandy Clay;** yellowish brown (10YR 5/4); soft, fine to medium grained sand; moist.
8	16	8	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine grained sand; siliceous shale gravel to 3"; moist.
16	18	2	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4) to grayish brown (10YR 5/2); soft, fine grained sand; moist.
18	28	10	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine grained sand; gravel to 3". Becomes wet at 25' depth.
28	41	13	**Clayey Sand with Gravel;** light yellowish brown (10YR 6/4); fine grained sand; gravel to ½", subrounded; saturated. Hole sloughing.
41	45	4	**Clayey Sand;** light yellowish brown (10YR 6/4); fine grained sand. Base of alluvium.
45	47	2	**Gravelly Sand with Clay;** with cobbles; grayish brown (10YR 5/2); fine to medium grained sand; clasts to 6", porcelaneous shale gravel, subrounded to rounded; interbedded with clay.
47	50	3	**Sandy Clay;** grayish brown (10YR 5/2); stiff.
50	55	5	**Clayey Sand;** trace gravel; grayish brown (10YR 5/2); fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
55	70	15	**Clay;** trace sand; grayish brown (10YR 5/2); stiff, fine grained sand.
70	105	35	**Gravelly Sand**; pale brown (10YR 6/3); medium to coarse grained quartzose sand, subangular to subrounded; subrounded to rounded porcelaneous shale and chert gravel to 2".
105	115	10	**Clay with Sand;** brown (10YR 5/3); soft, fine to medium grained sand.
115	134	19	**Sand with Gravel;** pale brown (10YR 6/3); fine to coarse grained, lesser coarse; gravel to ½".
134	140	6	**Sandy Clay;** trace gravel; brown (10YR 5/3); soft clay; fine to coarse grained sand.
140	155	15	**Clayey Sand;** trace gravel; brown (10YR 5/3); fine to coarse grained sand; gravel to ½".
155	175	20	**Sandy Clay;** trace gravel; brown (10YR 5/3); soft clay; fine to coarse grained sand; gravel to ½".
175	185	10	**Sand with Clay and Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
185	200	15	**Gravelly Sand with Clay;** yellowish brown (10YR 5/4); fine to coarse grained sand; subrounded porcelaneous shale gravel.
200	205	5	**Clay;** brown (10YR 5/3); soft, sticky.
205	225	20	**Sand and Gravel with Clay;** yellowish brown (10YR 5/4); fine to coarse grained sand; shale gravel to 1".
225	245	20	**Clay with Sand;** trace gravel; brown (10YR 5/3); fine to medium grained sand; gravel to ½".
245	265	20	**Sandy Clay;** yellowish brown (10YR 5/4); soft; fine to medium grained sand.
265	275	10	**Clayey Sand;** trace gravel; yellowish brown (10YR 5/4); fine to coarse grained, lesser coarse; gravel to ½".
275	278	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
278	285	7	**Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to 2", mostly siliceous shale and chert gravel.
285	298	13	**Clayey Sand with Gravel;** brown (10YR 5/3); fine to coarse grained, lesser coarse; gravel to 1".
298	315	17	**Clay;** brown (10YR 5/3); soft, sticky.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
315	327	12	**Sandy Clay;** brown (10YR 5/3); soft clay; fine to medium grained sand.
327	330	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained; gravel to ¾".
330	340	10	**Clay with Sand;** brown (10YR 5/3); soft; fine grained sand.
340	352	12	**Sand with Clay;** brown (10YR 5/3); fine to medium grained sand; olive yellow (5Y 6/6) clay from 251 to 352.
352	365	13	**Clayey Sand;** brown; (10YR 5/3); fine grained sand; soft clay.
365	385	20	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4); soft clay; fine to coarse grained sand; gravel to ½".
385	388	3	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to medium grained; gravel to ½".
388	391	3	**Clay with Sand;** yellowish brown (10YR 5/4); soft; fine to medium sand, lesser medium.
391	430	39	**Clay with Sand;** brown (10YR 5/3); soft; fine to medium grained, mostly fine.
430	450	20	**Clayey Sand;** trace gravel; brown (10YR 5/3); fine to coarse grained; porcelaneous shale gravel to ½".
450	480	30	**Clay;** trace sand; grayish brown (10YR 5/2); soft; fine to medium grained sand.
480	490	10	**Clay;** grayish brown (10YR 5/2); soft, plastic.
490	510	20	**Clay with Sand;** grayish brown (10YR 5/2); soft; fine to medium grained sand.
510	578	68	**Clay;** trace sand; grayish brown (10YR 5/2), soft, mottled yellowish brown (10YR 5/4); fine grained sand.
578	590	12	**Sandy Clay;** brown; (10YR 5/3); soft; fine to medium grained sand.
590	595	5	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ½", subrounded porcelaneous shale gravel.
595	610	15	**Clayey, Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; porcelaneous shale gravel to ¾".
610	620	10	**Clay with sand;** grayish brown (10YR 5/2); soft to medium consistency; fine grained sand.
620	625	5	**Sandy Clay;** trace gravel; yellowish brown (10YR 5/4); soft; fine to medium grained sand; gravel to ½".
625	630	5	**Clay with Sand;** grayish brown (10YR 5/2); soft to medium consistency; fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
630	638	8	**Clay with Sand;** trace gravel; yellowish brown (10YR 5/4); soft to medium consistency; fine to coarse grained sand; gravel to ½".
638	660	22	**Gravelly Sand with Clay;** yellowish brown (10YR 5/4); fine to coarse grained; siliceous and cherty gravel to ¾".
660	664	4	**Gravelly Sand;** thinly interbedded with clay; yellowish brown (10YR 5/4); fine to coarse grained sand; gravel to ¾".
664	675	11	**Clay;** grayish brown (10YR 5/2); soft, sticky.
675	690	15	**Clay;** dark greenish gray (5GY 4/1); stiff.
690	698	8	**Clayey Sand;** trace gravel; dark greenish gray (5GY 4/1); fine to medium grained; shale and mudstone gravel to ½".
698	722	24	**Clay with Sand;** trace gravel; dark greenish gray (10Y 4/1); stiff clay; fine grained sand; gravel to ½".
722	725	3	**Clay;** trace sand; dark greenish gray (10Y 4/1); stiff clay; fine grained sand.
725	740	15	**Sandy Clay;** trace gravel; greenish gray (10Y 5/1); stiff clay; fine to medium grained sand; gravel to ½".
740	750	10	**Clay with Sand;** greenish gray (10Y 5/1); soft clay; fine to medium grained sand.
750	765	15	**Sandy Clay;** trace gravel; greenish gray (10Y 5/1); soft clay; fine to medium grained sand; gravel to ¾".
765	772	7	**Clay with Sand;** greenish gray (10Y 5/1); soft clay; fine to medium grained sand.
772	790	18	**Clay;** trace sand; dark greenish gray (10Y 4/1); stiff; fine to medium grained sand.
790	805	15	**Clay;** trace sand; olive (5Y 5/3); soft; fine grained sand.
805	810	5	**Clay with Sand;** olive (5Y 5/3); soft; fine to medium grained sand.
810	824	14	**Sandy Clay;** olive (5Y 5/3); soft; mostly fine grained sand, lesser medium to coarse.
824	835	11	**Clay;** trace sand; yellowish brown (10YR 5/4); stiff; fine grained sand.
835	852	17	**Clayey Sand;** yellowish brown (10YR 5/4); sand mostly fine grained, lesser medium to coarse.
852	880	28	**Clay with Sand;** yellowish brown (10YR 5/4); soft clay; fine grained sand.
880	898	18	**Sandy Clay;** yellowish brown (10YR 5/4); soft; fine grained sand.

Los Alamos CSD St. Joseph Street Well (Well #5); (Continued)

Top	Bottom	Thickness	Description
898	910	12	**Clayey Sand with Gravel;** yellowish brown (10YR 5/4); fine to coarse grained sand; porcelaneous shale gravel to ½".
910	925	15	**Gravelly Sand;** yellowish brown (10YR 5/4); fine to coarse grained sand; subrounded porcelaneous shale gravel to ¾".
925	930	5	**Clayey Sand with Gravel;** light brownish gray (10YR 6/2); fine to coarse grained; gravel to ½".
930	950	20	**Sand and Gravel with Clay;** grayish brown (10YR 5/2); fine to coarse grained sand; porcelaneous shale gravel to 1".
950	960	10	**Sand with Gravel;** trace clay; light brownish gray (10YR 6/2); fine to coarse grained sand; gravel to ½".
960	970	10	**Sand and Gravel;** grayish brown (10YR 5/2); medium to coarse grained; porcelaneous shale gravel to ¾".
970	980	10	**Sandy, Gravelly Clay;** gray (10YR 6/1); fine to coarse grained sand; gravel to 1".
980	990	10	**Clay with Sand and Gravel;** gray (10YR 6/1); fine grained sand; gravel to 1".
990	1000	10	**Clay;** gray (10YR 6/1).
1000	1010	10	**Clay with Sand;** trace gravel; gray (10YR 6/1); fine grained sand; gravel to ½".

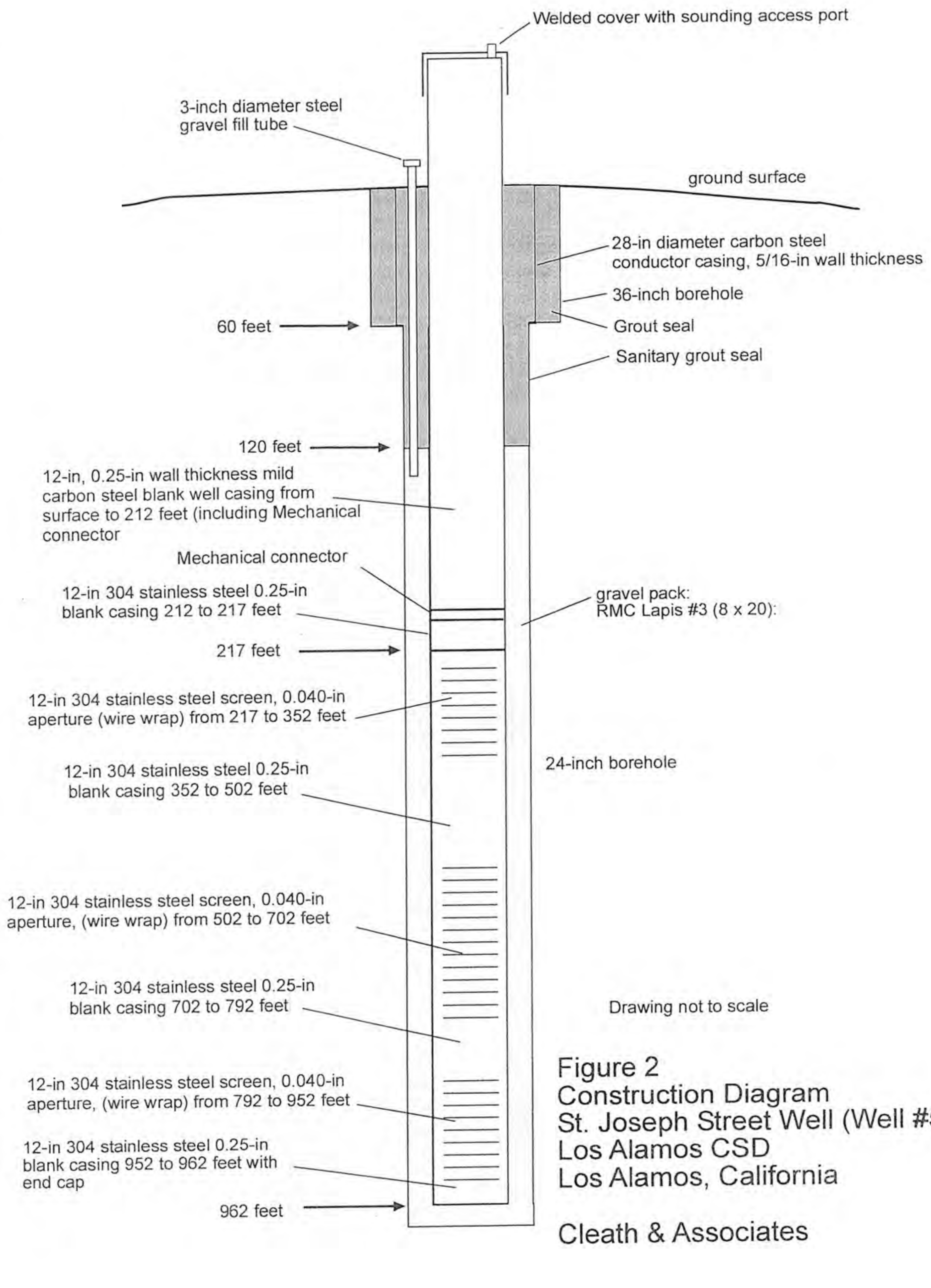
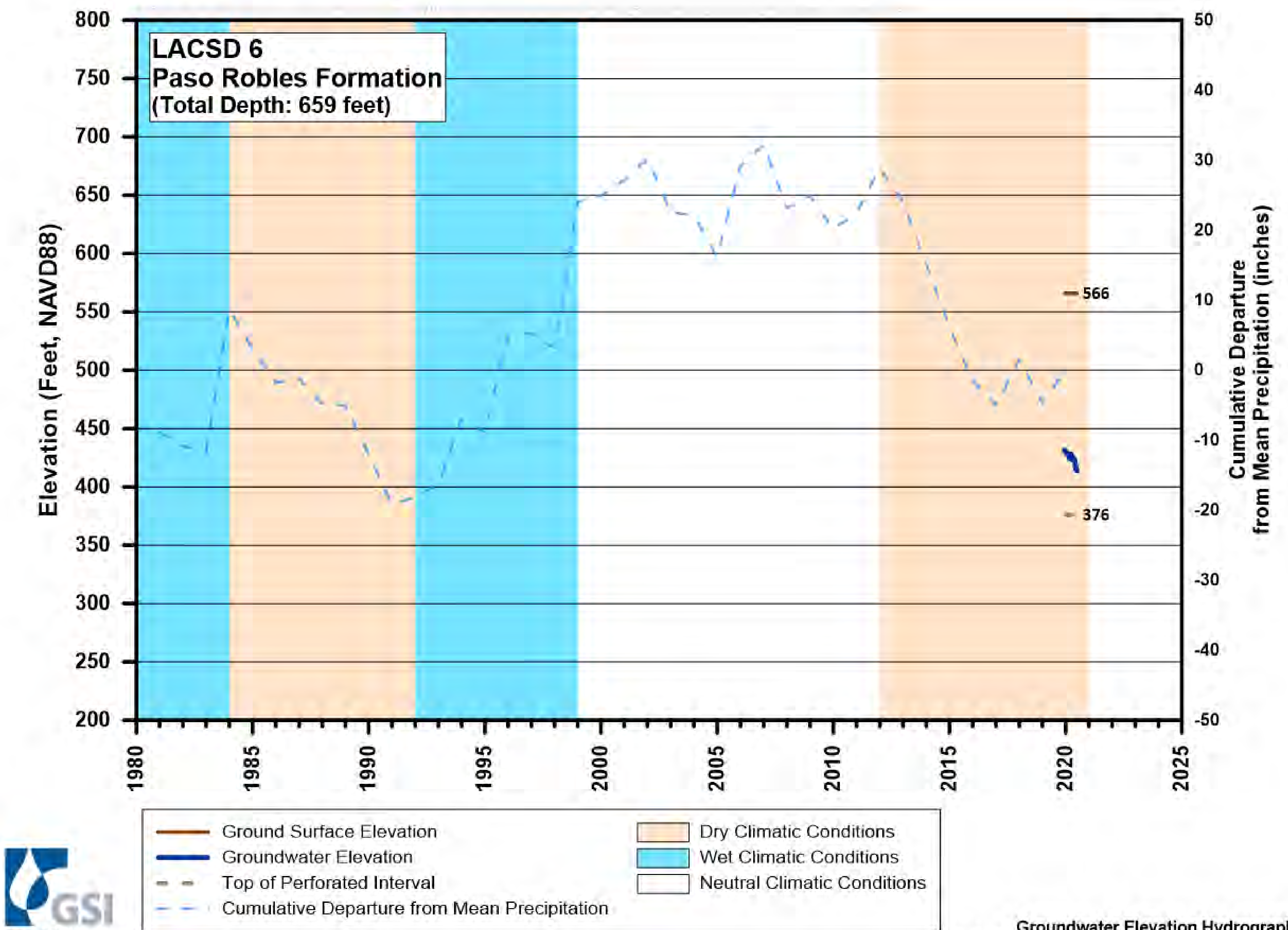


Figure 2
Construction Diagram
St. Joseph Street Well (Well #5)
Los Alamos CSD
Los Alamos, California

Cleath & Associates



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

State of California

Well Completion Report

Form DWR 188 In Review 4/3/2018

WCR2017-005628

Owner's Well Number: WELL #6 | Date Work Began: 10/23/2017 | Date Work Ended: 11/08/2017

Local Permit Agency: Santa Barbara County Environmental Health Services

Secondary Permit Agency: | Permit Number: 0002481 | Permit Date: 10/23/2017

Well Owner (must remain confidential pursuant to Water Code 13752)

Name: LOS ALAMOS COMMUNITY SERVICES,

Mailing Address: PO BOX 675

City: LOS ALAMOS | State: CA | Zip: 93440

Planned Use and Activity

Activity: New Well

Planned Use: Water Supply Public

Well Location

Address: 175 BELL ST

City: LOS ALAMOS | Zip: 93440 | County: Santa Barbara

Latitude: 34 Deg. 44 Min. 40.95 Sec. N | Longitude: -120 Deg. 16 Min. 47.23 Sec. W

Dec. Lat.: 34.7447083 | Dec. Long.: -120.2797861

Vertical Datum: | Horizontal Datum: WGS84

Location Accuracy: | Location Determination Method:

APN: 101-152-008

Township: 08 N

Range: 32 W

Section: 30

Baseline Meridian: San Bernardino

Ground Surface Elevation:

Elevation Accuracy:

Elevation Determination Method:

Borehole Information

Orientation: Vertical | Specify:

Drilling Method: Direct Rotary | Drilling Fluid: Bentonite

Total Depth of Boring: 1005 Feet

Total Depth of Completed Well: 959 Feet

Water Level and Yield of Completed Well

Depth to first water: (Feet below surface)

Depth to Static Water Level: 140 (Feet) | Date Measured: 11/08/2017

Estimated Yield*: 600 (GPM) | Test Type: Air Lift

Test Length: 12 (Hours) | Total Drawdown: (feet)

*May not be representative of a well's long term yield.

Geologic Log - Free Form

Depth from Surface Feet to Feet		Description
0	42	DARK BROWN CLAY
42	54	SAND & GRAVEL
54	71	BROWN SANDY CLAY
71	126	SAND & GRAVEL
126	143	BROWN CLAY
143	152	SAND & GRAVEL
152	157	BROWN CLAY
157	173	SAND & GRAVEL
173	179	BROWN CLAY & GRAVEL LAYERS
179	267	SAND & GRAVEL
267	272	BROWN CLAY
272	281	SAND & GRAVEL
281	293	BROWN CLAY
293	303	SAND & GRAVEL
303	308	BROWN CLAY & HARD LAYERS

308	317	SAND & GRAVEL
317	321	BROWN CLAY
321	348	SAND & GRAVEL
348	364	SAND W/ CLAY LAYERS
364	428	BROWN CLAY
428	437	SAND
437	463	GREY / BROWN CLAY
463	478	GRAVEL LAYERS
478	564	BROWN CLAY
564	570	SAND & GRAVEL
570	637	BROWN CLAY W/ SAND LAYERS
637	648	SAND & THIN GRAVEL ZONES
648	654	BROWN CLAY
654	665	SAND & THIN GRAVEL ZONES
665	677	BROWN CLAY
677	685	SAND & GRAVEL
685	732	BLUE CLAY W/ GRAVEL LAYERS
732	743	SAND & GRAVEL
743	757	BLUE CLAY
757	763	SAND & GRAVEL
763	768	BLUE CLAY
768	782	SAND & GRAVEL
782	836	BLUE CLAY
836	864	SAND
864	902	BLUE CLAY & SAND
902	935	SAND & GRAVEL
935	951	CLAY
951	958	SAND & GRAVEL
958	1005	BROWN CLAY

Casings

Casing #	Depth from Surface Feet to Feet		Casing Type	Material	Casings Specificatons	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if any (inches)	Description
1	0	58	Conductor or Fill Pipe	Low Carbon Steel	Grade: ASTM A53	0.25	24			
2	0	196	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	196	296	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	
2	296	338	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	338	700	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	
2	700	823	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	823	959	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	

Annular Material

Depth from Surface Feet to Feet		Fill	Fill Type Details	Filter Pack Size	Description
0	1005	Filter Pack	Other Gravel Pack		LAPIS #3

Other Observations:

Borehole Specifications

Depth from Surface Feet to Feet		Borehole Diameter (inches)
0	58	30
58	1005	22

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name: FILIPPONI-THOMPSON DRILLING INC
Person, Firm or Corporation

Address	City	State	Zip
P O BOX 845	ATASCADERO	CA	93423

	C-57 Licensed Water Well Contractor	Date Signed	C-57 License Number
Signed	*electronic signature received*	11/30/2017	432680

DWR Use Only

CSG #	State Well Number	Site Code	Local Well Number

N **Latitude Deg/Min/Sec**

W **Longitude Deg/Min/Sec**

TRS: 08N32W30H

APN:

ELECTRIC - GAMMA RAY-TEMPERATURE LOG

Reamed Borehole

· Phone: (888) 908-5226 Fax: (661) 505-6561 · Web: www.boredata.com Email: ccorbell@boredata.com

Filing No.

COMPANY **Filipponi and Thompson Drilling**

WELL **LACSD No 6**

FIELD **Los Alamos**

STATE **California** COUNTY **Santa Barbara**

LOCATION:
Corner of Leslie St and Centennial St

OTHER SERVICES:
None

Job No.
2447

SEC: ____ TWP: ____ RGE: ____ LAT.: **34.74476** LONG.: **-120.27983**

Permanent Datum: **Ground Level** Elev.: ____ Ft. Elevs.: K.B. ____ Ft.

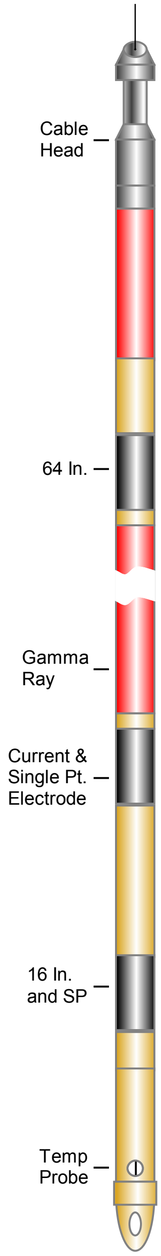
Log Measured From: **Ground Level** , **0** Ft. Above Perm. Datum D.F. ____ Ft.

Drilling Measured From: **Kelly Bushing** G.L. ____ Ft.

Run	One			
Date	Nov 01, 2017			
Depth-Driller	1000 Ft	Ft	Ft	Ft
Depth-Logger	1005 Ft	Ft	Ft	Ft
Top Logged Interval	6 Ft	Ft	Ft	Ft
Btm Logged Interval	1005 Ft	Ft	Ft	Ft
Casing-Driller	24 In @ 55 Ft	In @ Ft	In @ Ft	In @ Ft
Casing - Logger In@Ft	In @ Ft	In @ Ft	In @ Ft	In @ Ft
Bit Size	22 In @ 1003 Ft	In @ Ft	In @ Ft	In @ Ft
Time On Bottom	18:00			
Type Fluid in Hole	Bentonite			
Density / Viscosity				
pH / Fluid Loss	ml	ml	ml	ml
Source of Sample	Circ			
Rm @ Mea. Temp	5.8 @ 68.3 °F	@ °F	@ °F	@ °F
Rmf @ Mea. Temp	5.6 @ 68.3 °F	@ °F	@ °F	@ °F
Rmc @ Mea. Temp	@ °F	@ °F	@ °F	@ °F
Source Rmf / Rmc	Meas			
Rm @ BHT	@ °F	@ °F	@ °F	@ °F
Time Since Circ.	1 Hr	Hr	Hr	Hr
Max. Rec. Temp.	77.6 °F	°F	°F	°F
Van No. / Location	BD-1 / VTU			
Recorded By	Craig Corbell			
Witnessed By				

This Eagle Plot Heading Conforms To API RP 31A

ELECTRIC - GAMMA RAY-TEMPERATURE LOG TOOL



SPONTANEOUS POTENTIAL LOGS:
SP Logs record potentials or voltages developed between the borehole fluid and the surrounding formation and are representations of lithology and water quality. Recording of SP logs are limited to water-filled or mud-filled open holes.

NORMAL RESISTIIVITY LOGS:
Normal Resistivity Logs record the electrical resistivity of the borehole environment with lower resistivities indicative of clays and higher resistivities being sands and gravels. Normal resistivity logs are affected by bed thickness, Borehole diameter and borehole fluid.

SINGLE POINT RESISTIVITY LOGS:
Single Point Resistivity Logs record the electrical resistance from points within the borehole to an electrical ground at land surface. Single-point resistance logs are useful in the determination of lithology, water quality, and location of fracture zones.

GAMMA RAY LOGS:
Gamma Ray Logs record the amount of natural gamma radiation emitted by the rocks surrounding the borehole. The most significant naturally occurring sources of gamma radiation are potassium 40 and daughter products of the uranium and thorium decay series. Clay and shale bearing rocks commonly emit relatively high gamma radiation because they include weathering products of potassium feldspar and mica and tend to concentrate uranium and thorium by ion absorption and exchange.

TEMPERATURE LOGS:
Temperature Logs record the water temperature in the borehole. Temperature logs are useful for delineating water-bearing zones and identifying vertical flow in the borehole between zones of differing hydraulic head penetrated by wells. Borehole flow between zones is indicated by temperature gradients that are less than the regional geothermal gradient.

ELECTRIC LOG SPECIFICATIONS:

Diameter	1.73 Inches
Length	8.37 Feet
Weight	21.7 Lbs.
Max. Temp	158° F
Resist. Range	0 - 10,000 ohm-m
Gamma Ray	1.97 inches long x .98 inches diameter Scintillation crystal

NOTICE

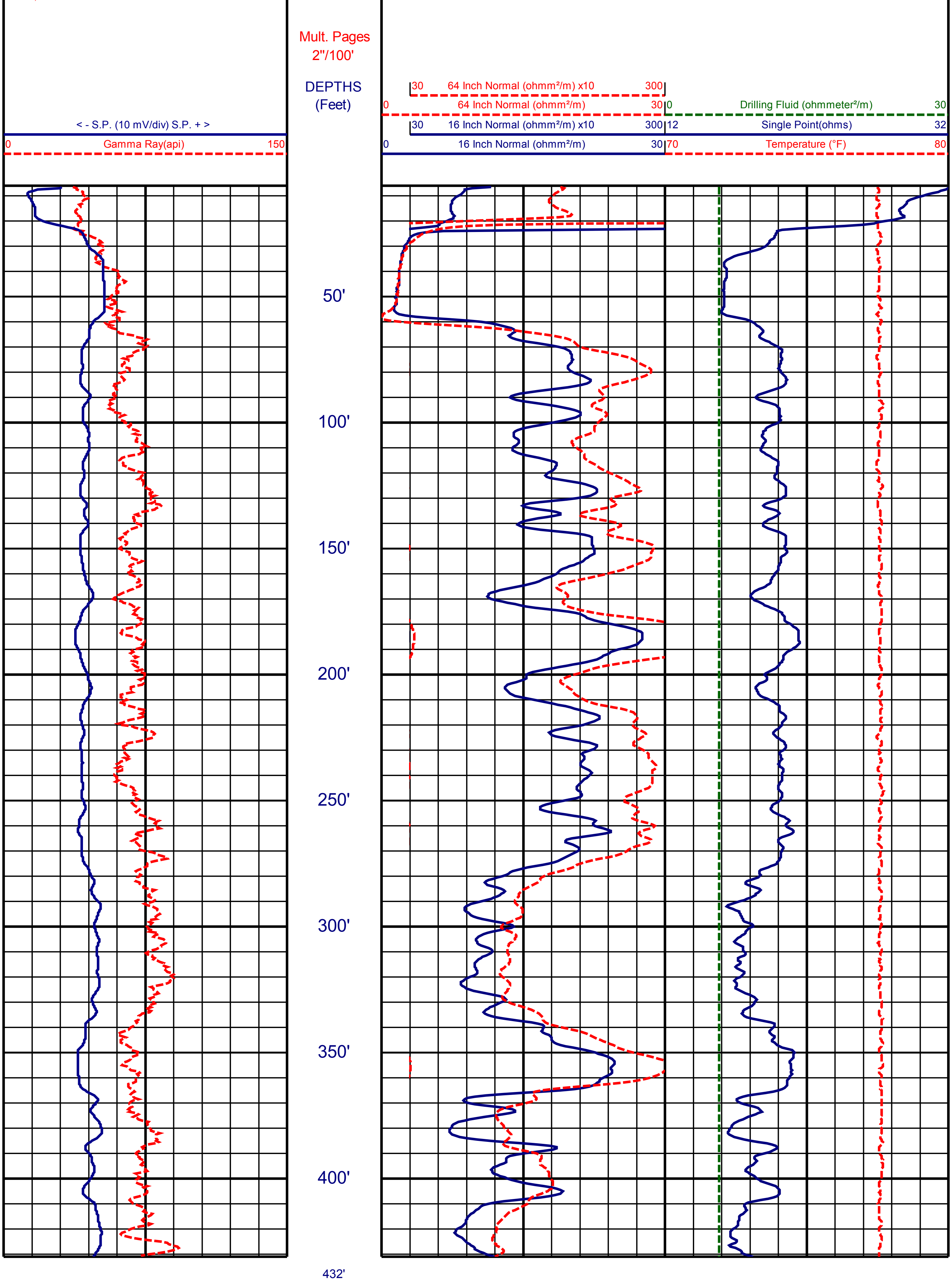
All interpretations are opinions based on inferences from electrical and other measurements and we do not guarantee the accuracy or correctness of any verbal or written interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by one of our officers, agents or employees. These interpretations are also subject to our General Terms and Conditions as set out in our current Price Schedule.

REMARKS

boredata - 11011 Villa Monterey Drive - CA - 93311 Fax: (661) 505-6561 Phone:(888) 908-5226

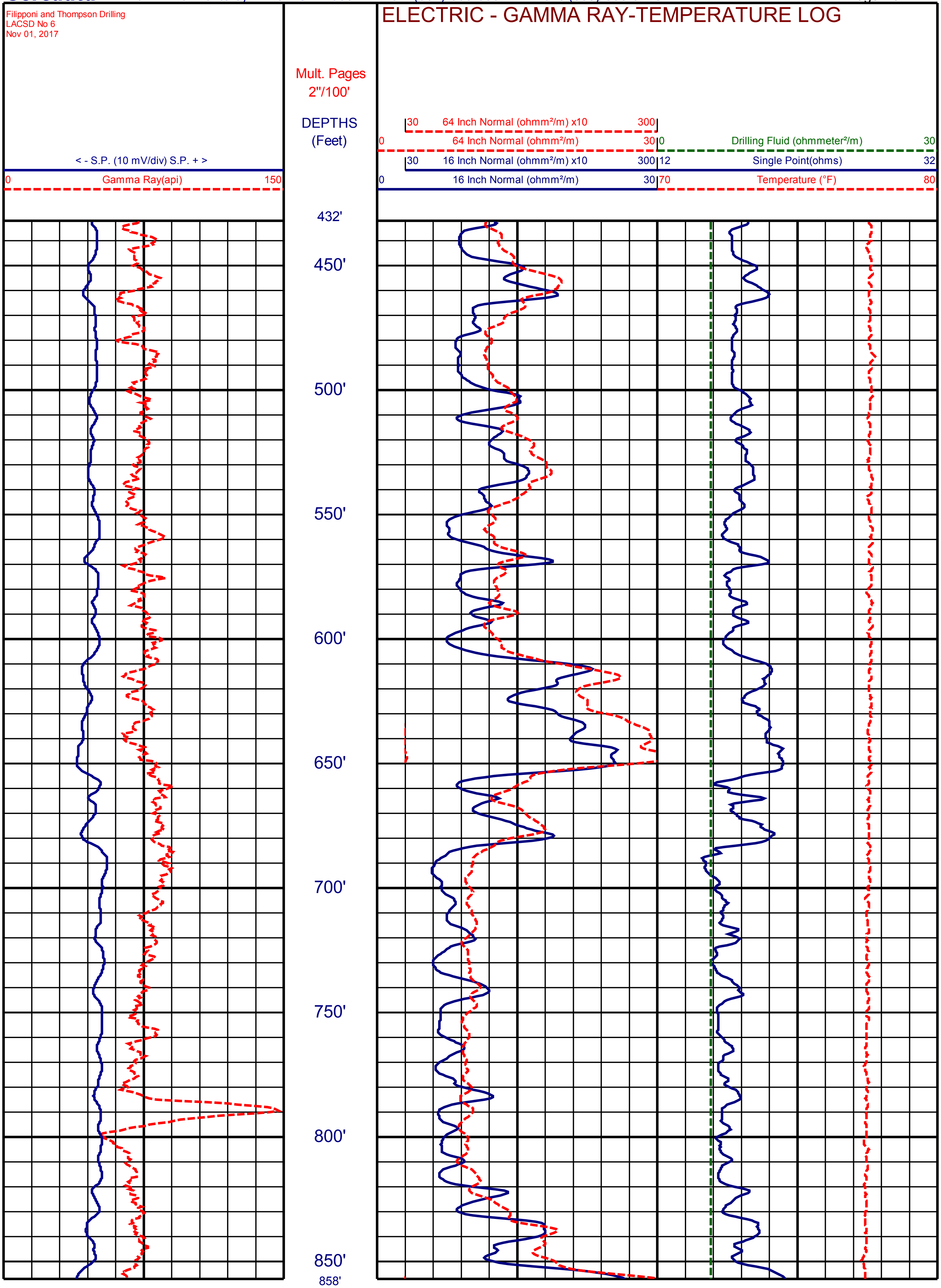
Filipponi and Thompson Drilling
LACSD No 6
Nov 01, 2017

ELECTRIC - GAMMA RAY-TEMPERATURE LOG



Filipponi and Thompson Drilling
LACSD No 6
Nov 01, 2017

ELECTRIC - GAMMA RAY-TEMPERATURE LOG



Filipponi and Thompson Drilling
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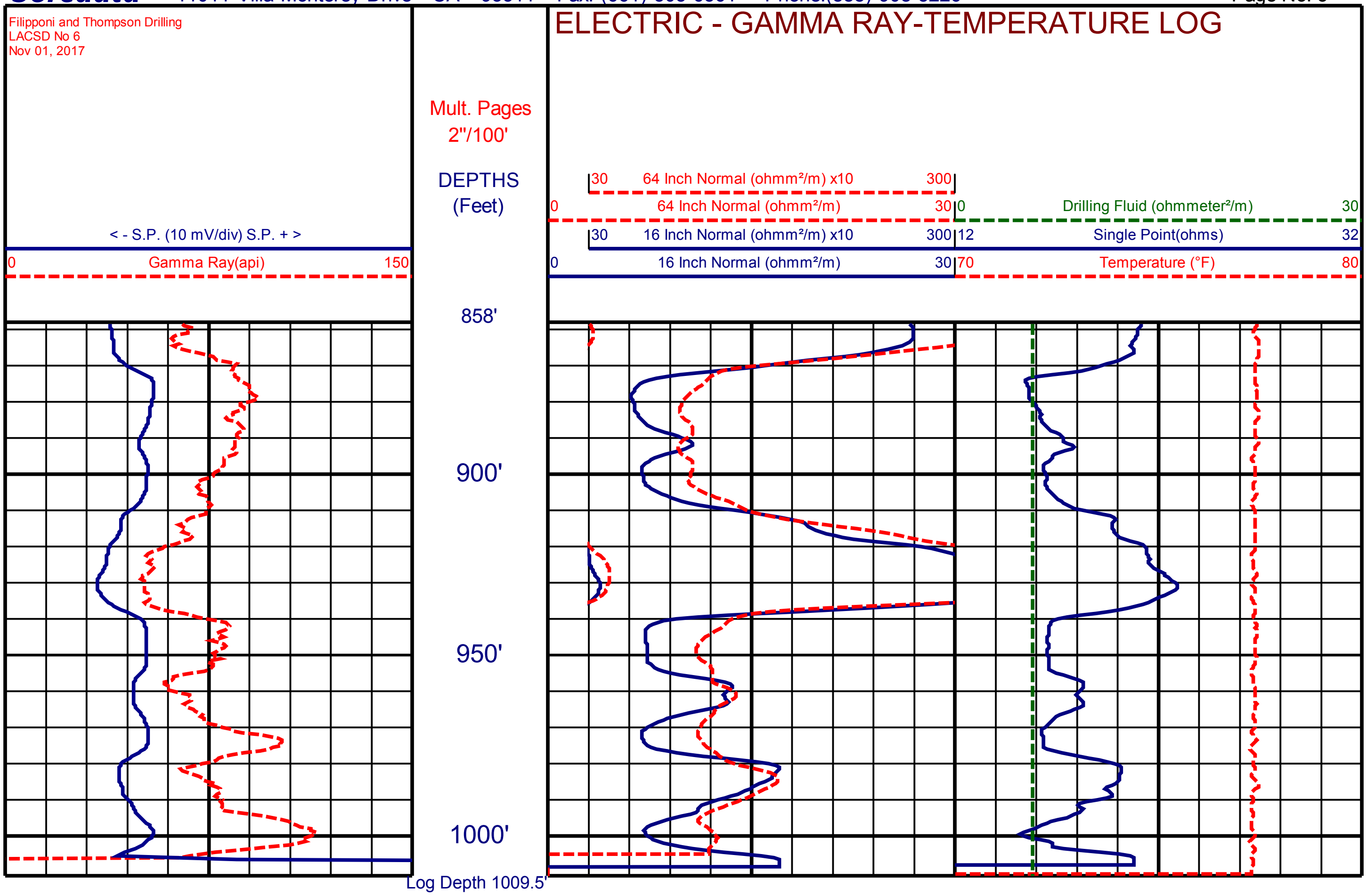
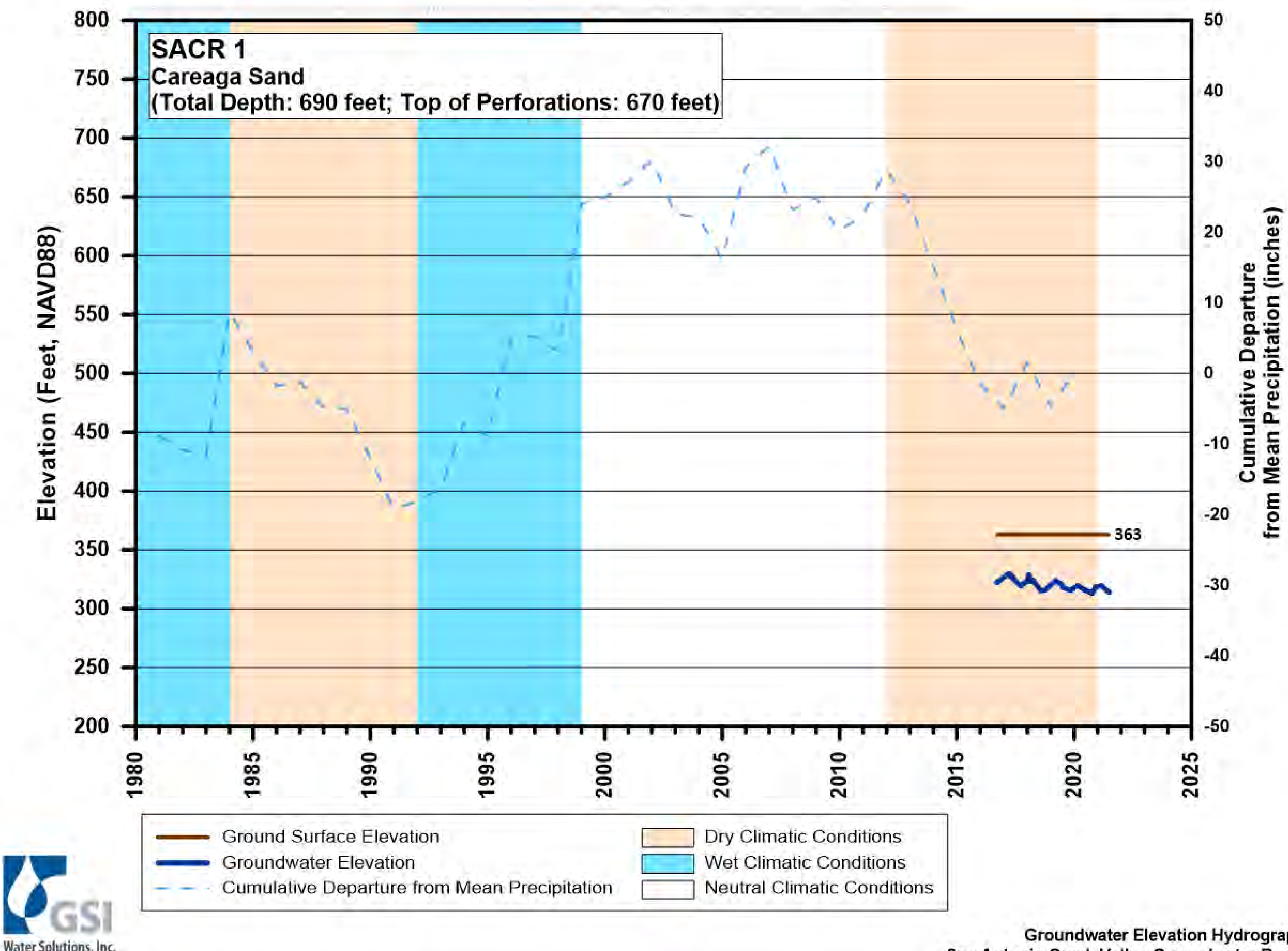




Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SACR 525 | PROJECT: GC16ZG00FUVS300 | PROJECT CHIEF: David O'Leary
ELEV: 361' | LOCATION: [redacted] CA-135, Los Alamos, CA 93455, N34°45'32" W120°23'39" | LOGGED BY: *Anthony Brown Adam Kjos*
DRILLED BY: *USGS RDP* | RIG TYPE: *Mud Rotary- TH60* | LAG METHOD: *Rice (mud)*

Date	Depth	Time (min)	Rig noise etc.	Color (Munsell - soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time	Date
	0				EC 4780				
7/30	20	1514 1543 1614		2.5y 3/2 2.5y 5/3	VHvy 3950		0-1 - wood 1-2 - RIPRAP - cement/asphalt 2-3 Soil - silty clay 3-4 silty clay 4-14 sand (gr-mp) (vf-vc) 14-16 sand (vf-vc) g (gr-mp) 16-17 clayey 17-20 = 14-16	20" HOLE Opener	7/30
7/31	40	0944 0949 0959	33'	2.5y 6/3	vHvy M 3080		SANDy (vf-vc) gravel (gran-md peb) Gravelly (gran-md peb) SAND (vf-vc)	9 7/8" longtooth tricone	7/31
	60	1132 1137 1142		2.5y 6/3	VHvy 3050		slightly Gravelly (gran-sm peb) sand (vf-vc)		
	80	1153 1209 1219	68' slow 71' Fast	2.5y 4/2 2.5y 5/3	Hvy 3010		64-65' soil hor 65-68' silty sand (vf-vc) w/ gravel (gran-md peb) 68'-71' clayey silt w/ med peb 71-80' - mainly (vf-m) w/ (vc) + gran		
	100	1229 1232 1236	81'	2.5y 5/3	mod 2920		SAnDy (vf-vc) gravel (gran-md peb)		
	120	1332 1337 1347	101' 117'	2.5y 6/3 2.5y 4/1	Hvy/H M 3310		Gravelly (md peb) sand (vf-m) Lost Circ. clayey silt		
	140	1437 1447 1455	128' 138'		VHvy M 3240		clayey silt sandy (vf-vc) gravel (gran-lg peb) sand (vf-m)		
	160	1504 1510 1519	152' 158'		VHvy M 3330		SAND (vf-m) SAND (vf-vc) SAND (m-vc) Abundant wood + Peat	Rice Time 2 MIN	
	180	1544 1552 1622	161' 168' color 171' 173' Fast 177' slow		VHvy M 3160		Gray SAND (vf-m) Green SAND (vf-m) clay SAND (vf-m) clay (silty)		
	200	1637 1659 1727	182' 190' 195'		VHvy/H M 2960		SAND (vf-m) silty clay SAND (vf-m)		
7/31	220	1736 1739 1752	216' slow		Hvy 2950		SAND (vf-m) SAND (vf-vc)		7/31
8/1	240	1801 1843 0844 0848	225' slow 230'		H/vHvy M 2830		silty clay SAND (vf-vc)	Rice Time 3 MIN	8/1
	260	0900 0908 0949	241' 257' slow		mod M 2850		SAndy (vf-m) silt clay		
	280	1208 1326 1402	274' Fast		H M 2950		clay		
	300	1419 1439 1447	288' Fast		Mod M 2640		silt		
	320	1500 1506 1511			VHvy 2630		SAND (vf-vc) upper - gray, mid - green, bottom - brown	Rice Time 3 MIN	
	340	1530 1536 1543			vHvy M 2640		SAND (vf-m)		
	360	1602 1611 1619			vHvy M 2690				
8/1	380	1629 1634 1656	374' slow		VHvy M 2820				8/1
8/2	400	1755 1845 0856 0908	383' slow		H M 2540		clay	7 7/8 tricone	8/2

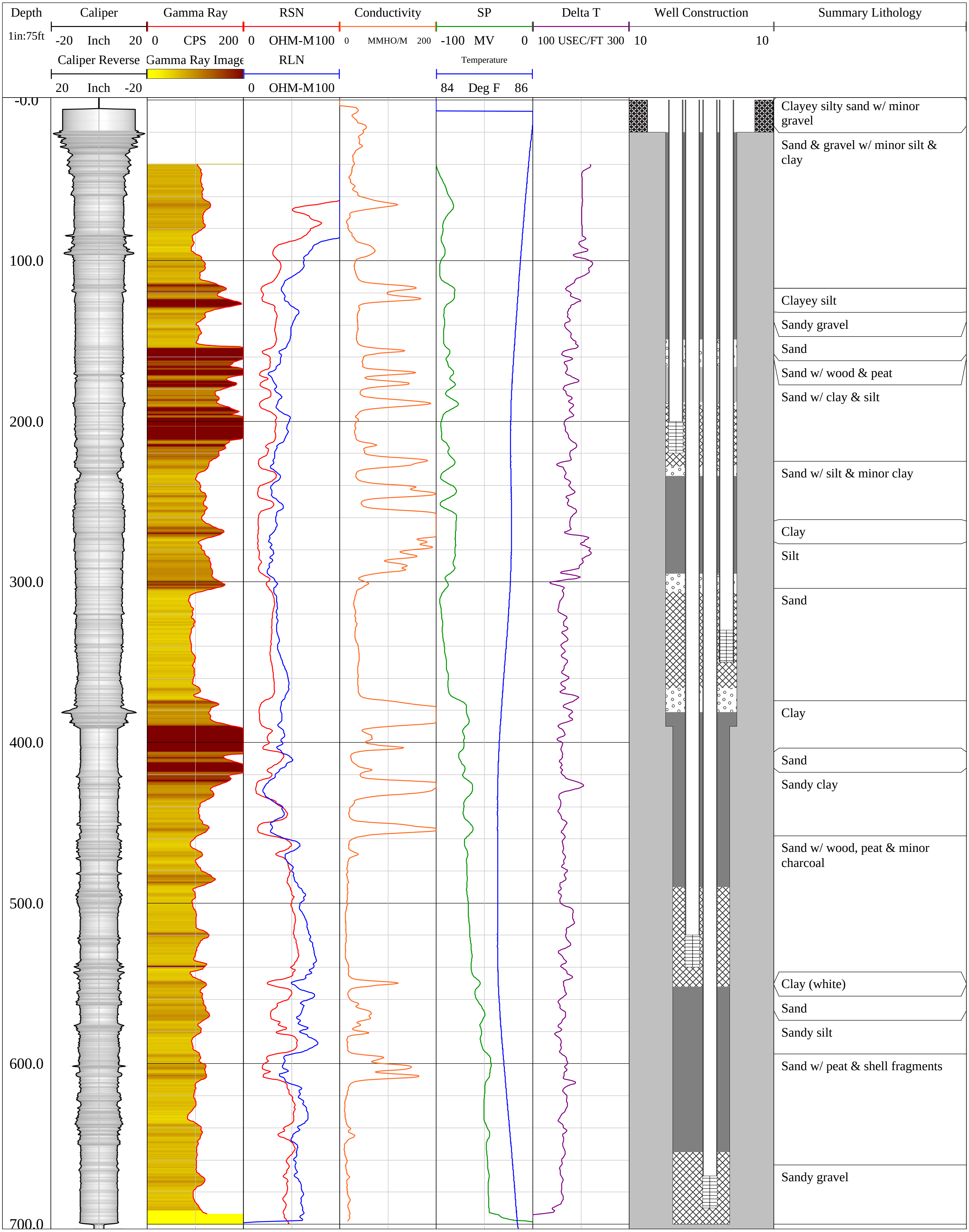
USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SACR	PROJECT: GC16ZG00FUVS300	PROJECT CHIEF: David O'Leary
ELEV: 361'	LOCATION: 1098 CA-135, Los Alamos, CA 93455, N34°45'32" W120°23'39"	LOGGED BY: Anthony Brown Adam Kjos
DRILLED BY: USGS RDP	RIG TYPE: Mud Rotary- TH60	LAG METHOD: Rice (mud)

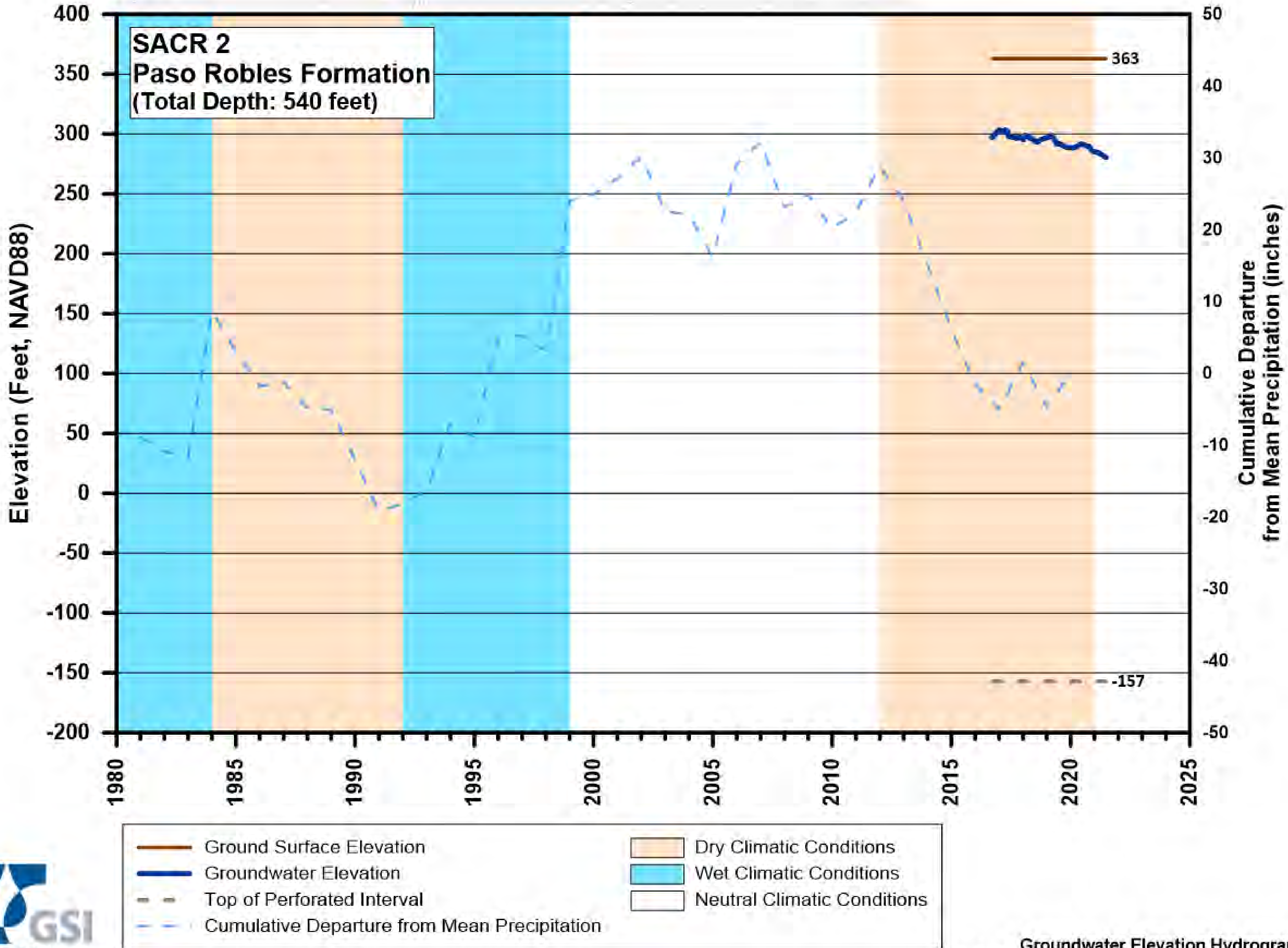
8/2

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
400							7 7/8" tricone
420	0919 0928 0934	407'		Hvy M / 2600		clay SAND(f-m) w/ SAND (c-vc) w/mafics	Rice Time 4 1/2 min
440	1003 1038 1101	425' slow 434' Fast		lt / 2420		sandy (vf-m) clay	
460	1114 1119 1141	443' Fast 454' slow 457' Fast		mod / 2440		SAND (vf-m) w/ small wood chips	
480	1155 1158 1202			vHvy / 2470		SAND(vf-m) w/ small woodchips	
500	1215 1218 1220			vHvy M / 2390		SAND (vf-m) w/ v sm wood chips	
520	1258 1301 1303			VHvy / 2470		SAND (vf-m) w/ v sm wood chips	Rice Time 5 min
540	1319 1321 1323	539'		vHvy / 2270		SAND (vf-m) w/ v sm wood chips some charcoal SAND (vf-m) w/ Peat and wood chips	
560	1340 1343 1346	550'		Hvy / 2170		SAND (vf-m)	
580	1400 1407 1409	567' slow-Fast		vHvy M / 2260		sandy (vf-m) silt	
600	1422 1423 1438	594' slow/fast		lt / 2310		Peat SAND (vf-vc) w/ shell fragments	
620	1451 1516 1518	601' slow 604' Fast 607' slow/Fast		mod / 2290			Rice Time 6 min
640	1531 1532 1533			Hvy / 2300		SAND (vf-m) w/ Peat + Shells @ 631'-640'	
660	1555 1558 1601			Mod / 2370		SAND (vf-m) w/ Peat + Shells	
680	1613 1616 1620	663' chatter		v Hvy m / 2360		SANDY (vf-vc) gravel (gran-sm peb) rounded	
TO 700	1633 1637 1643			vHvy / 2370		sandy (vf-vc) gravel (gran-sm peb)	

8/2

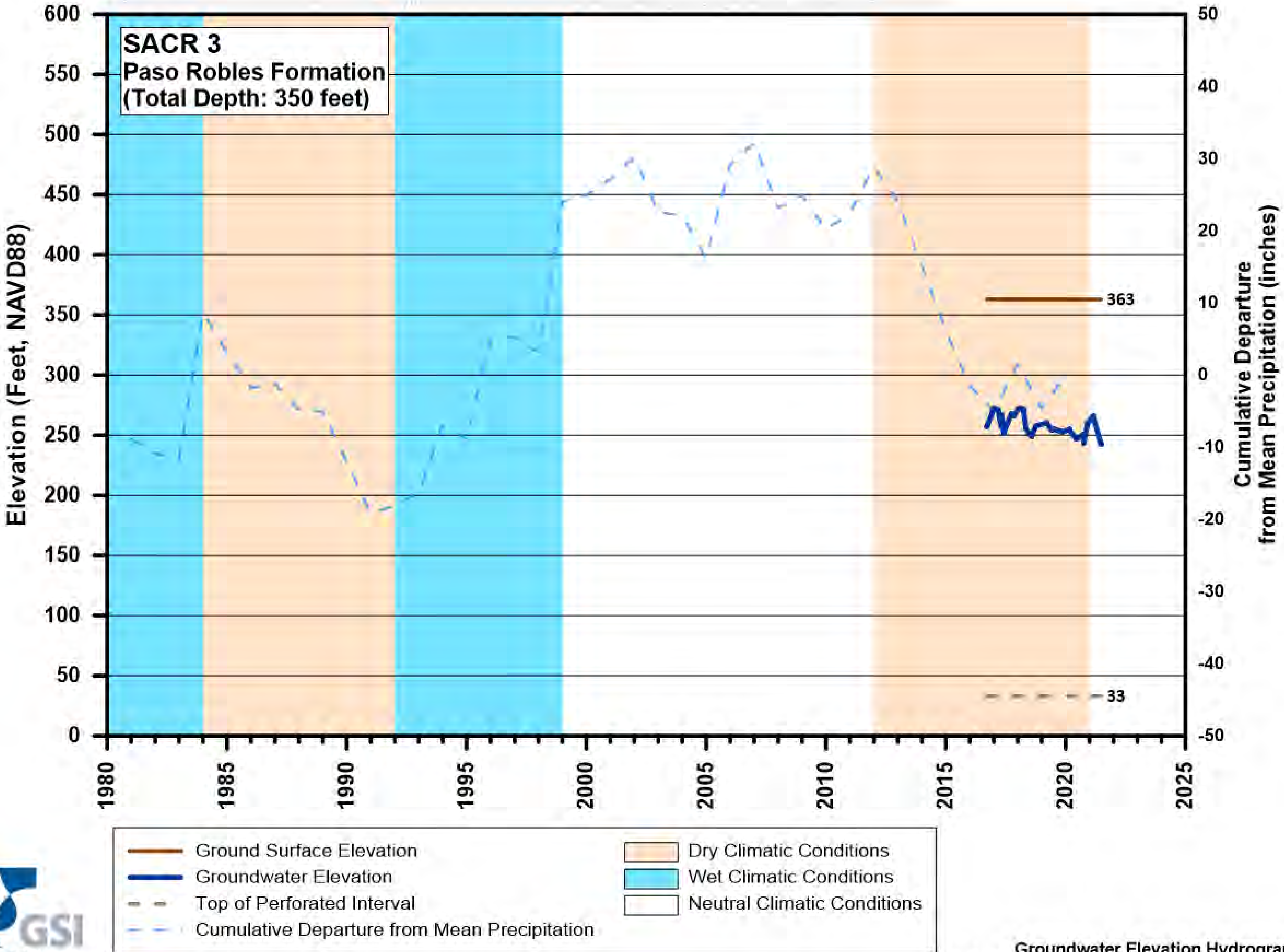


Depth
1in:75ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Gamma Ray
0 CPS 200
Gamma Ray Image
RSN
0 OHM-M100
RLN
0 OHM-M100
Conductivity
0 MMHO/M 200
SP
-100 MV 0
Temperature
84 Deg F 86
Delta T
100 USEC/FT 300
Well Construction
10 10
Summary Lithology
-0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Clayey silty sand w/ minor gravel
Sand & gravel w/ minor silt & clay
Clayey silt
Sandy gravel
Sand
Sand w/ wood & peat
Sand w/ clay & silt
Sand w/ silt & minor clay
Clay
Silt
Sand
Clay
Sand
Sandy clay
Sand w/ wood, peat & minor charcoal
Clay (white)
Sand
Sandy silt
Sand w/ peat & shell fragments
Sandy gravel



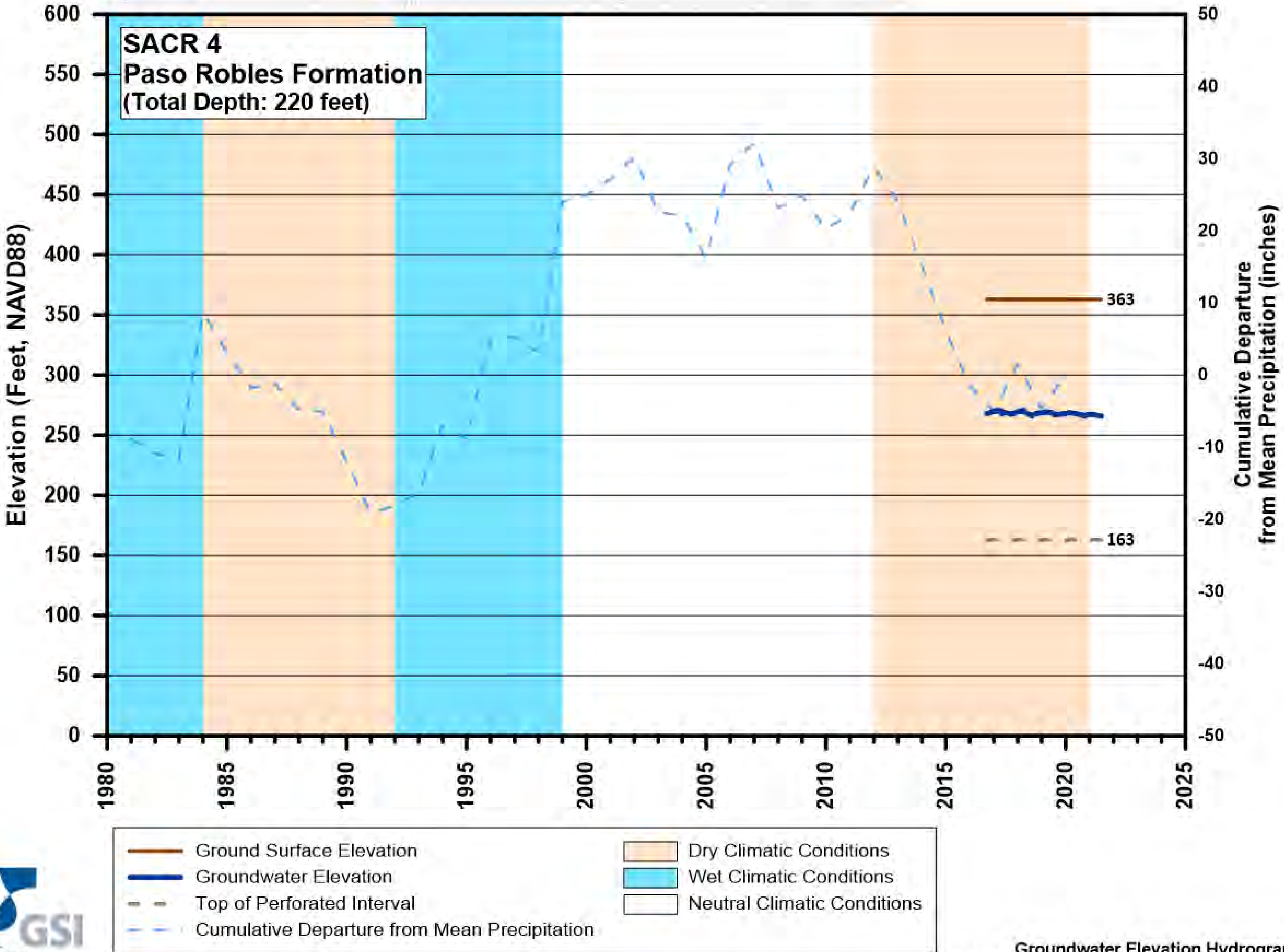
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



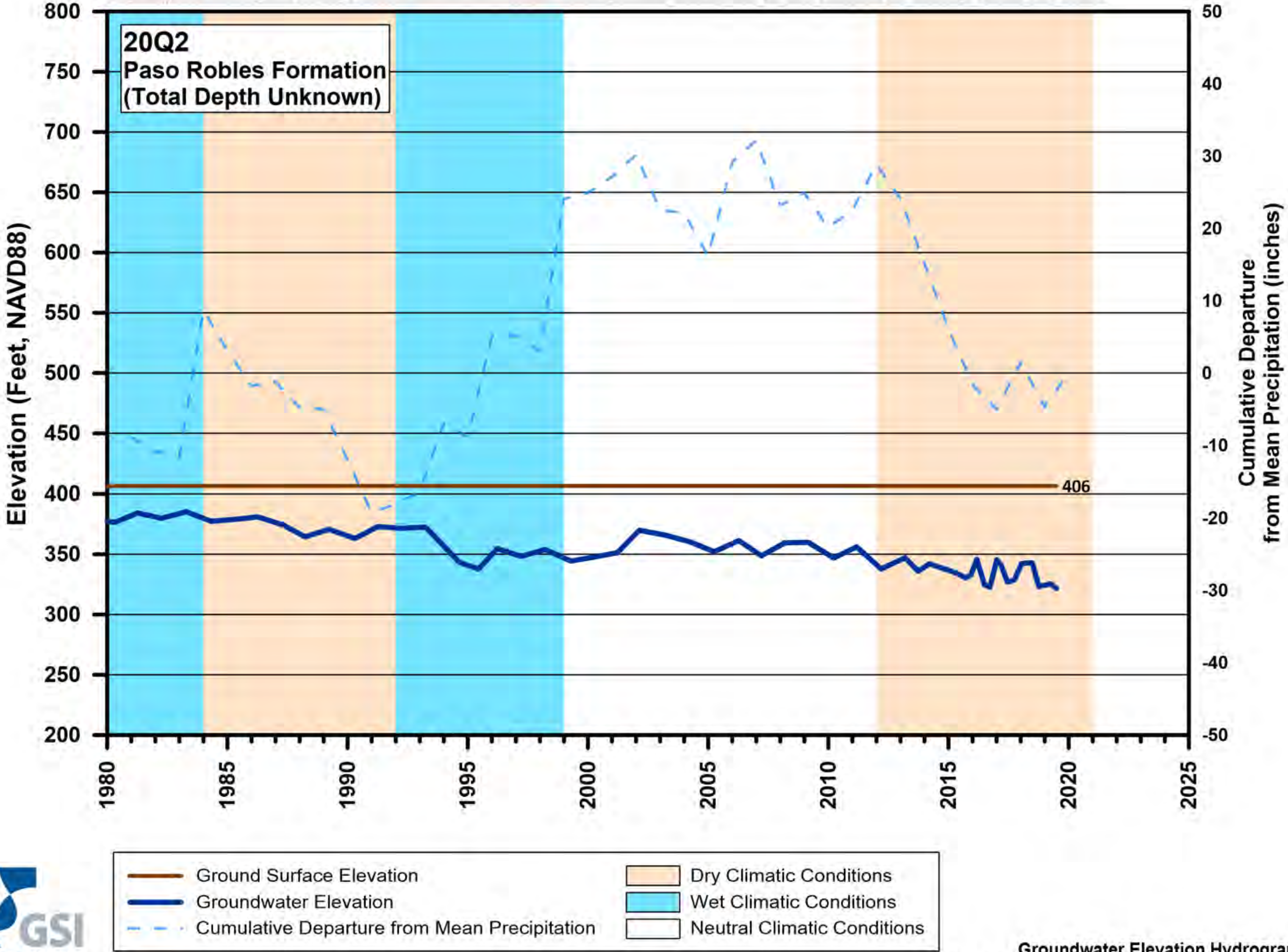
GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

APPENDIX D-7

Calculations for Surface and Groundwater Discharge in Barka Slough

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Surface and Groundwater Discharge to Barka Slough in Acre-Feet per Year (AFY)

Water Type	Discharge Type	Discharge Volume (AFY)
Surface Water	Streamflow	1,006
Groundwater	Alluvium	1,877
Groundwater	Vertical Flux	221
Total		**3,104**

Notes:

AFY: Acre feet per year

Average annual surface water discharge volume was calculated using reported flow rate measurements for calendar years 2017 and 2018 from the United States Geological Survey (USGS) surface water gage 11136040 located east of the Barka Slough.

Groundwater baseflow discharge volume was calculated using the following:
- A transmissivity value of 1,600 square-feet per day;
- An aquifer thickness of 50 feet (Hutchinson, 1980);
- A hydraulic gradient of 0.04. The hydraulic gradient was calculated using the average San Antonio Creek bed gradient from the Barka Slough to 1/2-mile east of the Barka Slough; and,
- A cross-sectional area of 175,000 square-feet. The cross-sectional area was calculated by measuring the north-south lateral extent of the Barka Slough, multiplied by an aquifer thickness of 50 feet (Hutchinson, 1980).

Groundwater vertical flux was calculated using the following:
- A hydraulic conductivity of 0.045 feet per day (Martin, 1985);
- A hydraulic gradient of 0.02. The hydraulic gradient was calculated using total well depth elevation and groundwater elevation of nested groundwater wells 16C2 and 16C4 screened in the Careaga Formation Aquifer; and,
- A Barka Slough cross-sectional area of 660 acres (Martin, 1985).

References:

Muir, K. S., (1964). *Geology and Ground Water of San Antonio Creek Valley, Santa Barbara County, California.*

Hutchinson, C. B., (1980). *Appraisal of Ground-Water Resources in the San Antonio Creek Valley, Santa Barbara County, California* , August.

Martin, P., (1985). *Development and Calibration of a Two-Dimensional Digital Model for the Analysis of the Ground-Water Flow System in the San Antonio Creek Valley, Santa Barbara County, California* , August.

Driscoll, F. G., (1986). *Groundwater and Wells, Second Edition, A comprehensive study of groundwater and the technologies used to locate, extract, treat, and protect this resource* .

Baseflow Discharge to Barka Slough in Acre-Feet per Year (AFY)

Water Type	Discharge Type	Hydraulic Conductivity (feet per day)	Hydraulic Gradient	Area (square feet)	Discharge Volume (AFY)
Groundwater	Alluvium	32	0.04	175,000	1,877

Notes:

AFY: Acre feet per year
Groundwater baseflow discharge volume was calculated using the following:
- A transmissivity value of 1,600 square-feet per day;
- An aquifer thickness of 50 feet (Hutchinson, 1980);
- A hydraulic gradient of 0.04. The hydraulic gradient was calculated using the average San Antonio Creek bed gradient from the Barka Slough to 1/2-mile east of the Barka Slough;
- A cross-sectional area of 175,000 square-feet. The cross-sectional area was calculated by measuring the north-south lateral extent of the Barka Slough, multiplied by an aquifer thickness of 50 feet (Hutchinson, 1980);
- A conversion factor of 365 days = 1 year; and,
- A conversion factor of 43,560 cubic feet = 1 acre-foot.

References:

Hutchinson, C. B., (1980). *Appraisal of Ground-Water Resources in the San Antonio Creek Valley, Santa Barbara County, California* , August.

Transmissivity Calculation from Alluvial Pumping Data

Well Location(s)	Formation	Specific Yield (gallons per minute per foot)[1]	Transmissivity (square feet per day)
Between Los Alamos and Harris Canyon	Alluvium	8	1,604

Notes:

[1] - Value for specific yield for wells completed in the alluvium of Santa Antonio Creek Valley between the town of Los Alamos and Harris Canyon (Muir, 1964).

Transmissivity was calculated using the modified Cooper-Jacob Equation (Driscoll, 1986):
T = [(Q/s) x 1,500] / 7.48;
T = Transmissivity (square-feet per day);
Q/s = Specific Yield (gallons per minute per foot);
1,500 = Constant for Unconfined Aquifers; and,
7.48 = Constant to covert from gallons per day per foot to square-feet per day.

References:

Muir, K. S., (1964). Geology and Ground Water of San Antonio Creek Valley, Santa Barbara County, California.
Driscoll, F. G., (1986). *Groundwater and Wells, Second Edition, A comprehensive study of groundwater and the technologies used to locate, extract, treat, and protect this resource.*

Vertical Flux Groundwater Discharge to Barka Slough in Acre-Feet per Year (AFY)

Water Type	Discharge Type	Hydraulic Conductivity (feet per day)	Hydraulic Gradient	Area (square feet)	Discharge Volume (AFY)
Groundwater	Vertical Flux	0.045	0.02	28,749,600	221
Groundwater	Vertical Flux	0.054	0.02	28,749,600	265

Notes:

AFY: Acre feet per year

Groundwater vertical flux was calculated using the following:

- A hydraulic conductivity of 0.045 and 0.054 feet per day (Martin, 1985);
- A hydraulic gradient of 0.02. The hydraulic gradient was calculated using total well depth elevation and groundwater elevation of nested groundwater wells 16C2 and 16C4 screened in the Careaga Formation Aquifer;
- A Barka Slough cross-sectional area of 660 acres (Martin, 1985);
- A conversion factor of 365 days = 1 year;
- A conversion factor of 43,560 square feet = 1 acre; and

References:

Martin, P., (1985). *Development and Calibration of a Two-Dimensional Digital Model for the Analysis of the Ground-Water Flow System in the San Antonio Creek Valley, Santa Barbara County, California* , August.

Hydraulic Gradient Calculation from Nested Wells 16C2 and 16C4

Well	Surface Elevation (feet msl)	Bottom of Well (feet bgs)	Groundwater Elevation (feet msl)	Hydraulic Gradient
16C2	328.59	169	256.97	0.02
16C4	328.59	560	264.93	

Notes:

bgs: below ground surface

msl: above mean seal level

Groundwater elevations were measured on October 2, 2018.

The vertical flux of groundwater leaking into the Barka Slough was calcuated at 0.018 feet per day in 1985 (Martin, 1985).

APPENDIX E

Water Budget Documentation

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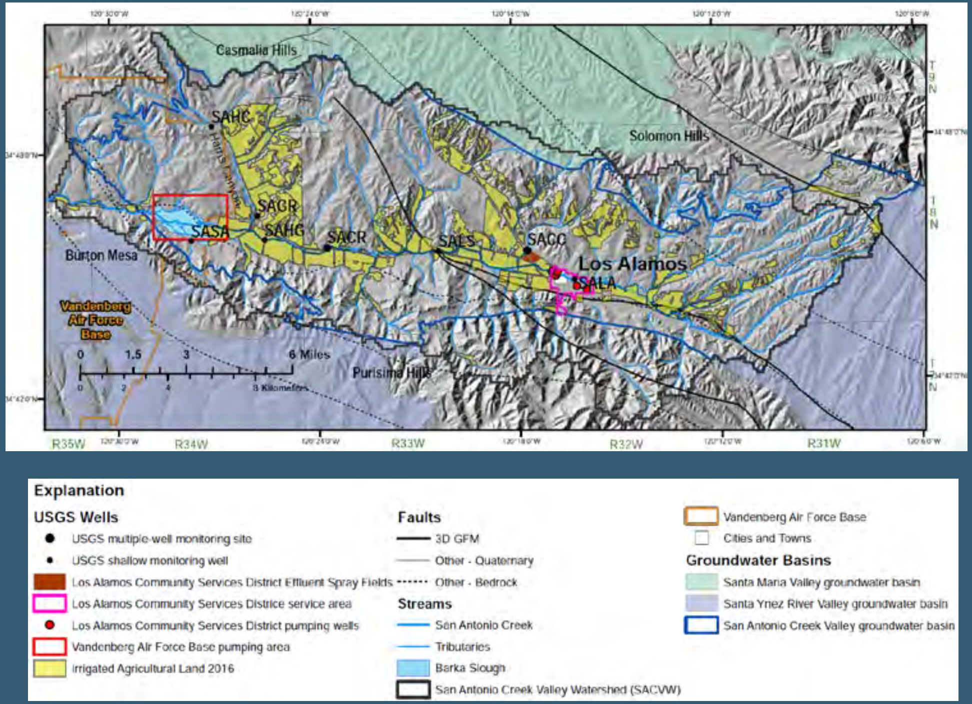
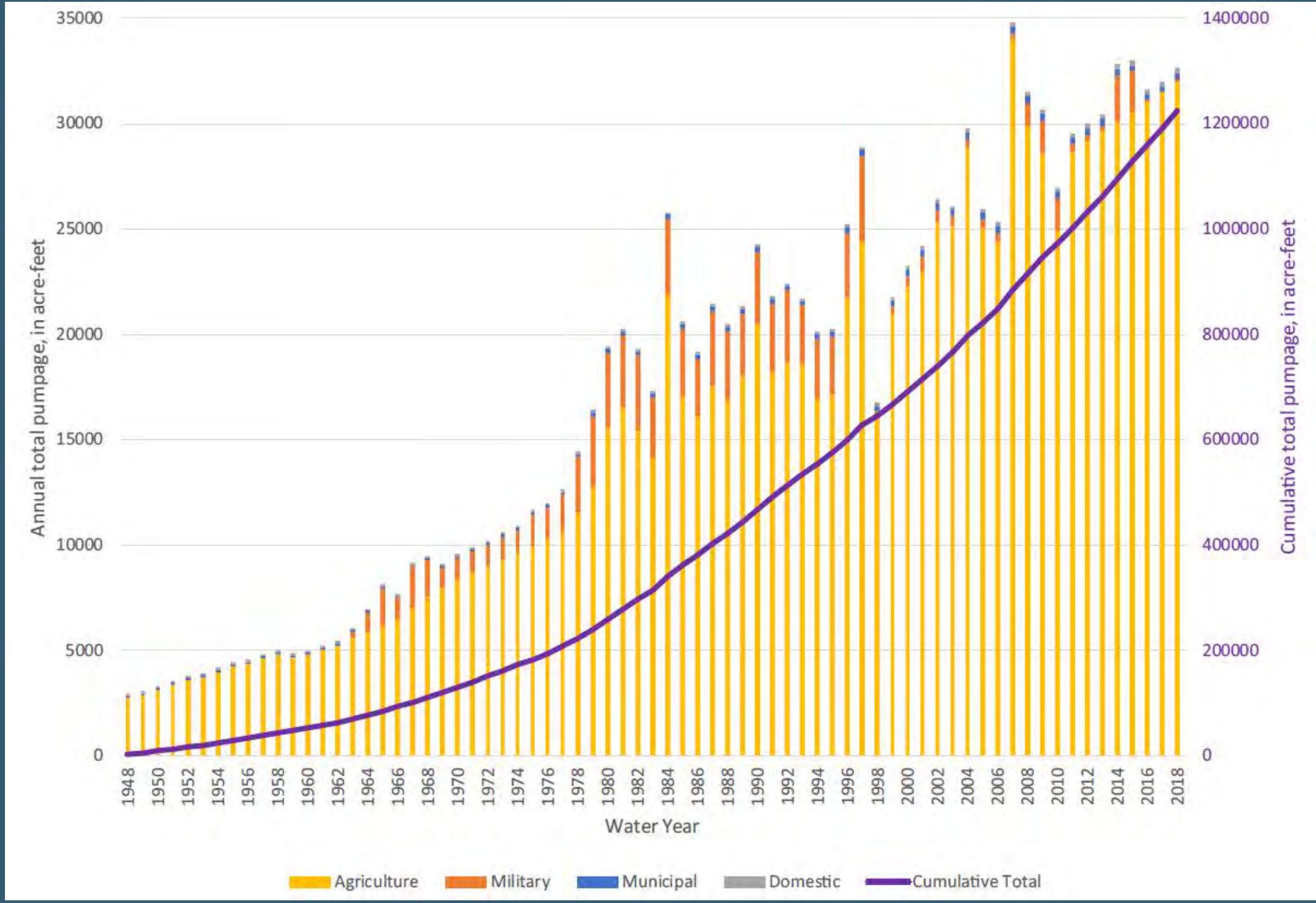
Estimates of Groundwater Discharge



Estimated annual and cumulative pumpage



- Reported pumping from:
  - Muir (1964), Hutchinson (1980), Martin (1985), TetraTech Inc. (2012)
  - Vandenberg Air Force Base, Los Alamos Community Services District

Preliminary, subject to revision

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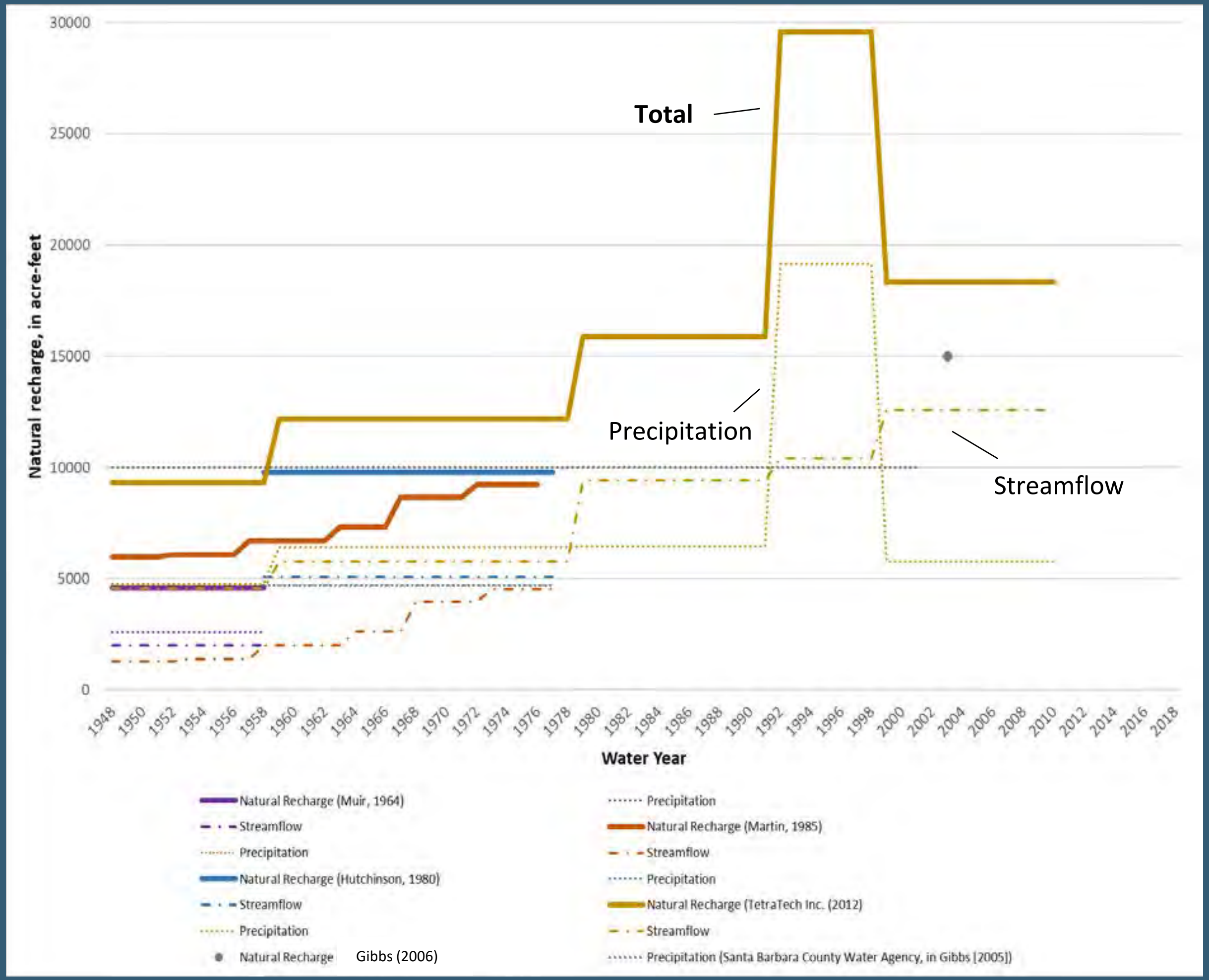
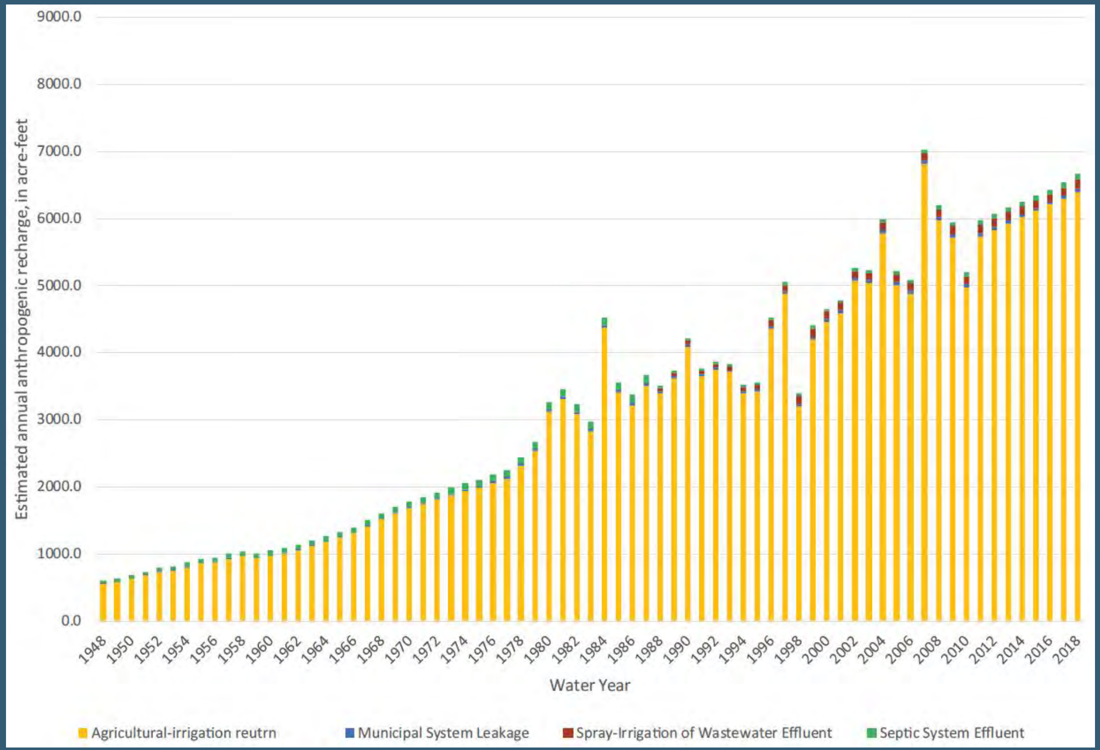
Estimates of Groundwater Recharge

Natural



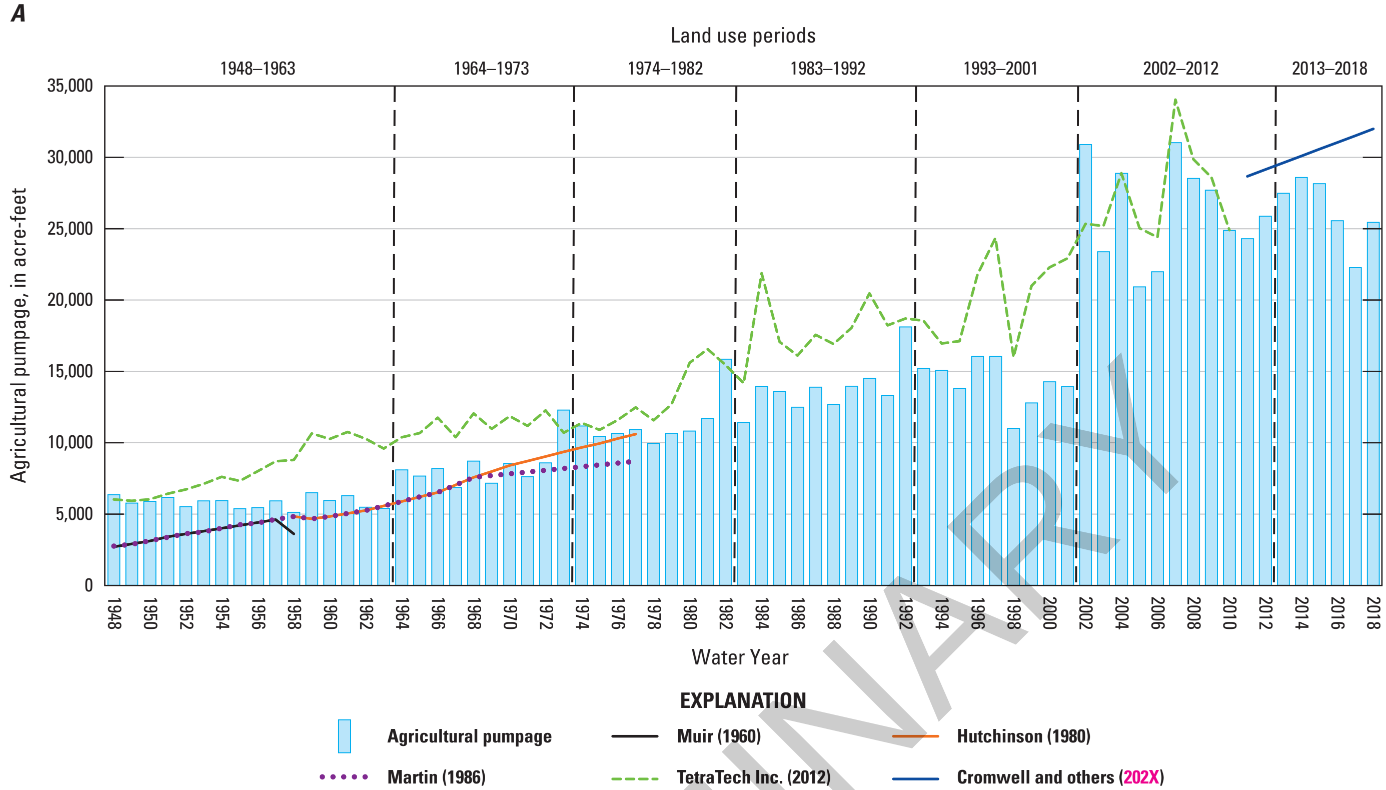
Anthropogenic



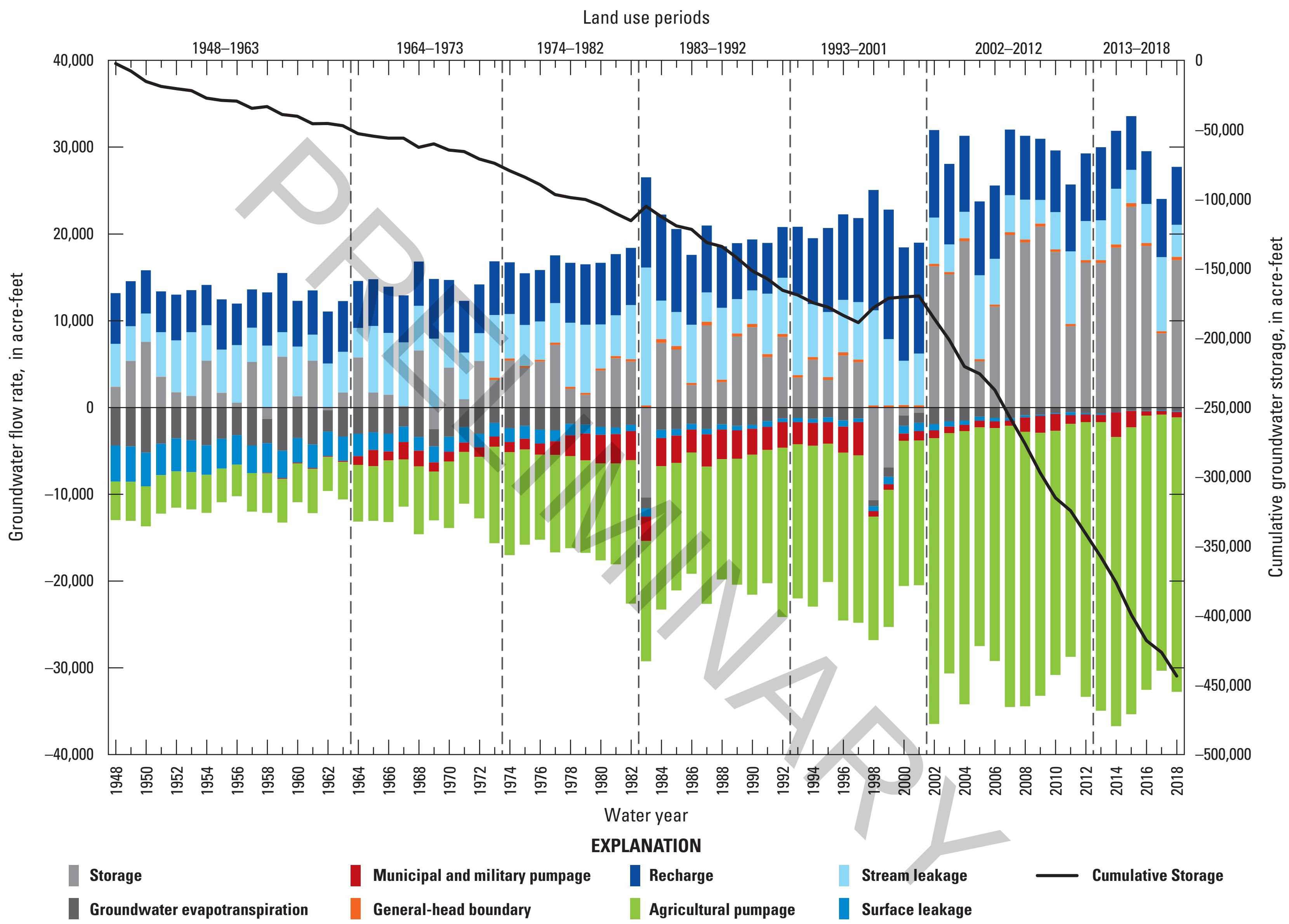
Preliminary, subject to revision

USGS science for a changing world

A



sac21-0754_fig27



sac21-0754_fig 28

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www.lynker.com

Technical Memorandum

To:	Jeff Barry, Principal Hydrogeologist
Company:	GSI Water Solutions
Subject:	Application of Basin Characterization Model Data to Water Budget Modeling for San Antonio Creek Basin
CC:	Michael McAlpin, GSI Water Solutions
From:	Jim McCord, PhD, PE (Principal Hydrogeologist)
Date:	09 August 2021

Contents

1 INTRODUCTION

IRP Water Resources Consulting (IRP Water) has been contracted by GSI Water Solutions (GSI) to provide technical support and senior review of the development and application of a spreadsheet water budget tool developed for the San Antonio Creek Valley Groundwater Basin (Basin) Groundwater Sustainability Plan. As part of that scope, IRP Water worked with GSI to acquire, compile, and process modeling data from the United State Geological Survey's (USGS) Basin Characterization Model (BCM) that was used for key components of the water budget, specifically precipitation, areal precipitation recharge, mountain-front recharge, evapotranspiration, and surface runoff.

2 BCM DATASETS USED IN WATER BUDGET MODEL

One of the most important inflows to the groundwater system occurs due to deep percolation of precipitation. When precipitation falls on the ground surface, part of that water will infiltrate into the soils and part will runoff the surface when the near-surface soils become saturated and/or when the rainfall intensity exceeds the soil's infiltration capacity. Infiltrated water within the plant root zone can subsequently be removed from the soil profile by plant uptake and evapotranspiration as described above. Once the infiltrated water percolates to depths beyond the rooting zone, it will become groundwater recharge, eventually accreting to the uppermost groundwater table it encounters.

Various techniques are available to estimate recharge, including:

- environmental tracer profiles in the vadose zone,
- environmental tracer concentrations in groundwater,
- streamflow analysis (hydrograph separation and recession-curve displacement) methods for estimating baseflow and groundwater recharge, and
- numerical model calibration parameter.

Scanlon et al. (2002) provide a summary and comparative evaluation of a range of methods to estimate recharge, including those listed above, citing the advantages and disadvantages of each. Results from recent studies show that distributed parameter hydrological modeling can provide better recharge estimates (LBG-Guyton, 2005; Dietsch and Wehmeyer, 2012; Ehtiat and others 2016) than some of the competing.

2.1 BCM Background

The USGS's BCM (Flint et al., 2021) is a recently developed distributed parameter hydrologic model. In concept, the BCM computes a hydrologic water balance on a raster map over the landscape, with a hydrologic water balance computed for each raster as shown in **Figure 1**, with the inflows of precipitation, and outflows of evapotranspiration, recharge (deep percolation to groundwater), and runoff.

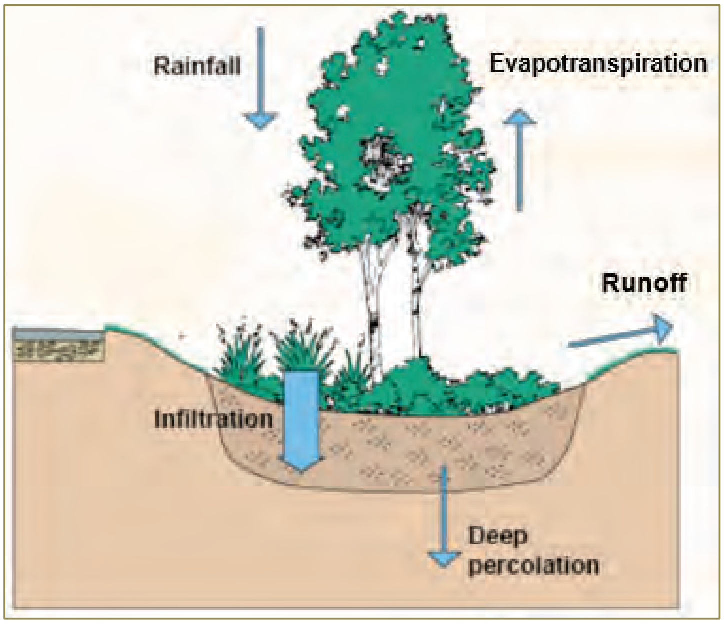


Figure 1. Simplified schematic diagram of parcel water balance conducted in BCM distributed parameter model.

It is a distributed parameter model in the sense that for each 270 meter (m) x 270 m raster of the landscape:

- The input of rainfall and evapotranspiration are obtained from processing of re-gridded Parameter-elevation Regressions on Independent Slopes Model (PRISM) climate data.

- Similarly, the land response (runoff, infiltration, and deep percolation) for each parcel is computed using spatially distributed physical parameters relevant to simulation of those hydrologic processes, such as soil permeability, runoff, and storage characteristics parameter available as part of the SSURGO[1] dataset.

The BCM has been applied across the entire state of California on a grid of 270 m x 270 m (886 feet [ft] x 886 ft, approximately 16-acre) land parcels on monthly time steps for the period from 1951 to 2019. For the Basin's water budget modeling tool, the BCM model results[2] were downloaded for the historical period of record and were utilized for a variety of inputs, specifically: Precipitation, Areal Recharge, Mountain-Front Recharge, Evapotranspiration, and Surface Runoff.

2.2 Clip to Area of Interest

The downloaded data covers the entire state of California. The dataset was clipped to an area of interest (AOI extending from the headwaters of the Santa Ynez River on the east to

[1] Soil Survey Geographic Database (SSURGO) developed by USDA Natural Resources Conservation Service and available online

[2] Flint, L.E., Flint, A.L., and Stern, M.A., 2021, The Basin Characterization Model - A regional water balance software package (BCMv8) data release and model archive for hydrologic California, water years 1896-2020, U.S. Geological Survey data release, https://doi.org/10.5066/P9PT36UI

Vandenberg Space Force Base on the west, and from the southern Santa Maria Valley and Sisquoc River headwaters on the north down to the southern slopes of the Santa Ynez Mountains on the south. This larger area encompasses both the Basin and Santa Ynez River Groundwater Basin. This area was selected since GSI has been developing GSPs for both the Basin's Groundwater Sustainability Agency (GSA) and the Santa Ynez River Basin Eastern Management Area (EMA) GSA, and clipping the data to this area allowed GSI efficiently process all the data for both study areas in one pass.

2.3 Comparison and Correction to Local Weather Stations

For the AOI, the monthly BCM precipitation data was compared to monthly total precipitation for all weather stations located across the region. The overall annual values and long-term values were quite close, with the BCM annual total exhibiting an approximate 2% overestimation bias compared to the weather station data. Discrete monthly values at the individual station locations, however, could exhibit larger errors. We employed a simple conditional simulation approach to correct for the monthly errors (Sidler, 2003; Wang and Zhang, 2008). For each weather station *i* located at (x_i, y_i) for each monthly time *t* , we define the monthly precipitation error P_{error} for that station as:

$$P_{error}(x_i, y_i, t) = P_{BCM}(x_i, y_i, t) - P_{station,i}(t) \qquad (1)$$

Then, for each timestep the precipitation error point values $P_{error,i}\ (t)$ are interpolated onto the BCM grid over the AOI to yield a continuous field of $P_{error}\ (x,y,t)$. That continuous precipitation error field is then subtracted from the original BCM data, finally yielding a continuous smoothly varying precipitation field adjusted to exactly match recorded precipitation at each weather station location (*x,y*) data each month *t*, $P_{corr}(x,y,t)$.

Figure 2 illustrates how this procedure is applied to the AOI around the Basin and the EMA for the month of January 1981. The top image shows the raw BCM precipitation data for the AOI. The middle image shows the gridded precipitation error for that month, where one can see that both the Solvang and San Marcos Pass precipitation gages recorded considerably more precipitation than the raw BCM data at those locations. The bottom image shows the "corrected" BCM precipitation, where one can see that the corrected precipitation pattern looks similar to the raw BCM field, but with higher precipitation in the areas about the two stations with large errors for that month.

2.4 Adjusting Recharge and Runoff by the Corrected Precipitation

Note that the BCM precipitation was not used directly in the model, rather the BCM recharge and runoff from the BCM dataset were used in the Basin's water budget tool. To account for the adjustments to the BCM precipitation data, the raw BCM recharge and runoff were adjusted by scaling it by the precipitation ratio P_{corr} / P_{BCM}. For example, for the adjusted recharge for each parcel located at *x,y* for time *t* would be computed as :

$$RCH_{adjusted}(x, y, t) = RCH_{BCM}(x, y, t) * \frac{P_{corr}(x,y,t)}{P_{BCM}(x,y,t)} \qquad (2)$$

Figure 3 shows how the recharge can significantly vary over space and time, showing the both the raw and adjusted BCM rechange for the months of January, February, and March

1981 for the large AOI including the Basin and the EMA. The same precipitation-scaling approach is used to adjust the runoff, and is illustrated in **Figure 4.**

Figure 2. Illustration of approach to adjust gridded precipitation to match values at weather stations located in region

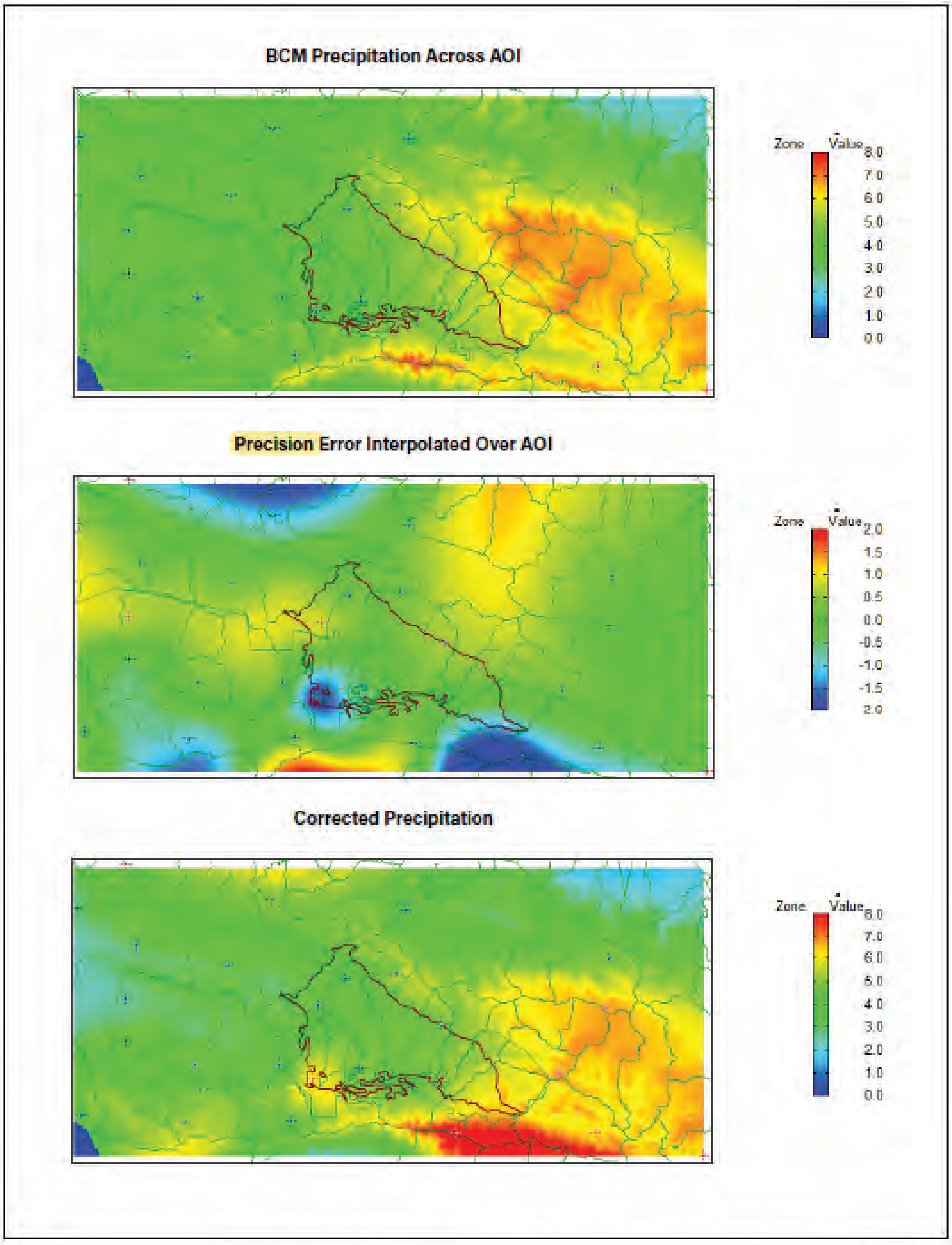


FIGURE 3-4
Illustration of BCM Precipitation Variability Over Time
Groundwater Sustainability Plan
Eastern Management Area

GSI

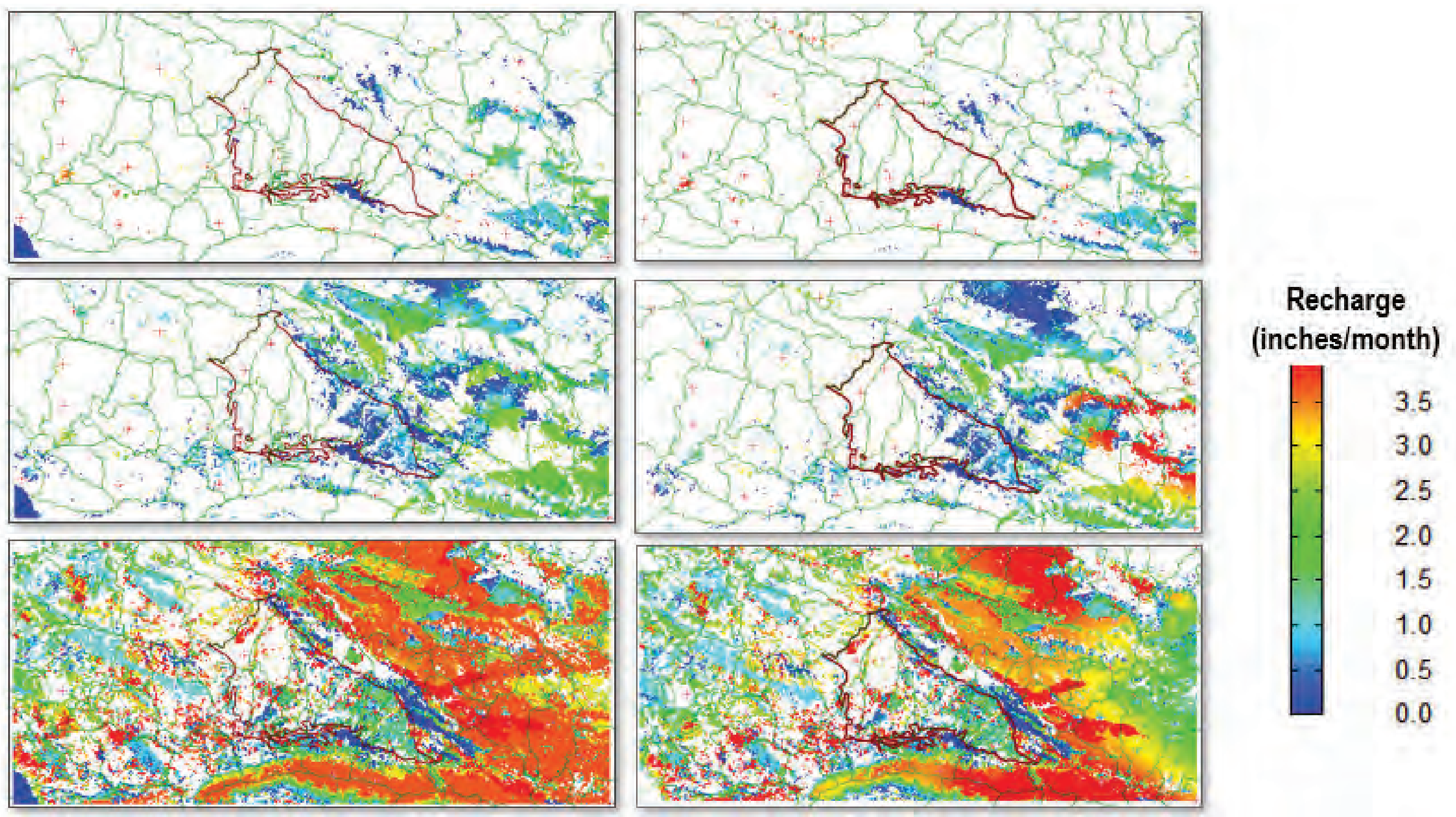


Figure 3. Illustration of temporal and spatial variability in BCM gridded recharge, for the months of January, February, and March 1981. Raw BCM data on left and adjusted based on precipitation correction on the right.

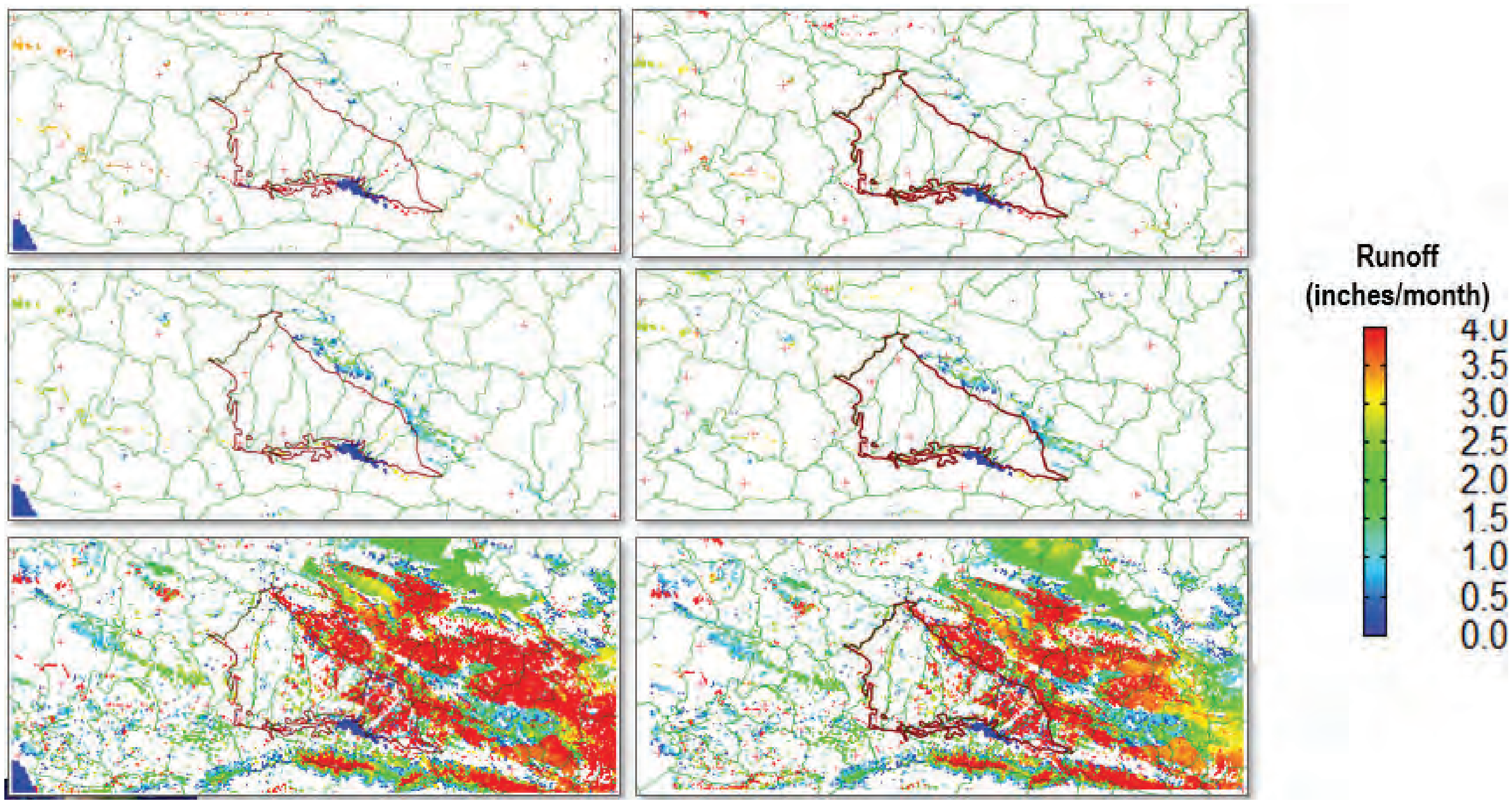


Figure 4. Illustration of temporal and spatial variability in BCM gridded runoff, for the months of January, February, and March 1981. Raw BCM data on left and adjusted based on precipitation correction on the right.

3 STREAMBED PERCOLATION OF RUNOFF AND REJECTED RECHARGE

The distinct hydrology and hydrogeology of the Basin dictates that two additional hydrologic processes should be considered when applying the BCM data to the project water budget. Those processes are the infiltration of runoff into the sediments below the stream channel and the rejected recharge, and each is addressed in separate subsections below. After considering these various hydrologic processes, a practical and mass-conservative procedure is developed to adjust and calibrate the BCM runoff and recharge based on comparisons to independent estimates of streambed percolation and surface flows into Barka Slough.

3.1 BCM Runoff and Streambed Percolation

When reviewing the BCM runoff data and comparing it to gaged and estimated surface water inflows into Barka Slough, it is notable that the total BCM runoff is much larger than the surface water inflows into Barka Slough.

Specifically highlighted in the BCM technical report (Flint et al., 2021) is that the runoff (and recharge) calculated by the BCM should be considered as “unimpaired.” This means they do not account for what happens to the runoff that is generated on each parcel along its flow path: (i) from that parcel to the nearest stream channel, and (ii) along the stream channel to its outflow point at a gauged location.

3.1.1 Surface Runoff to Nearest Stream Channel

Figure 5 addresses the first leg of the flow path of a molecule of runoff water, from the point where runoff is generated at the ground surface to the point that it enters the nearest stream channel. One can see that the runoff generated at one location may infiltrate at another location downslope where it crosses an area with more permeable surface soils. Or it may accumulate in a local small swale and infiltrate at that point. Water infiltrated as such would collect with the water infiltrated in the parcel itself. That combined flow can continue to percolate downward to become enhanced groundwater recharge in some areas, while in other areas it may hit a lower permeability layer and at that point flow laterally to daylight again as interflow discharging to shallow surface water downslope.

3.1.2 Stream Channel Percolation

San Antonio Creek is classified as an intermittent stream along nearly its entire length until it arrives to Barka Slough, which is located at the downstream end of the Basin. This means that the stream channel is typically dry most of the year, only conveying surface flows during a wet winter season. In the period that GSI has been working on this GSP project, flow has rarely been observed in San Antonio Creek. This also means that when the creek is flowing, water is likely infiltrating into the streambed sediments and recharging the aquifer, a condition known as a “losing stream,” as illustrated in **Figure 6**.

3.1.3 Adjustment to BCM Runoff

Based on this discussion, and the fact that Barka Slough receives surface inflows only during the wet season, it is clear that some large fraction of the runoff generated locally (and calculated in the BCM model) actually never makes it to Barka Slough. This “surface water

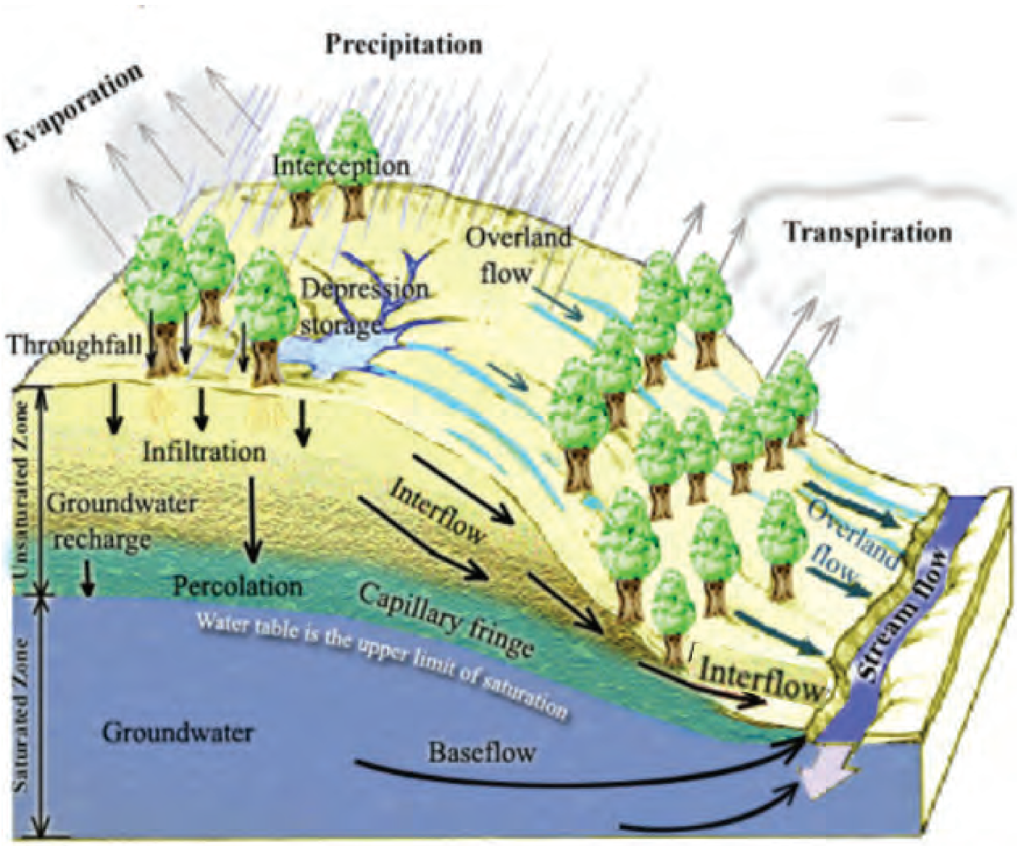


Figure 5. Hillslope hydrologic processes, showing overland flow (runoff), and infiltration and recharge, interflow, groundwater flow, and the interactions between these processes

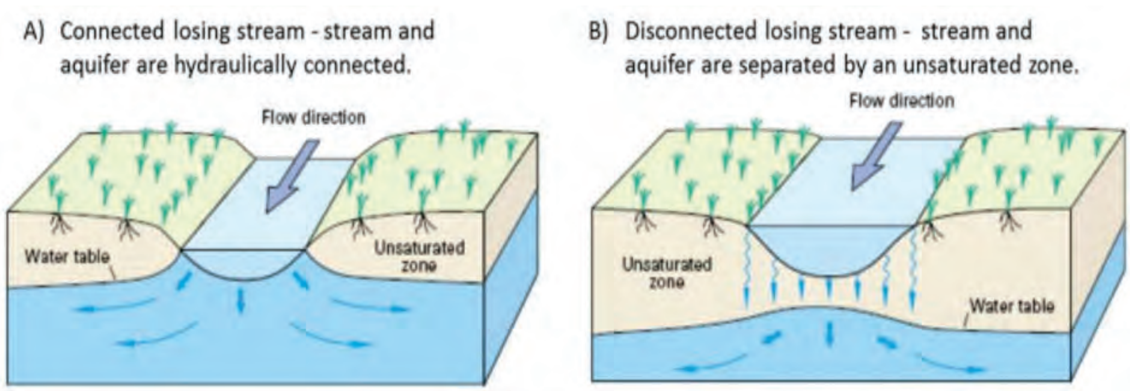


Figure 6. Generalized surface water - groundwater interactions between an unconfined aquifer and a losing stream (adapted from Alley et al., 1999)

What is Rejected Recharge

loss" instead infiltrates at some point along its flow path to the basin outlet, and thus contributes to groundwater recharge. Flint et al. (2021) address this type of behavior in *Figure 18* and associated text of their report, and they offer a suggested approach to determine these runoff losses via comparison to stream gage data. Given the limitations of the streamflow data available for the study area, surface flow into Barka Slough needed to be estimated from Casmalia gage flows adjusted to account for gains and losses between the slough and the gage (see section 3.3.3.1.2). With this estimated surface water inflow to the slough as a calibration target, a simple mass conservative method was developed to adjust the BCM runoff values.

The BCM runoff adjustment procedure is based on the concept that in drier years essentially all of the locally generated runoff infiltrates and recharges the groundwater system before it can reach the slough, while in very wet years most of the runoff eventually arrives to the slough as surface water inflow. And between these two limiting conditions, the fraction of runoff that arrives to the slough and the balance to recharge varies. We can thus define the recharge due to streambed percolation RCH_{SB} as:

$$RCH_{SB} = RUNOFF_{BCM} * FACTOR_{RCH} \tag{3}$$

To simulate this behavior, we first developed the probability exceedance curve of annual BCM Runoff, shown as the red curve in **Figure 7**. Based on anecdotal information, we assumed that in 50% of the years, no sufficient runoff was generated to result in surface flows into Barka Slough. Thus, all runoff for those years with annual discharge less than the 50% exceedance value was calculated to recharge the groundwater system as streambed percolation, and $FACTOR_{RCH}$ = 1. For wetter years beyond that point, $FACTOR_{RCH}$ was calculated to drop off at a steady rate, as shown by the blue symbols in **Figure 7**. Using this procedure, one can calculate the fraction of BCM runoff that results in streambed percolation recharge and the remaining fraction that results as surface flows into Barka Slough.

As described previously, this adjustment procedure was applied in a mass-conservative way for the water balance. This was accomplished in the surface budget by counting all BCM runoff as surface water inflow, and the streambed percolation was counted as surface water outflow to groundwater, and the balance was computed as surface water outflow to Barka Slough. The rate of drop of the recharge factor in **Figure 7** was adjusted so that the surface water inflow to Barka Slough computed by this method closely matched an independent estimate of surface water inflow to Barka Slough.

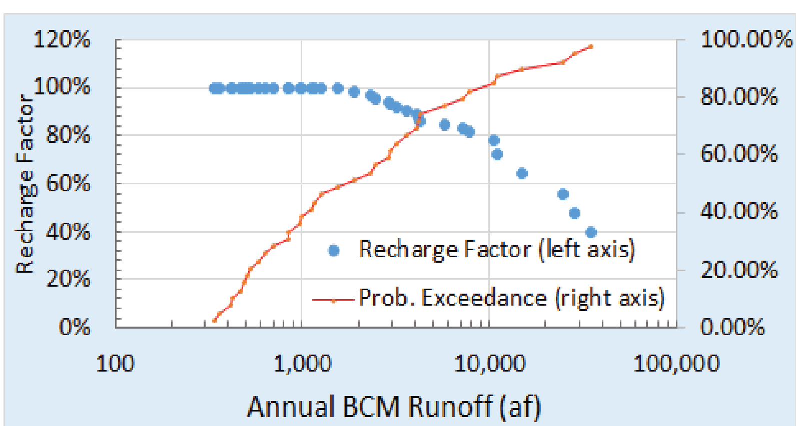


Figure 7. Estimating streambed percolation recharge from BCM runoff data for San Antonio Creek Basin.

3.2 BCM Recharge and Rejected Recharge

Similar to the concept that not all runoff generated in a parcel by BCM remains surface water along a flow path, not all recharge computed by BCM remains as groundwater along its flow path to the Basin discharge point. This is also illustrated in **Figure 5**, for example where subsurface interflow idaylights at the ground surface as a seep or spring near a stream channel, and where runoff collected in a depression storage may prevent BCM calculated recharge to infiltrate at that location. (This concept is also illustrated in Figure 8 of Flint et al., 2021.)

From the perspective of the groundwater budget, collectively these can be referred to as “rejected recharge.” The concept of rejected recharge was introduced by Theis (1940). When applying the BCM recharge to a Basin water budget, the rejected recharge can be treated in a similar fashion as the recharged runoff described above. In this case, it is assumed rejected recharge occurs only in the wetter years. Given the relative absence of surface water in the Basin, it was assumed that rejected recharge was negligible in this Basin. In the nearby EMA, however, the more frequent surface flows occurring in the major ephemeral and intermittent tributaries indicates rejected recharge can play an important role in the hydrologic system in very wet years. **Figure 8** shows the BCM recharge factor curve developed and employed to compute rejected recharge for the water balance in that study area.

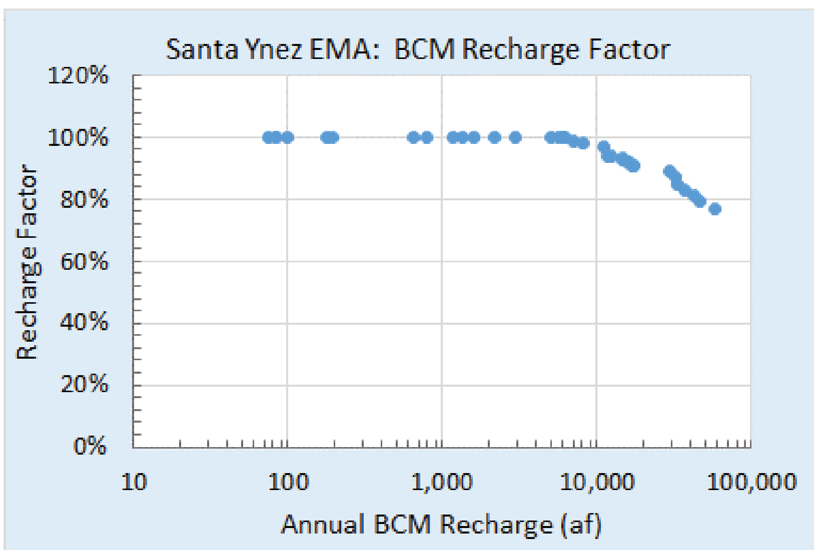


Figure 2. Estimating recharge and rejected recharge from BCM recharge data for Santa Ynez Basin Eastern Management Area.

4 SUMMARY

The BCM is a recently developed distributed parameter hydrologic model, which computes a hydrologic water balance on a raster map over the landscape, with a hydrologic water balance computed for each cell. For the Basin water budget modeling tool, the BCM model results were downloaded for the historical period of record and were utilized for a variety of inputs, specifically: Precipitation, Areal Recharge, Mountain-Front Recharge, Evapotranspiration, and Surface Runoff.

The BCM precipitation data was compared to local weather stations data for the area of interest, and it was corrected to exactly match the monthly weather station rainfall values using a conditional simulation procedure. The runoff, recharge, and streamflow data were subsequently adjusted by scaling each monthly value by the ratio of the corrected precipitation divided by the original BCM precipitation. Consistent with recommendations by Flint et al. (2021; pp. 31 – 33) for "calibrating" raw BCM output to better match gaged surface flows, a procedure was developed for computing streambed percolation recharge from the BCM runoff data, and computed rejected recharge from raw BCM recharge data. This procedure was mass conservative in the sense that all BCM inflow volumes (both runoff and recharge) are accounted for the surface water and groundwater budgets.

5 REFERENCES

Alley, W.M., T.E Reilly, and O.L. Franke, 1999. Sustainability of ground-water resources, US Geological Survey Circular 1186.

Dietsch, B.J., and Wehmeyer, L.L., 2012, Simulation of streamflow, evapotranspiration, and groundwater recharge in the middle Nueces River watershed, south Texas, 1961–2008: U.S. Geological Survey Scientific Investigations Report 2012–5136, 37 p

Ehtiat, M., S. Jamshid Mousavi, Saeed A. Vaghefi & Abbas Ghaheri (2016) Analysis of recharge conceptualization in inverse groundwater modeling, Hydrological Sciences Journal, 61:15, 2789-280

Flint, L.E., Flint, A.L., and Stern, M.A., 2021, The basin characterization model—A regional water balance software package: U.S. Geological Survey Techniques and Methods 6–H1, 85 p., https://doi.org/ 10.3133/ tm6H1.

LBG-Guyton Associates and Aqua Terra Consultants. 2005. HSPF recharge models for the San Antonio Segment of the Balcones Fault Zone Edwards Aquifer. Prepared for the Edwards Aquifer Authority

Sidler, R., 2003. Kriging and Conditional Geostatistical Simulation Based on Scale-Invariant Covariance Models, Institute Of Geophysics Department Of Earth Science, Swiss Federal Institute of Technology, Zurich, 84 pp.

Wang, X., and Z.P. Zhang, 1999. A comparison of conditional simulation, kriging and trend surface analysis for soil heavy metal pollution pattern analysis, Journal of Environmental Science and Health, Part A, 34:1, 73-89, DOI: 10.1080/10934529909376824

San Antonio Creek Valley Groundwater Basin Water Budget

Values in acre-feet

= Component of Inflow (blue)

= Component of Outflow (orange)

Water Budget	Water Year	Rainfall: Inches	Rainfall: % of Average	Components of Inflow: Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows	Total Inflow	Components of Outflow: Groundwater Pumping: LACSD Pumping	VAFB Pumping	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping	Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow	Total Outflow	Change in Storage	Cumulative Change in Storage
Historical Water Budget	1981	13.3	86%	0	1,400	2,300	4,900	0	10	2,100	1	10,700	170	3,270	10,300	100	13,800	6,600	3,000	0	23,400	-12,700	-12,700
	1982	14.4	94%	0	1,600	1,600	4,600	0	10	2,100	1	9,900	170	3,430	10,700	100	14,400	6,400	1,500	0	22,300	-12,400	-25,100
	1983	35.7	232%	0	13,600	11,400	42,400	0	10	2,200	1	69,600	180	3,080	11,200	110	14,600	6,500	5,400	0	26,500	43,100	18,000
	1984	9.7	63%	0	200	500	600	0	10	2,300	1	3,600	190	3,230	11,600	110	15,100	6,600	1,300	0	23,000	-19,400	-1,400
	1985	10.4	68%	0	400	600	1,400	0	10	2,400	1	4,800	190	3,370	12,000	110	15,700	6,500	1,100	0	23,300	-18,500	-19,900
	1986	15.9	103%	0	2,700	3,900	8,500	0	10	2,500	1	17,600	200	3,000	12,500	120	15,800	6,500	1,500	0	23,800	-6,200	-26,100
	1987	11.7	76%	0	700	800	2,200	0	10	2,500	1	6,200	210	3,140	12,700	120	16,200	6,500	1,000	0	23,700	-17,500	-43,600
	1988	15.1	98%	0	1,100	1,000	3,200	0	10	2,600	1	7,900	210	3,250	13,000	120	16,600	6,500	1,000	0	24,100	-16,200	-59,800
	1989	8.2	54%	0	10	500	200	0	10	2,600	1	3,300	220	3,080	13,200	130	16,600	6,500	800	0	23,900	-20,600	-80,400
	1990	8.1	52%	0	20	500	200	0	10	2,700	1	3,400	220	3,410	13,400	130	17,200	6,500	600	0	24,300	-20,900	-101,300
	1991	16.5	107%	0	700	2,500	4,100	0	10	2,700	1	10,000	230	3,240	13,600	130	17,200	6,400	4,500	0	28,100	-18,100	-119,400
	1992	17.0	110%	0	3,800	4,600	14,000	0	10	2,800	1	25,200	230	3,240	13,900	130	17,500	6,600	4,000	0	28,100	-2,900	-122,300
	1993	24.7	160%	0	6,800	6,800	21,300	0	10	2,800	1	37,700	230	2,840	14,100	140	17,300	6,600	3,300	0	27,200	10,500	-111,800
	1994	13.4	87%	0	600	1,000	1,900	0	10	2,900	1	6,400	230	2,860	14,300	140	17,500	6,500	1,100	0	25,100	-18,700	-130,500
	1995	29.2	190%	0	7,500	11,300	32,400	0	10	2,900	1	54,100	240	2,690	14,600	140	17,700	6,500	1,800	0	26,000	28,100	-102,400
	1996	15.5	101%	0	1,300	1,900	5,100	0	10	3,000	1	11,300	290	3,120	14,800	140	18,400	6,600	3,000	0	28,000	-16,700	-119,100
	1997	13.2	85%	0	2,500	2,900	6,900	0	20	3,100	1	15,400	290	3,320	15,500	140	19,300	6,600	2,600	0	28,500	-13,100	-132,200
	1998	36.2	235%	0	7,400	12,000	38,300	0	20	3,200	1	60,900	260	1,130	16,200	140	17,700	6,400	300	0	24,400	36,500	-95,700
	1999	16.2	105%	0	2,800	3,900	8,900	0	20	3,400	1	19,000	300	410	16,900	140	17,800	6,300	1,600	0	25,700	-6,700	-102,400
	2000	17.5	114%	0	3,400	3,600	10,400	0	20	3,500	1	20,900	320	840	17,700	150	19,000	6,600	4,500	0	30,100	-9,200	-111,600
	2001	18.3	119%	0	4,400	5,500	12,400	0	20	3,700	1	26,000	310	640	18,400	150	19,500	6,500	4,800	0	30,800	-4,800	-116,400
	2002	7.7	50%	0	20	500	400	0	20	3,800	1	4,700	340	460	19,100	150	20,100	6,500	1,200	0	27,800	-23,100	-139,500
	2003	14.8	96%	0	1,100	1,200	3,400	0	20	4,000	1	9,700	320	410	19,800	150	20,700	6,500	1,200	0	28,400	-18,700	-158,200
	2004	9.4	61%	0	800	1,100	2,400	0	20	4,100	1	8,400	370	460	20,500	150	21,500	6,600	900	0	29,000	-20,600	-178,800
	2005	28.3	184%	0	7,800	6,400	22,700	0	20	4,200	1	41,100	350	430	21,200	150	22,100	6,500	5,100	0	33,700	7,400	-171,400
	2006	18.3	119%	0	3,100	3,000	8,100	0	20	4,400	1	18,600	350	340	21,900	150	22,700	6,500	4,400	0	33,600	-15,000	-186,400
	2007	6.3	41%	0	10	300	100	0	20	4,400	1	4,800	360	340	21,900	150	22,800	6,500	400	0	29,700	-24,900	-211,300
	2008	17.0	111%	0	2,200	3,200	8,600	0	20	4,400	1	18,400	360	1,140	22,000	160	23,700	6,500	4,200	0	34,400	-16,000	-227,300
	2009	10.5	68%	0	200	700	800	0	20	4,400	1	6,100	350	1,420	22,000	160	23,900	6,500	1,100	0	31,500	-25,400	-252,700
	2010	17.6	114%	0	2,900	3,800	11,600	0	20	4,400	1	22,700	300	1,470	22,000	160	23,900	6,400	4,300	0	34,600	-11,900	-264,600
	2011	21.7	141%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	300	590	22,000	160	23,100	6,400	700	0	30,200	16,700	-247,900
	2012	10.6	69%	0	50	1,300	1,200	0	20	4,400	1	7,000	310	300	22,000	160	22,800	6,500	1,100	0	30,400	-23,400	-271,300
	2013	6.3	41%	0	100	400	300	0	20	4,400	1	5,200	320	430	22,000	160	22,900	6,600	400	0	29,900	-24,700	-296,000
	2014	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	320	1,800	22,000	160	24,300	6,600	400	0	31,300	-26,300	-322,300
	2015	7.6	50%	0	10	400	200	0	20	4,400	1	5,000	250	1,720	22,000	160	24,100	6,700	600	0	31,400	-26,400	-348,700
	2016	11.8	77%	0	30	900	1,100	0	20	4,400	1	6,500	250	390	22,000	160	22,800	6,600	700	0	30,100	-23,600	-372,300
	2017	21.8	142%	0	2,600	5,400	14,500	0	20	4,400	1	26,900	250	0	22,100	170	22,500	6,600	900	0	30,000	-3,100	-375,400
	2018	9.1	59%	0	100	600	500	0	20	4,400	1	5,600	280	150	22,200	170	22,800	6,600	900	0	30,300	-24,700	-400,100
	Minimum	6.2	41%	0	10	300	100	0	10	2,100	1	3,300	170	0	10,300	100	13,800	6,300	300	0	22,300	-26,400	
	Maximum	36.2	235%	0	13,600	12,000	42,400	0	20	4,400	1	69,600	370	3,430	22,200	170	24,300	6,700	5,400	0	34,600	43,100	**Basin Yield**
	Average	**15.4**	**100%**	**0**	**2,400**	**3,100**	**8,600**	**0**	**20**	**3,500**	**1**	**17,500**	**270**	**1,800**	**17,300**	**140**	**19,500**	**6,500**	**2,000**	**0**	**28,100**	**-10,600**	**8,900**
			% of Total:	0%	14%	18%	49%	0%	0%	20%	0%		1%	6%	62%	0%		23%	7%	0%			
Current Water Budget	2011	21.7	141%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	300	590	22,000	160	23,100	6,400	700	0	30,200	16,700	16,700
	2012	10.6	69%	0	50	1,300	1,200	0	20	4,400	1	7,000	310	300	22,000	160	22,800	6,500	1,100	0	30,400	-23,400	-6,700
	2013	6.3	41%	0	100	400	300	0	20	4,400	1	5,200	320	430	22,000	160	22,900	6,600	400	0	29,900	-24,700	-31,400
	2014	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	320	1,800	22,000	160	24,300	6,600	400	0	31,300	-26,300	-57,700
	2015	7.6	50%	0	10	400	200	0	20	4,400	1	5,000	250	1,720	22,000	160	24,100	6,700	600	0	31,400	-26,400	-84,100
	2016	11.8	77%	0	30	900	1,100	0	20	4,400	1	6,500	250	390	22,000	160	22,800	6,600	700	0	30,100	-23,600	-107,700
	2017	21.8	142%	0	2,600	5,400	14,500	0	20	4,400	1	26,900	250	0	22,100	170	22,500	6,600	900	0	30,000	-3,100	-110,800
	2018	9.1	59%	0	100	600	500	0	20	4,400	1	5,600	280	150	22,200	170	22,800	6,600	900	0	30,300	-24,700	-135,500
	Minimum	6.2	41%	0	10	400	200	0	20	4,400	1	5,000	250	0	22,000	160	22,500	6,400	400	0	29,900	-26,400	
	Maximum	21.8	142%	0	7,500	7,700	27,300	0	20	4,400	1	46,900	320	1,800	22,200	170	24,300	6,700	1,100	0	31,400	16,700	**Basin Yield**
	Average	**11.9**	**77%**	**0**	**1,300**	**2,100**	**5,700**	**0**	**20**	**4,400**	**1**	**13,500**	**290**	**670**	**22,000**	**160**	**23,200**	**6,600**	**700**	**0**	**30,500**	**-17,000**	**6,200**
			% of Total:	0.0%	10%	16%	42%	0%	0%	33%	0%		1%	2%	72%	1%		22%	2%	0%			
																							Basin Yield
Projected Water Budget	2042	15.8	101%	0	2,300	4,200	8,200	0	20	5,000	1	19,700	340	510	24,900	220	26,000	6,900	2,100	0	35,000	-15,300	10,700
	2072	15.4	100%	0	2,200	4,200	8,000	0	20	5,100	1	19,500	340	510	25,500	220	26,600	7,000	2,100	0	35,700	-16,200	10,400
	Minimum	15.4	100%	0	2,200	4,200	8,000	0	20	5,000	1	19,500	340	510	24,900	220	26,000	6,900	2,100	0	35,000	-16,200	
	Maximum	15.8	101%	0	2,300	4,200	8,200	0	20	5,100	1	19,700	340	510	25,500	220	26,600	7,000	2,100	0	35,700	-15,300	**Basin Yield**
	Average	**15.6**	**101%**	**0**	**2,300**	**4,200**	**8,100**	**0**	**20**	**5,100**	**1**	**19,600**	**340**	**510**	**25,200**	**220**	**26,300**	**7,000**	**2,100**	**0**	**35,400**	**-15,800**	**10,500**
			% of Total:	0.0%	12%	21%	41%	0%	0%	26%	0%		1%	1%	71%	1%		20%	6%	0%			

Water Budget	WY	Casmalia Stream Gage (AFY)	Surface Runoff Contribution between Casmalia Gage and Slough (AFY)	D/S Crop ET [consumed water] (AFY)	Total SW Discharge from Slough (AFY)	Total SW Flow Entering Slough [BCM]	GW Discharge to Slough that contributes to SW flow[raw]	GW Discharge to Slough that contributes to SW flow [Adjusted]	Adjustment remainder	SW Flow Entering Slough [Adjusted]	Slough ET (includes capture of portion of GW discharge)	VAFB pumping (AF)
Historical Water Budget	1981	2,667	33	320	2,954	0	2,954	2,954	0	0	2,924	3,273
	1982	1,221	28	320	1,513	0	1,513	1,513	0	0	2,839	3,430
	1983	28,732	1,527	320	27,525	15,848	11,677	5,420	6,258	22,106	2,869	3,078
	1984	1,010	15	320	1,315	0	1,315	1,315	0	0	2,932	3,227
	1985	812	16	320	1,116	0	1,116	1,116	0	0	2,864	3,372
	1986	1,582	80	320	1,823	314	1,509	1,509	0	314	2,878	3,000
	1987	724	20	320	1,025	0	1,025	1,025	0	0	2,871	3,141
	1988	747	22	320	1,045	0	1,045	1,045	0	0	2,883	3,250
	1989	479	15	320	784	0	784	784	0	0	2,882	3,081
	1990	338	15	320	644	0	644	644	0	0	2,890	3,414
	1991	5,312	28	320	5,604	0	5,604	4,511	1,094	1,094	2,836	3,242
	1992	4,928	128	320	5,121	1,084	4,037	4,037	0	1,084	2,933	3,243
	1993	6,910	381	320	6,849	3,527	3,322	3,322	0	3,527	2,898	2,838
	1994	833	23	320	1,130	0	1,130	1,130	0	0	2,892	2,862
	1995	15,039	1,343	320	14,016	12,251	1,765	1,765	0	12,251	2,856	2,692
	1996	2,716	39	320	2,998	0	2,998	2,998	0	0	2,931	3,117
	1997	2,334	61	320	2,593	0	2,593	2,593	0	0	2,911	3,317
	1998	18,978	1,985	320	17,313	21,589	-4,276	300	-4,576	17,013	2,842	1,131
	1999	1,614	119	320	1,815	251	1,564	1,564	0	251	2,803	410
	2000	5,478	60	320	5,739	0	5,739	4,538	1,201	1,201	2,899	844
	2001	8,835	241	320	8,914	1,664	7,250	4,811	2,439	4,103	2,867	643
	2002	858	13	320	1,165	0	1,165	1,165	0	0	2,873	456
	2003	949	21	320	1,248	0	1,248	1,248	0	0	2,882	413
	2004	617	16	320	920	0	920	920	0	0	2,904	463
	2005	13,242	548	320	13,014	4,191	8,823	5,053	3,770	7,961	2,854	434
	2006	4,950	38	320	5,232	0	5,232	4,434	798	798	2,892	335
	2007	48	11	320	358	0	358	358	0	0	2,881	338
	2008	3,883	42	320	4,162	0	4,162	4,162	0	0	2,880	1,142
	2009	830	17	320	1,133	0	1,133	1,133	0	0	2,890	1,420
	2010	4,367	80	320	4,607	182	4,425	4,252	173	355	2,820	1,467
	2011	7,758	935	320	7,144	6,407	737	737	0	6,407	2,836	586
	2012	839	36	320	1,123	0	1,123	1,123	0	0	2,888	295
	2013	52	11	320	361	0	361	361	0	0	2,912	429
	2014	41	10	320	351	0	351	351	0	0	2,936	1,801
	2015	306	11	320	615	0	615	615	0	0	2,958	1,724
	2016	375	20	320	676	0	676	676	0	0	2,929	388
	2017	3,010	328	320	3,003	2,107	896	896	0	2,107	2,925	0
	2018	553	14	320	860	0	860	860	0	0	2,931	147
	Min	41	10	320	351	0	-4,276	300	-4,576	0	2,803	0
	Max	28,732	1,985	320	27,525	21,589	11,677	5,420	6,258	22,106	2,958	3,430
	Average	4,052	219	320	4,153	1,827	2,326	2,033	294	2,120	2,887	1,801

Water Budget: Approach to Future Projections

San Antonio Creek Basin

December 21, 2020

Sustaining Water For The Future
San Antonio Basin
Groundwater Sustainability Agency
Established 2017

GSI Water Solutions, Inc.

San Antonio Creek Basin Future Projections (1/3)

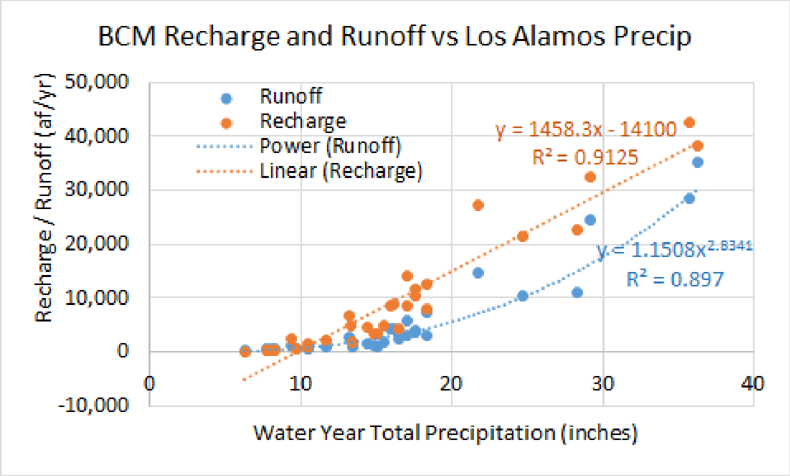
- Requirement: 50-year series based on historical climate record
- Currently readily available data and period of record
  - BCM Precip, Recharge, Runoff, and ET, Water Years 1981 – 2011
  - Los Alamos Fire Station Precip, 1918-2020
  - DWC VIC model ET and Precip Factors, 1915-2011
- Additional Constraints
  - How to utilize BCM data
    - Develop 50-yr POR recycled from existing BCM 30-yr POR
    - Use Precip – RCH and Precip – Runoff correlation to estimate BCM values for water years outside BCM 30-yr POR
  - Precip cumulative departure ~ zero for 50-yr period

§354.18 Water Budget.

(c) Each Plan shall quantify the current, historical, and projected water budget for the basin as follows:

(3) Projected water budgets shall be used to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation, and to identify the uncertainties of these projected water budget components. The projected water budget shall utilize the following methodologies and assumptions to estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

> (A) Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise.



San Antonio Creek Basin, Future Projections (2/3): DWR Guidance to Account for Climate Change in Future Scenarios for GSP

4.5 Incorporating Climate Change Analysis Into Water Budgets

As described in the GSP regulations, the Water Budget BMP and earlier in this Guidance Document, the following water budgets are required as part of GSP development:

- Water budget representing historical conditions extending back a minimum of 10 years
- Water budget representing current conditions
- Water budget representing projected conditions over the 50-year SGMA planning and implementation horizon

Based on the available climate change data provided by DWR and described in this Guidance Document, projected water budget could be developed for two future conditions using a climate period analysis as follows:

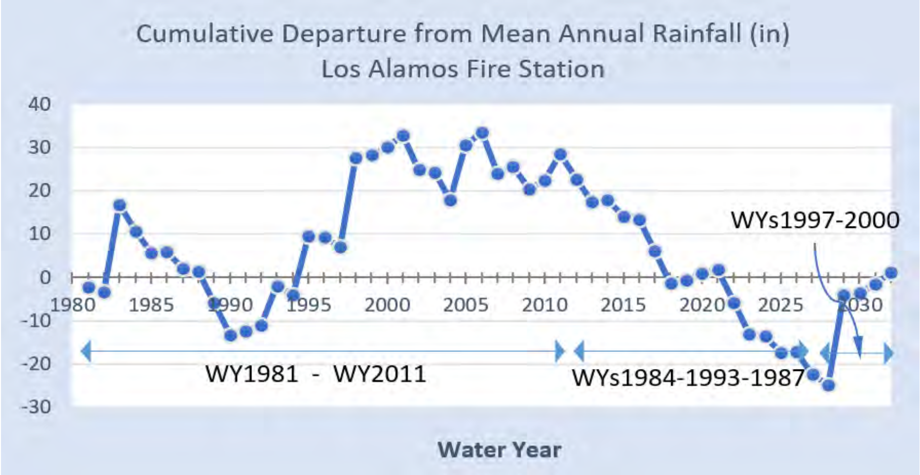
- Water budget representing conditions at 2030 with uncertainty (using 50 years of historical record representative of the range of inter-annual variability as baseline). Projected 2030 central tendency data will be useful to evaluate projects and actions to achieve sustainability in the early future.
- Water budget representing conditions at 2070 with uncertainty (using 50 years of historical record representative of the range of inter-annual variability as baseline). Projected 2070 central tendency data will be useful to show that sustainability will be maintained into the planning and implementation horizon (i.e., late future), within 50 years after GSP approval.

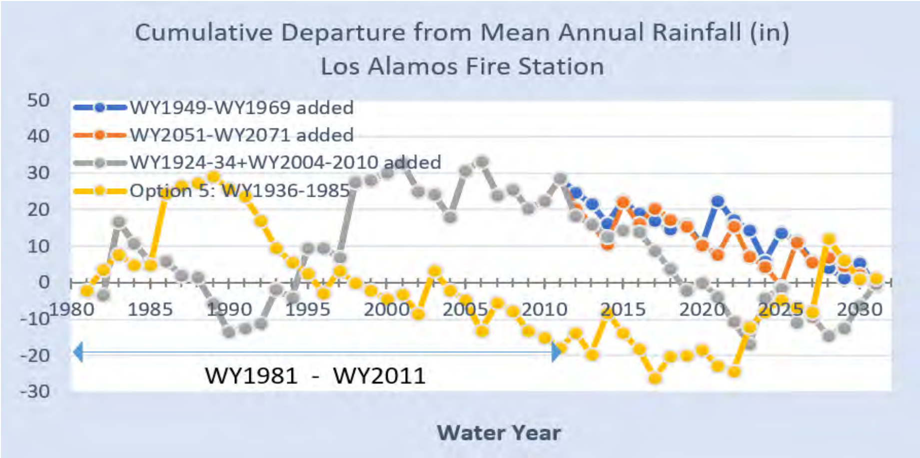
4.5.1 Projected Water Budget Development Without a Numerical Model

For projected water budgets developed without a numerical groundwater flow model, the datasets described above can be incorporated into a spreadsheet-type water budget where the monthly time series of change factors and direct flow values are used to generate projected future conditions. The 50-year baseline condition timeseries is modified using the change factors from the 2030 projections and 2070 projections, respectively. The resulting timeseries would represent a 50-year projection to understand the uncertainty of what climate and hydrologic conditions could look like in 2030 and the uncertainty of what the climate and hydrologic conditions could look like in 2070. These timeseries include a range of variability in hydrology and temperature as projected for the 2030 and 2070 conditions. The resulting projected water budgets developed for 2030 and for 2070 conditions can be reviewed and interpreted through statistical analysis using water year type averaging and describing ranges in conditions to describe uncertainties in projected water budgets, as further discussed in Section 4.6 below.

San Antonio Creek Basin Future Projections (3/3)

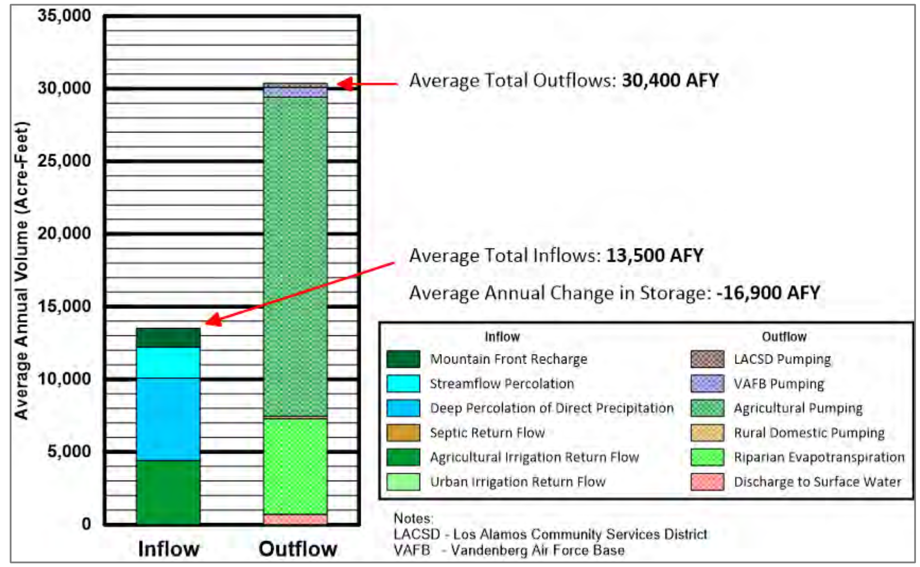
- BCM data available for 1980-2018
  - For climate change analysis, must overlap with VIC-model POR(1915-2011)
  - Overlapping POR between BCM and VIC is 1980 – 2011
- Precip cumulative departure ~ zero for 50-yr period
  - Five candidate series, four utilize the 1981- 2011 historical for first 30 years;
    - *At 30-yr (2011), the cumulative departure from avg precipitation is +28.63 inches*
    - *Objective is to close cumulative departure in final 20-yr sequence*
  - Option 1 (top) employs two sequences from BCM – VIC overlap POR to close cumulative departure
  - Three additional options were investigated the VIC POR for the final 20 years
  - One additional plotted was the "optimal" 50-year sequence from the entire POR for the Los Alamos rain gage (WY 1936 – 1985)





Next steps

1. Select 50-yr climate series
2. Run future model for three 50-yr series (Baseline current conditions, VIC-2030, VIC-2070)
3. Develop three stacked-bar charts similar to figure in top right showing average for Baseline, 2032, and 2072
4. 2032 bar chart based on VIC-2030 model, and 2072 bar chart based on VIC-2070 model



- Areal recharge, mtn recharge, streambed perc, surface flow to slough: all from BCM
- M&I pumping demand: demographics and per capita use
- Agricultural Pumping demand:
  - Irrigated lands + crop trends (Nate)
  - Crop duty factors, $Kc_{adj} = Kc_{baseline} * ET_{VIC}$
  - CIR_{adj} = Crop Irrigation Req'mnt = $CIR_{baseline} * ET_{VIC}$
- Plug all values in to WB spreadsheet, solve for storage change

ID Final Steps in WB Spreadsheet

- Select 50-yr climate series tab (Future Baseline, 2030 Climate Change, or 2070 Climate Change)
- Insert data related to M&I (columns E, F, L, M, P in spreadsheet); these should be based on demographics, and independent of future climate (i.e., will be same on all tabs)
- Agricultural Pumping demand (column O) will be calculated the same as for historical model, but updated with irrigated land trends (acreage and crop mix), AND multiply by ET factor (column N)
- Again, the Ag trends are independent of climate and so will be the same on all tabs; the only difference will be the ET factor multiplier
- Columns R through T relate to the hydrogeologic CM and water balance at Barka Slough
- Bar chart avg values for Current Condition, 2032, and 2072 “snapshots” taken from line 53

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1																	OUTFLOW (Acre Feet per Year)						
2	Year Count	Water Year	Precip at LAFD (inches)	Perc Aerial Rech of Direct Precip	Perc of Waste-water	Urban Irr Return Flow	Ag Irrigation Return Flow	Streambed Infiltration	Mountain front Recharge	Other Subsurface GW Inflow?	Total Inflow	LACSD Pumping	VAFB Pumping	Future ET factor	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping	Riparian Evapo-transpiration	Discharge to SW?	Subsurface Outflow	Total Outflow	Change in Storage (AF)	Cumulative Change in Storage (AF)
3	1	2023	13.71	4,818				2,231	1,351	0	8,400			1.085					0	0	1	8,399	8,399
4	2	2024	13.85	4,249				1,414	1,477	0	7,140			1.075							1	7,139	15,538
33	31	2053	20.92	25,163				11,749	6,905	0	43,816			1.092							1	43,815	537,642
34	32	2054	8.72	485				484	198	0	1,167			1.090							1	1,166	538,808
35	33	2055	10.64	1,364				649	445	0	2,457			1.097							1	2,456	541,265
36	34	2056	16.50	8,599				4,033	2,668	0	15,299			1.081							1	15,298	556,563
37	35	2057	12.42	2,214				886	683	0	3,783			1.089							1	3,782	560,345
38	36	2058	16.64	3,406				1,073	1,188	0	5,667			1.075							1	5,666	566,011
39	37	2059	7.98	195				496	12	0	702			1.066							1	701	566,712
40	38	2060	8.24	184				497	16	0	698			1.058							1	697	567,409
41	39	2061	15.31	3,750				2,164	630	0	6,544			1.081							1	6,543	573,952
42	40	2062	15.54	12,363				4,659	3,387	0	20,409			1.078							1	20,408	594,360
43	41	2063	14.16	3,455				2,001	580	0	6,036			1.083							1	6,035	600,395
44	42	2064	8.04	180				485	16	0	681			1.088							1	680	601,075
45	43	2065	8.40	205				522	12	0	739			1.075							1	738	601,812
46	44	2066	13.67	2,780				881	970	0	4,631			1.081							1	4,630	606,443
47	45	2067	12.41	2,206				885	681	0	3,772			1.059							1	3,771	610,214
48	46	2068	16.61	8,795				4,061	2,729	0	15,585			1.068							1	15,584	625,798
49	47	2069	9.98	1,265				608	413	0	2,285			1.101							1	2,284	628,082
50	48	2070	35.51	36,078				26,148	7,014	0	69,241			1.100							1	69,240	697,322
51	49	2071	13.49	7,093				3,142	2,224	0	12,459			1.127							1	12,457	709,779
52	50	2072	15.30	8,899				2,833	2,880	0	14,612			1.064							1	14,611	724,390
53		Average	15.40	8,070	#DIV/0!	#DIV/0!	#DIV/0!	4,164	2,255	0	14,489	#DIV/0!	#DIV/0!	1.0824	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	1	14,488	

San Antonio Creek Valley Groundwater Basin Water Budget

Values in acre-feet

(blue) = Component of Inflow
(orange) = Component of Outflow

Water Budget	Year Count	Historical Index Year	Water Year	Rainfall: Inches	Rainfall: % of Average	Components of Inflow: Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows	Total Inflow	Components of Outflow: Groundwater Pumping: LACSD Pumping	VAFB Pumping	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping	Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow	Total Outflow	Change in Storage	Cumulative Change in Storage
Projected Water Budget 50-Year Future Baseline	1	1981	2023	13.3	85%	0	1,400	2,200	4,900	0	20	4,700	1	13,200	270	410	23,600	180	24,500	6,600	3,000	0	34,100	-20,900	-20,900
	2	1982	2024	14.4	93%	0	1,600	1,500	4,600	0	20	4,700	1	12,400	270	410	23,600	180	24,500	6,400	1,500	0	32,400	-20,000	-40,900
	3	1983	2025	35.7	229%	0	13,600	22,200	42,400	0	20	4,700	1	82,900	280	420	23,600	180	24,500	6,500	4,200	0	35,200	47,700	6,800
	4	1984	2026	9.7	62%	0	200	500	600	0	20	4,700	1	6,000	280	420	23,600	180	24,500	6,600	1,300	0	32,400	-26,400	-19,600
	5	1985	2027	10.4	67%	0	400	600	1,400	0	20	4,700	1	7,100	280	430	23,600	180	24,500	6,500	1,100	0	32,100	-25,000	-44,600
	6	1986	2028	15.9	102%	0	2,700	3,800	8,500	0	20	4,700	1	19,700	280	430	23,600	180	24,500	6,500	1,500	0	32,500	-12,800	-57,400
	7	1987	2029	11.7	75%	0	700	800	2,200	0	20	4,700	1	8,400	290	430	23,600	190	24,500	6,500	1,000	0	32,000	-23,600	-81,000
	8	1988	2030	15.1	97%	0	1,100	1,000	3,200	0	20	4,700	1	10,000	290	440	23,600	190	24,500	6,500	1,000	0	32,000	-22,000	-103,000
	9	1989	2031	8.2	53%	0	0	500	200	0	20	4,700	1	5,400	290	440	23,600	190	24,500	6,500	800	0	31,800	-26,400	-129,400
	10	1990	2032	8.1	52%	0	0	500	200	0	20	4,700	1	5,400	290	450	23,600	190	24,500	6,500	600	0	31,600	-26,200	-155,600
	11	1991	2033	16.5	106%	0	700	2,300	4,100	0	20	4,700	1	11,800	300	450	23,600	190	24,500	6,400	4,200	0	35,100	-23,300	-178,900
	12	1992	2034	17.0	109%	0	3,800	5,200	14,000	0	20	4,700	1	27,700	300	460	23,600	190	24,600	6,600	4,000	0	35,200	-7,500	-186,400
	13	1993	2035	24.7	158%	0	6,800	9,100	21,300	0	20	4,700	1	41,900	300	460	23,600	200	24,600	6,600	3,300	0	34,500	7,400	-179,000
	14	1994	2036	13.4	86%	0	600	900	1,900	0	20	4,700	1	8,100	310	460	23,600	200	24,600	6,500	1,100	0	32,200	-24,100	-203,100
	15	1995	2037	29.2	187%	0	7,500	19,700	32,400	0	20	4,700	1	64,300	310	470	23,600	200	24,600	6,500	1,800	0	32,900	31,400	-171,700
	16	1996	2038	15.5	99%	0	1,300	1,800	5,100	0	20	4,700	1	12,900	310	470	23,600	200	24,600	6,600	3,000	0	34,200	-21,300	-193,000
	17	1997	2039	13.2	84%	0	2,500	2,700	6,900	0	20	4,700	1	16,800	310	480	23,600	200	24,600	6,600	2,600	0	33,800	-17,000	-210,000
	18	1998	2040	36.2	232%	0	7,400	26,700	38,300	0	20	4,700	1	77,100	320	480	23,600	200	24,600	6,400	1,000	0	32,000	45,100	-164,900
	19	1999	2041	16.2	104%	0	2,800	3,700	8,900	0	20	4,700	1	20,100	320	480	23,600	210	24,600	6,300	1,600	0	32,500	-12,400	-177,300
	20	2000	2042	17.5	112%	0	3,400	3,300	10,400	0	20	4,700	1	21,800	320	490	23,600	210	24,600	6,600	4,200	0	35,400	-13,600	-190,900
	21	2001	2043	18.3	118%	0	4,400	6,400	12,400	0	20	4,700	1	27,900	320	490	23,600	210	24,600	6,500	4,200	0	35,300	-7,400	-198,300
	22	2002	2044	7.7	49%	0	0	500	400	0	20	4,700	1	5,600	330	500	23,600	210	24,600	6,500	1,200	0	32,300	-26,700	-225,000
	23	2003	2045	14.8	95%	0	1,100	1,100	3,400	0	20	4,700	1	10,300	330	500	23,600	210	24,600	6,500	1,200	0	32,300	-22,000	-247,000
	24	2004	2046	9.4	60%	0	800	1,100	2,400	0	20	4,700	1	9,000	330	500	23,600	210	24,600	6,600	900	0	32,100	-23,100	-270,100
	25	2005	2047	28.3	181%	0	7,800	9,200	22,700	0	20	4,700	1	44,400	330	510	23,600	220	24,700	6,500	4,200	0	35,400	9,000	-261,100
	26	2006	2048	18.3	117%	0	3,100	2,700	8,100	0	20	4,700	1	18,600	340	510	23,600	220	24,700	6,500	4,200	0	35,400	-16,800	-277,900
	27	2007	2049	6.3	40%	0	0	300	100	0	20	4,700	1	5,100	340	520	23,600	220	24,700	6,500	400	0	31,600	-26,500	-304,400
	28	2008	2050	17.0	109%	0	2,200	3,000	8,600	0	20	4,700	1	18,500	340	520	23,600	220	24,700	6,500	4,200	0	35,400	-16,900	-321,300
	29	2009	2051	10.5	67%	0	200	700	800	0	20	4,700	1	6,400	350	520	23,600	220	24,700	6,500	1,100	0	32,300	-25,900	-347,200
	30	2010	2052	17.6	113%	0	2,900	3,700	11,600	0	20	4,700	1	22,900	350	530	23,600	230	24,700	6,400	4,200	0	35,300	-12,400	-359,600
	31	2011	2053	21.7	139%	0	7,500	12,200	27,300	0	20	4,700	1	51,700	350	530	23,600	230	24,700	6,400	700	0	31,800	19,900	-339,700
	32	1984	2054	9.7	62%	0	200	500	600	0	20	4,700	1	6,000	350	540	23,600	230	24,700	6,600	1,300	0	32,600	-26,600	-366,300
	33	1985	2055	10.4	67%	0	400	600	1,400	0	20	4,700	1	7,100	360	540	23,600	230	24,700	6,500	1,100	0	32,300	-25,200	-391,500
	34	1986	2056	15.9	102%	0	2,600	3,800	8,500	0	20	4,700	1	19,600	360	540	23,600	230	24,700	6,500	1,500	0	32,700	-13,100	-404,600
	35	1987	2057	11.7	75%	0	700	800	2,200	0	20	4,700	1	8,400	360	550	23,600	230	24,700	6,500	1,000	0	32,200	-23,800	-428,400
	36	1988	2058	15.1	97%	0	1,100	1,000	3,200	0	20	4,700	1	10,000	360	550	23,600	240	24,800	6,500	1,000	0	32,300	-22,300	-450,700
	37	1989	2059	8.2	53%	0	0	500	200	0	30	4,700	1	5,400	370	560	23,600	240	24,800	6,500	800	0	32,100	-26,700	-477,400
	38	1990	2060	8.1	52%	0	0	500	200	0	30	4,700	1	5,400	370	560	23,600	240	24,800	6,500	600	0	31,900	-26,500	-503,900
	39	1991	2061	16.5	106%	0	700	2,300	4,100	0	30	4,700	1	11,800	370	560	23,600	240	24,800	6,400	4,200	0	35,400	-23,600	-527,500
	40	1992	2062	17.0	109%	0	3,800	5,100	14,000	0	30	4,700	1	27,600	370	570	23,600	240	24,800	6,600	4,000	0	35,400	-7,800	-535,300
	41	1991	2063	16.5	106%	0	700	2,300	4,100	0	30	4,700	1	11,800	380	570	23,600	240	24,800	6,400	4,200	0	35,400	-23,600	-558,900
	42	1990	2064	8.1	52%	0	0	500	200	0	30	4,700	1	5,400	380	580	23,600	250	24,800	6,500	600	0	31,900	-26,500	-585,400
	43	1989	2065	8.2	53%	0	0	500	200	0	30	4,700	1	5,400	380	580	23,600	250	24,800	6,500	800	0	32,100	-26,700	-612,100
	44	1988	2066	15.1	97%	0	1,100	1,000	3,300	0	30	4,700	1	10,100	390	580	23,600	250	24,800	6,500	1,000	0	32,300	-22,200	-634,300
	45	1987	2067	11.7	75%	0	700	800	2,200	0	30	4,700	1	8,400	390	590	23,600	250	24,800	6,500	1,000	0	32,300	-23,900	-658,200
	46	1986	2068	15.9	102%	0	2,600	3,800	8,500	0	30	4,700	1	19,600	390	590	23,600	250	24,800	6,500	1,500	0	32,800	-13,200	-671,400
	47	1985	2069	10.4	67%	0	400	600	1,400	0	30	4,700	1	7,100	390	600	23,600	250	24,800	6,500	1,100	0	32,400	-25,300	-696,700
	48	1998	2070	36.2	232%	0	7,400	26,700	38,400	0	30	4,700	1	77,200	400	600	23,600	260	24,900	6,400	1,000	0	32,300	44,900	-651,800
	49	1999	2071	16.2	104%	0	2,800	3,800	8,800	0	30	4,700	1	20,100	400	600	23,600	260	24,900	6,300	1,600	0	32,800	-12,700	-664,500
	50	2000	2072	17.5	112%	0	3,400	3,200	10,300	0	30	4,700	1	21,600	400	610	23,600	260	24,900	6,600	4,200	0	35,700	-14,100	-678,600
			Minimum	6.3	40%	0	0	300	100	0	20	4,700	1	5,100	270	410	23,600	180	24,500	6,300	400	0	31,600	-26,700	
			Maximum	36.2	232%	0	13,600	26,700	42,400	0	30	4,700	1	82,900	400	610	23,600	260	24,900	6,600	4,200	0	35,700	47,700	**Basin Yield**
			Average	**15.6**	**100%**	**0**	**2,300**	**4,200**	**8,400**	**0**	**20**	**4,700**	**1**	**19,600**	**336**	**510**	**23,600**	**220**	**24,700**	**6,500**	**2,000**	**0**	**33,200**	**-13,600**	*11,100*
					% of Total:	0%	12%	21%	43%	0%	0%	24%	0%		1%	2%	71%	1%		20%	6%	0%			

San Antonio Creek Valley Groundwater Basin Water Budget

Values in acre-feet

= Component of Inflow (blue)

= Component of Outflow (orange)

Water Budget	Year Count	Historical Index Year	Water Year	Rainfall				Components of Inflow								Total Inflow	2030 DWR ET Factor	Components of Outflow								Total Outflow	Change in Storage	Cumulative Change in Storage
				Inches	% of Average	2030 DWR Precip Factors	2030 Inches	Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows			Groundwater Pumping: LACSD Pumping	Groundwater Pumping: VAFB Pumping	Groundwater Pumping: Ag Irrigation Pumping	Groundwater Pumping: Rural Domestic Pumping	Groundwater Pumping: Total Pumping	Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow			
Projected Water Budget 2030	1	1981	2023	13.3	85%	1.029	14.03	0	1,400	2,200	4,800	0	20	4,900	1	13,300	1.034	270	410	24,400	180	25,300	6,800	2,900	0	35,000	-21,700	-21,700
	2	1982	2024	14.4	93%	0.967	13.50	0	1,500	1,400	4,300	0	20	4,900	1	12,100	1.044	270	410	24,600	180	25,500	6,700	1,500	0	33,700	-21,600	-43,300
	3	1983	2025	35.7	229%	1.020	36.30	0	13,400	22,600	41,800	0	20	4,900	1	82,700	1.035	280	420	24,400	180	25,300	6,700	5,500	0	37,500	45,200	1,900
	4	1984	2026	9.7	62%	0.998	9.63	0	200	500	600	0	20	4,900	1	6,200	1.033	280	420	24,400	180	25,300	6,800	1,300	0	33,400	-27,200	-25,300
	5	1985	2027	10.4	67%	1.119	12.87	0	500	700	1,500	0	20	4,900	1	7,600	1.033	280	430	24,400	180	25,300	6,700	1,100	0	33,100	-25,500	-50,800
	6	1986	2028	15.9	102%	1.025	16.62	0	2,600	3,900	8,400	0	20	4,900	1	19,800	1.036	280	430	24,400	180	25,300	6,700	1,400	0	33,400	-13,600	-64,400
	7	1987	2029	11.7	75%	1.070	12.29	0	700	900	2,300	0	20	4,900	1	8,800	1.038	290	430	24,500	190	25,400	6,700	1,000	0	33,100	-24,300	-88,700
	8	1988	2030	15.1	97%	1.040	15.71	0	1,100	1,000	3,300	0	20	4,900	1	10,300	1.029	290	440	24,300	190	25,200	6,700	1,100	0	33,000	-22,700	-111,400
	9	1989	2031	8.2	53%	1.076	9.37	0	0	600	200	0	20	4,900	1	5,700	1.040	290	440	24,500	190	25,400	6,800	800	0	33,000	-27,300	-138,700
	10	1990	2032	8.1	52%	1.051	8.79	0	0	500	200	0	20	4,900	1	5,600	1.032	290	450	24,300	190	25,200	6,700	700	0	32,600	-27,000	-165,700
	11	1991	2033	16.5	106%	1.036	17.01	0	700	2,400	4,200	0	20	4,900	1	12,200	1.035	300	450	24,400	190	25,300	6,600	4,600	0	36,500	-24,300	-190,000
	12	1992	2034	17.0	109%	1.054	18.89	0	3,900	5,400	14,200	0	20	4,900	1	28,400	1.037	300	460	24,400	190	25,400	6,900	4,300	0	36,600	-8,200	-198,200
	13	1993	2035	24.7	158%	1.149	30.80	0	7,600	10,400	23,700	0	20	4,900	1	46,600	1.034	300	460	24,400	200	25,400	6,800	3,200	0	35,400	11,200	-187,000
	14	1994	2036	13.4	86%	1.047	14.66	0	600	1,000	1,900	0	20	4,900	1	8,400	1.037	310	460	24,500	200	25,500	6,800	1,200	0	33,500	-25,100	-212,100
	15	1995	2037	29.2	187%	1.013	28.63	0	7,400	20,000	31,700	0	20	4,900	1	64,000	1.034	310	470	24,400	200	25,400	6,700	1,800	0	33,900	30,100	-182,000
	16	1996	2038	15.5	99%	1.044	16.57	0	1,300	1,900	5,100	0	20	4,900	1	13,200	1.042	310	470	24,600	200	25,600	6,900	3,200	0	35,700	-22,500	-204,500
	17	1997	2039	13.2	84%	0.971	12.40	0	2,400	2,600	6,400	0	20	4,900	1	16,300	1.034	310	480	24,400	200	25,400	6,800	2,600	0	34,800	-18,500	-223,000
	18	1998	2040	36.2	232%	1.035	37.97	0	7,400	27,700	38,200	0	20	4,900	1	78,200	1.039	320	480	24,500	200	25,500	6,700	300	0	32,500	45,700	-177,300
	19	1999	2041	16.2	104%	0.999	15.80	0	2,700	3,700	8,600	0	20	4,900	1	19,900	1.035	320	480	24,400	210	25,400	6,600	1,500	0	33,500	-13,600	-190,900
	20	2000	2042	17.5	112%	1.014	16.98	0	3,300	3,300	10,200	0	20	4,900	1	21,700	1.041	320	490	24,500	210	25,500	6,800	4,600	0	36,900	-15,200	-206,100
	21	2001	2043	18.3	118%	0.975	17.15	0	4,200	6,300	11,700	0	20	4,900	1	27,100	1.037	320	490	24,500	210	25,500	6,700	4,800	0	37,000	-9,900	-216,000
	22	2002	2044	7.7	49%	1.065	8.66	0	0	500	400	0	20	4,900	1	5,800	1.039	330	500	24,500	210	25,500	6,700	1,200	0	33,400	-27,600	-243,600
	23	2003	2045	14.8	95%	1.006	14.86	0	1,100	1,100	3,300	0	20	4,900	1	10,400	1.032	330	500	24,300	210	25,300	6,700	1,300	0	33,300	-22,900	-266,500
	24	2004	2046	9.4	60%	1.011	9.55	0	800	1,100	2,300	0	20	4,900	1	9,100	1.035	330	500	24,400	210	25,400	6,800	900	0	33,100	-24,000	-290,500
	25	2005	2047	28.3	181%	1.033	28.23	0	7,700	9,500	22,600	0	20	4,900	1	44,700	1.039	330	510	24,500	220	25,600	6,700	5,200	0	37,500	7,200	-283,300
	26	2006	2048	18.3	117%	0.942	16.20	0	2,800	2,600	7,300	0	20	4,900	1	17,600	1.035	340	510	24,400	220	25,500	6,800	4,400	0	36,700	-19,100	-302,400
	27	2007	2049	6.3	40%	1.027	6.48	0	0	400	100	0	20	4,900	1	5,400	1.045	340	520	24,700	220	25,800	6,800	400	0	33,000	-27,600	-330,000
	28	2008	2050	17.0	109%	1.195	22.53	0	2,500	3,500	9,900	0	20	4,900	1	20,800	1.039	340	520	24,500	220	25,600	6,800	4,300	0	36,700	-15,900	-345,900
	29	2009	2051	10.5	67%	1.079	11.72	0	200	800	800	0	20	4,900	1	6,700	1.036	350	520	24,400	220	25,500	6,800	1,200	0	33,500	-26,800	-372,700
	30	2010	2052	17.6	113%	1.182	23.62	0	3,400	4,300	13,100	0	20	4,900	1	25,700	1.040	350	530	24,500	230	25,600	6,600	4,300	0	36,500	-10,800	-383,500
	31	2011	2053	21.7	139%	1.049	22.55	0	7,500	12,800	27,400	0	20	4,900	1	52,600	1.042	350	530	24,600	230	25,700	6,700	600	0	33,000	19,600	-363,900
	32	1984	2054	9.7	62%	1.057	10.19	0	200	500	600	0	20	4,900	1	6,200	1.030	350	540	24,300	230	25,400	6,800	1,300	0	33,500	-27,300	-391,200
	33	1985	2055	10.4	67%	1.006	11.69	0	400	800	1,300	0	20	4,900	1	7,400	1.039	360	540	24,500	230	25,600	6,700	1,100	0	33,400	-26,000	-417,200
	34	1986	2056	15.9	102%	1.063	17.40	0	2,700	4,100	8,700	0	20	4,900	1	20,400	1.043	360	540	24,600	230	25,700	6,800	1,400	0	33,900	-13,500	-430,700
	35	1987	2057	11.7	75%	1.105	12.56	0	700	1,000	2,300	0	20	4,900	1	8,900	1.040	360	550	24,500	230	25,600	6,700	1,000	0	33,300	-24,400	-455,100
	36	1988	2058	15.1	97%	0.998	14.92	0	1,100	1,000	3,100	0	20	4,800	1	10,000	1.026	360	550	24,200	240	25,400	6,700	1,100	0	33,200	-23,200	-478,300
	37	1989	2059	8.2	53%	1.018	8.78	0	0	600	200	0	30	4,900	1	5,700	1.035	370	560	24,400	240	25,600	6,700	800	0	33,100	-27,400	-505,700
	38	1990	2060	8.1	52%	1.078	8.92	0	0	500	200	0	30	4,800	1	5,500	1.027	370	560	24,200	240	25,400	6,700	700	0	32,800	-27,300	-533,000
	39	1991	2061	16.5	106%	1.054	17.14	0	700	2,300	4,300	0	30	4,800	1	12,100	1.027	370	560	24,200	240	25,400	6,600	4,600	0	36,600	-24,500	-557,500
	40	1992	2062	17.0	109%	1.102	19.55	0	4,100	5,700	14,800	0	30	4,900	1	29,500	1.038	370	570	24,500	240	25,700	6,900	4,300	0	36,900	-7,400	-564,900
	41	1991	2063	16.5	106%	1.080	17.73	0	700	2,600	4,400	0	30	4,800	1	12,500	1.027	380	570	24,200	240	25,400	6,600	4,600	0	36,600	-24,100	-589,000
	42	1990	2064	8.1	52%	1.058	8.75	0	0	500	200	0	30	4,900	1	5,600	1.030	380	580	24,300	250	25,500	6,700	700	0	32,900	-27,300	-616,300
	43	1989	2065	8.2	53%	1.133	9.87	0	0	600	200	0	30	4,900	1	5,700	1.042	380	580	24,600	250	25,800	6,800	800	0	33,400	-27,700	-644,000
	44	1988	2066	15.1	97%	0.994	14.86	0	1,100	1,000	3,200	0	30	4,800	1	10,100	1.025	390	580	24,200	250	25,400	6,700	1,100	0	33,200	-23,100	-667,100
	45	1987	2067	11.7	75%	1.035	11.65	0	700	1,000	2,200	0	30	4,900	1	8,800	1.036	390	590	24,400	250	25,600	6,700	1,000	0	33,300	-24,500	-691,600
	46	1986	2068	15.9	102%	1.049	17.35	0	2,700	4,000	8,600	0	30	4,900	1	20,200	1.040	390	590	24,500	250	25,700	6,800	1,400	0	33,900	-13,700	-705,300
	47	1985	2069	10.4	67%	1.191	13.97	0	500	700	1,600	0	30	4,900	1	7,700	1.038	390	600	24,500	250	25,700	6,700	1,100	0	33,500	-25,800	-731,100
	48	1998	2070	36.2	232%	0.992	36.74	0	7,200	28,500	37,000	0	30	4,900	1	77,600	1.029	400	600	24,300	260	25,600	6,600	300	0	32,500	45,100	-686,000
	49	1999	2071	16.2	104%	1.075	16.83	0	2,900	3,700	9,300	0	30	4,800	1	20,700	1.023	400	600	24,100	260	25,400	6,500	1,500	0	33,400	-12,700	-698,700
	50	2000	2072	17.5	112%	0.897	15.01	0	3,000	3,100	9,000	0	30	4,800	1	19,900	1.028	400	610	24,200	260	25,500	6,700	4,600	0	36,800	-16,900	-715,600
			Minimum	6.3	40%	0.897	6.48	0	0	400	100	0	20	4,800	1	5,400	1.023	270	410	24,100	180	25,200	6,500	300	0	32,500	-27,700	
			Maximum	36.2	232%	1.195	37.97	0	13,400	28,500	41,800	0	30	4,900	1	82,700	1.045	400	610	24,700	260	25,800	6,900	5,500	0	37,500	45,700	**Basin Yield**
			Average	**15.6**	**100%**	**1.046**	**16.49**	**0**	**2,400**	**4,400**	**8,400**	**0**	**20**	**4,900**	**1**	**20,000**	**1.035**	**336**	**510**	**24,400**	**220**	**25,500**	**6,700**	**2,100**	**0**	**34,300**	**-14,300**	***11,200***
							% of Total:	0%	12%	22%	42%	0%	0%	25%	0%			1%	1%	71%	1%		20%	6%	0%			

Water Budget	Year Count	Index WY	WY	DWR Streamflow Factors 2030	Casmalia Stream Gage (AFY)	Proj. Casmalia Stream Gage (AFY)	Surface Runoff Contribution between Casmalia Gage and Slough (AFY)	D/S Crop ET [consumed water] (AFY)	Total SW Discharge from Slough (AFY)	Total SW Flow Entering Slough [BCM]	GW Discharge to Slough that contributes to SW flow[raw]	GW Discharge to Slough that contributes to SW flow [Adjusted]	Adjustment remainder	SW Flow Entering Slough [Adjusted]	Slough ET (includes capture of portion of GW discharge)	VAFB pumping (AF)
Projected Water Budget 2030	1	1981	2023	0.9839	2,667	2,624	34	331	2,921	0	2,921	2,921	0	0	6,834	411
	2	1982	2024	0.9657	1,221	1,179	27	334	1,486	0	1,486	1,486	0	0	6,702	415
	3	1983	2025	1.0273	28,732	29,516	1,557	331	28,291	16,281	12,010	5,501	6,509	22,790	6,712	419
	4	1984	2026	1.0091	1,010	1,019	15	331	1,335	0	1,335	1,335	0	0	6,849	423
	5	1985	2027	1.0195	812	828	18	331	1,141	0	1,141	1,141	0	0	6,689	427
	6	1986	2028	0.9435	1,582	1,493	82	332	1,743	296	1,447	1,447	0	296	6,740	431
	7	1987	2029	0.9837	724	712	21	332	1,024	0	1,024	1,024	0	0	6,739	435
	8	1988	2030	1.0512	747	785	23	329	1,091	0	1,091	1,091	0	0	6,706	439
	9	1989	2031	1.0350	479	496	16	333	812	0	812	812	0	0	6,774	443
	10	1990	2032	1.0541	338	356	15	331	672	0	672	672	0	0	6,745	447
	11	1991	2033	1.0614	5,312	5,639	29	331	5,941	0	5,941	4,613	1,328	1,328	6,634	451
	12	1992	2034	1.1228	4,928	5,534	135	332	5,731	1,217	4,514	4,307	207	1,424	6,875	455
	13	1993	2035	0.9918	6,910	6,854	438	331	6,747	3,498	3,249	3,249	0	3,498	6,775	459
	14	1994	2036	1.0576	833	881	24	332	1,189	0	1,189	1,189	0	0	6,782	463
	15	1995	2037	1.0258	15,039	15,427	1,361	331	14,397	12,567	1,830	1,830	0	12,567	6,679	467
	16	1996	2038	1.0555	2,716	2,867	41	334	3,160	0	3,160	3,160	0	0	6,906	471
	17	1997	2039	0.9835	2,334	2,295	59	331	2,567	0	2,567	2,567	0	0	6,807	475
	18	1998	2040	1.1199	18,978	21,254	2,055	333	19,531	24,178	-4,647	300	-4,947	19,231	6,677	479
	19	1999	2041	0.9567	1,614	1,544	119	331	1,756	240	1,516	1,516	0	240	6,557	483
	20	2000	2042	1.0648	5,478	5,833	61	333	6,106	0	6,106	4,645	1,461	1,461	6,823	487
	21	2001	2043	0.9204	8,835	8,131	235	332	8,228	1,532	6,697	4,753	1,944	3,475	6,721	491
	22	2002	2044	0.9869	858	847	13	333	1,166	0	1,166	1,166	0	0	6,749	495
	23	2003	2045	1.0285	949	976	21	331	1,285	0	1,285	1,285	0	0	6,727	499
	24	2004	2046	1.0201	617	629	17	331	944	0	944	944	0	0	6,793	503
	25	2005	2047	1.0688	13,242	14,153	566	333	13,919	4,479	9,440	5,179	4,260	8,740	6,702	507
	26	2006	2048	0.9143	4,950	4,526	36	331	4,821	0	4,821	4,378	443	443	6,765	511
	27	2007	2049	1.0044	48	48	11	335	372	0	372	372	0	0	6,808	516
	28	2008	2050	1.0590	3,883	4,112	50	333	4,395	0	4,395	4,278	117	117	6,765	520
	29	2009	2051	1.0245	830	850	18	332	1,164	0	1,164	1,164	0	0	6,770	524
	30	2010	2052	0.9893	4,367	4,320	94	333	4,559	180	4,379	4,274	105	285	6,631	528
	31	2011	2053	0.9322	7,758	7,232	980	334	6,585	5,973	613	613	0	5,973	6,681	532
	32	1984	2054	1.0091	1,010	1,019	15	331	1,335	0	1,335	1,335	0	0	6,831	536
	33	1985	2055	1.0195	812	828	18	331	1,141	0	1,141	1,141	0	0	6,728	540
	34	1986	2056	0.9435	1,582	1,493	82	332	1,743	296	1,447	1,447	0	296	6,785	544
	35	1987	2057	0.9837	724	712	21	332	1,024	0	1,024	1,024	0	0	6,750	548
	36	1988	2058	1.0512	747	785	23	329	1,091	0	1,091	1,091	0	0	6,689	552
	37	1989	2059	1.0350	479	496	16	333	812	0	812	812	0	0	6,741	556
	38	1990	2060	1.0541	338	356	15	331	672	0	672	672	0	0	6,713	560
	39	1991	2061	1.0614	5,312	5,639	29	331	5,941	0	5,941	4,613	1,328	1,328	6,586	564
	40	1992	2062	1.1228	4,928	5,534	135	332	5,731	1,217	4,514	4,307	207	1,424	6,883	568
	41	1991	2063	1.0614	5,312	5,639	29	331	5,941	0	5,941	4,613	1,328	1,328	6,586	572
	42	1990	2064	1.0541	338	356	15	331	672	0	672	672	0	0	6,730	576
	43	1989	2065	1.0350	479	496	16	333	812	0	812	812	0	0	6,791	580
	44	1988	2066	1.0512	747	785	23	329	1,091	0	1,091	1,091	0	0	6,680	584
	45	1987	2067	0.9837	724	712	21	332	1,024	0	1,024	1,024	0	0	6,725	588
	46	1986	2068	0.9435	1,582	1,493	82	332	1,743	296	1,447	1,447	0	296	6,766	592
	47	1985	2069	1.0195	812	828	18	331	1,141	0	1,141	1,141	0	0	6,720	596
	48	1998	2070	1.1199	18,978	21,254	2,055	333	19,531	24,178	-4,647	300	-4,947	19,231	6,612	600
	49	1999	2071	0.9567	1,614	1,544	119	331	1,756	240	1,516	1,516	0	240	6,485	604
	50	2000	2072	1.0648	5,478	5,833	61	333	6,106	0	6,106	4,645	1,461	1,461	6,739	608
			Average	1.0206	4,016	4,175	219	332	4,288	1,933	2,354	2,138	216	2,150	6,733	509
			Min	0.9143	48	48	11	329	372	0	-4,647	300	-4,947	0	6,485	411
			Max	1.1228	28,732	29,516	2,055	335	28,291	24,178	12,010	5,501	6,509	22,790	6,906	608

San Antonio Creek Valley Groundwater Basin Water Budget

Values in acre-feet

= Component of Inflow

= Component of Outflow

Water Budget	Year Count	Historical Index Year	Water Year	Rainfall Inches	Rainfall % of Average	Rainfall 2042 DWR Precip Factors	Rainfall 2042 Inches	Components of Inflow: Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows	Total Inflow	2042 DWR ET Factor	Components of Outflow: Groundwater Pumping: LACSD Pumping	VAFB Pumping	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping	Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow	Total Outflow	Change in Storage	Cumulative Change in Storage
Projected Water Budget 2042	1	1981	2023	13.3	85%	1.029	13.69	0	1,400	2,200	4,800	0	20	4,900	1	13,300	1.034	270	410	24,400	180	25,300	6,800	2,900	0	35,000	-21,700	-21,700
	2	1982	2024	14.4	93%	0.967	13.96	0	1,500	1,400	4,300	0	20	4,900	1	12,100	1.044	270	410	24,600	180	25,500	6,700	1,500	0	33,700	-21,600	-43,300
	3	1983	2025	35.7	229%	1.020	36.40	0	13,400	22,600	41,800	0	20	4,900	1	82,700	1.035	280	420	24,400	180	25,300	6,700	5,300	0	37,300	45,400	2,100
	4	1984	2026	9.7	62%	0.998	9.64	0	200	500	600	0	20	4,900	1	6,200	1.033	280	420	24,400	180	25,300	6,800	1,300	0	33,400	-27,200	-25,100
	5	1985	2027	10.4	67%	1.119	11.68	0	500	700	1,500	0	20	4,900	1	7,600	1.033	280	430	24,400	180	25,300	6,700	1,100	0	33,100	-25,500	-50,600
	6	1986	2028	15.9	102%	1.025	16.27	0	2,600	3,900	8,400	0	20	4,900	1	19,800	1.036	280	430	24,400	180	25,300	6,700	1,400	0	33,400	-13,600	-64,200
	7	1987	2029	11.7	75%	1.070	12.53	0	700	900	2,300	0	20	4,900	1	8,800	1.038	290	430	24,500	190	25,400	6,700	1,000	0	33,100	-24,300	-88,500
	8	1988	2030	15.1	97%	1.040	15.67	0	1,100	1,000	3,300	0	20	4,900	1	10,300	1.029	290	440	24,300	190	25,200	6,700	1,100	0	33,000	-22,700	-111,200
	9	1989	2031	8.2	53%	1.073	8.84	0	0	500	200	0	20	4,900	1	5,600	1.040	290	440	24,500	190	25,400	6,800	800	0	33,000	-27,400	-138,600
	10	1990	2032	8.1	52%	1.047	8.45	0	0	500	200	0	20	4,900	1	5,600	1.034	290	450	24,400	190	25,300	6,800	700	0	32,800	-27,200	-165,800
	11	1991	2033	16.5	106%	1.027	16.93	0	700	2,400	4,100	0	20	4,900	1	12,100	1.038	300	450	24,500	190	25,400	6,700	4,500	0	36,600	-24,500	-190,300
	12	1992	2034	17.0	109%	1.051	17.86	0	3,800	5,400	14,100	0	20	4,900	1	28,200	1.041	300	460	24,500	190	25,500	6,900	4,200	0	36,600	-8,400	-198,700
	13	1993	2035	24.7	158%	1.140	28.18	0	7,500	10,300	23,400	0	20	4,900	1	46,100	1.040	300	460	24,500	200	25,500	6,800	3,300	0	35,600	10,500	-188,200
	14	1994	2036	13.4	86%	1.041	13.92	0	600	1,000	1,800	0	20	4,900	1	8,300	1.045	310	460	24,600	200	25,600	6,800	1,200	0	33,600	-25,300	-213,500
	15	1995	2037	29.2	187%	1.008	29.42	0	7,300	19,900	31,300	0	20	4,900	1	63,400	1.042	310	470	24,600	200	25,600	6,700	1,900	0	34,200	29,200	-184,300
	16	1996	2038	15.5	99%	1.037	16.07	0	1,300	1,900	5,000	0	20	5,000	1	13,200	1.050	310	470	24,800	200	25,800	7,000	3,200	0	36,000	-22,800	-207,100
	17	1997	2039	13.2	84%	0.969	12.75	0	2,300	2,600	6,400	0	20	4,900	1	16,200	1.044	310	480	24,600	200	25,600	6,900	2,600	0	35,100	-18,900	-226,000
	18	1998	2040	36.2	232%	1.038	37.62	0	7,300	27,800	37,800	0	20	5,000	1	77,900	1.051	320	480	24,800	200	25,800	6,800	300	0	32,900	45,000	-181,000
	19	1999	2041	16.2	104%	0.996	16.08	0	2,600	3,700	8,400	0	20	5,000	1	19,700	1.052	320	480	24,800	210	25,800	6,700	1,500	0	34,000	-14,300	-195,300
	20	2000	2042	17.5	112%	1.002	17.55	0	3,200	3,300	9,900	0	20	5,000	1	21,400	1.056	320	490	24,900	210	25,900	6,900	4,500	0	37,300	-15,900	-211,200
	21	2001	2043	18.3	118%	0.979	17.95	0	4,100	6,300	11,600	0	20	5,000	1	27,000	1.050	320	490	24,800	210	25,800	6,800	4,700	0	37,300	-10,300	-221,500
	22	2002	2044	7.7	49%	1.031	7.92	0	0	500	300	0	20	5,000	1	5,800	1.054	330	500	24,900	210	25,900	6,800	1,200	0	33,900	-28,100	-249,600
	23	2003	2045	14.8	95%	0.984	14.59	0	1,100	1,100	3,100	0	20	5,000	1	10,300	1.055	330	500	24,900	210	25,900	6,900	1,300	0	34,100	-23,800	-273,400
	24	2004	2046	9.4	60%	1.007	9.42	0	800	1,100	2,300	0	20	5,000	1	9,200	1.052	330	500	24,800	210	25,800	6,900	1,000	0	33,700	-24,500	-297,900
	25	2005	2047	28.3	181%	1.014	28.67	0	7,400	9,300	21,700	0	20	5,000	1	43,400	1.062	330	510	25,000	220	26,100	6,800	5,100	0	38,000	5,400	-292,500
	26	2006	2048	18.3	117%	0.937	17.15	0	2,800	2,600	7,100	0	20	5,000	1	17,500	1.057	340	510	24,900	220	26,000	6,900	4,300	0	37,200	-19,700	-312,200
	27	2007	2049	6.3	40%	0.984	6.19	0	0	300	100	0	20	5,000	1	5,400	1.063	340	520	25,100	220	26,200	6,900	400	0	33,500	-28,100	-340,300
	28	2008	2050	17.0	109%	1.114	18.98	0	2,300	3,300	9,000	0	20	5,000	1	19,600	1.060	340	520	25,000	220	26,100	6,900	4,200	0	37,200	-17,600	-357,900
	29	2009	2051	10.5	67%	1.038	10.91	0	200	700	800	0	20	5,000	1	6,700	1.060	350	520	25,000	220	26,100	6,900	1,200	0	34,200	-27,500	-385,400
	30	2010	2052	17.6	113%	1.139	20.06	0	3,100	4,200	12,300	0	20	5,000	1	24,600	1.066	350	530	25,100	230	26,200	6,800	4,200	0	37,200	-12,600	-398,000
	31	2011	2053	21.7	139%	1.001	21.70	0	7,000	12,200	25,500	0	20	5,100	1	49,800	1.071	350	530	25,300	230	26,400	6,900	700	0	34,000	15,800	-382,200
	32	1984	2054	9.7	62%	0.966	9.33	0	200	500	500	0	20	5,000	1	6,200	1.066	350	540	25,100	230	26,200	7,100	1,300	0	34,600	-28,400	-410,600
	33	1985	2055	10.4	67%	0.993	10.36	0	400	700	1,300	0	20	5,100	1	7,500	1.075	360	540	25,400	230	26,500	7,000	1,100	0	34,600	-27,100	-437,700
	34	1986	2056	15.9	102%	1.012	16.06	0	2,500	4,000	8,100	0	20	5,000	1	19,600	1.068	360	540	25,200	230	26,300	6,900	1,500	0	34,700	-15,100	-452,800
	35	1987	2057	11.7	75%	1.018	11.92	0	600	900	2,100	0	20	5,100	1	8,700	1.073	360	550	25,300	230	26,400	7,000	1,000	0	34,400	-25,700	-478,500
	36	1988	2058	15.1	97%	0.979	14.74	0	1,000	1,000	3,000	0	20	5,000	1	10,000	1.060	360	550	25,000	240	26,200	6,900	1,100	0	34,200	-24,200	-502,700
	37	1989	2059	8.2	53%	0.905	7.46	0	0	500	200	0	30	5,000	1	5,700	1.057	370	560	24,900	240	26,100	6,900	800	0	33,800	-28,100	-530,800
	38	1990	2060	8.1	52%	0.991	8.00	0	0	500	200	0	30	5,000	1	5,700	1.051	370	560	24,800	240	26,000	6,900	700	0	33,600	-27,900	-558,700
	39	1991	2061	16.5	106%	0.997	16.43	0	700	2,200	3,900	0	30	5,000	1	11,800	1.069	370	560	25,200	240	26,400	6,900	4,500	0	37,800	-26,000	-584,700
	40	1992	2062	17.0	109%	1.048	17.82	0	3,800	4,900	13,700	0	30	5,000	1	27,400	1.070	370	570	25,200	240	26,400	7,100	4,200	0	37,700	-10,300	-595,000
	41	1991	2063	16.5	106%	0.935	15.41	0	600	2,100	3,600	0	30	5,100	1	11,400	1.073	380	570	25,300	240	26,500	6,900	4,500	0	37,900	-26,500	-621,500
	42	1990	2064	8.1	52%	1.057	8.53	0	0	500	200	0	30	5,100	1	5,800	1.080	380	580	25,500	250	26,700	7,100	700	0	34,500	-28,700	-650,200
	43	1989	2065	8.2	53%	1.029	8.48	0	0	500	200	0	30	5,100	1	5,800	1.071	380	580	25,300	250	26,500	7,000	800	0	34,300	-28,500	-678,700
	44	1988	2066	15.1	97%	0.988	14.88	0	1,000	900	3,000	0	30	5,100	1	10,000	1.076	390	580	25,400	250	26,600	7,000	1,100	0	34,700	-24,700	-703,400
	45	1987	2067	11.7	75%	0.941	11.02	0	600	900	1,900	0	30	5,000	1	8,400	1.057	390	590	24,900	250	26,100	6,900	1,100	0	34,100	-25,700	-729,100
	46	1986	2068	15.9	102%	1.029	16.33	0	2,600	4,000	8,200	0	30	5,000	1	19,800	1.067	390	590	25,200	250	26,400	6,900	1,500	0	34,800	-15,000	-744,100
	47	1985	2069	10.4	67%	1.054	11.00	0	400	600	1,300	0	30	5,200	1	7,500	1.100	390	600	25,900	250	27,100	7,100	1,100	0	35,300	-27,800	-771,900
	48	1998	2070	36.2	232%	1.060	38.41	0	7,200	26,200	37,000	0	30	5,200	1	75,600	1.100	400	600	25,900	260	27,200	7,100	300	0	34,600	41,000	-730,900
	49	1999	2071	16.2	104%	1.028	16.60	0	2,500	3,200	8,100	0	30	5,300	1	19,100	1.127	400	600	26,600	260	27,900	7,100	1,500	0	36,500	-17,400	-748,300
	50	2000	2072	17.5	112%	1.172	20.53	0	3,800	2,800	11,400	0	30	5,000	1	23,000	1.064	400	610	25,100	260	26,400	7,000	4,500	0	37,900	-14,900	-763,200
			Minimum	6.3	40%	0.905	6.19	0	0	300	100	0	20	4,900	1	5,400	1.029	270	410	24,300	180	25,200	6,700	300	0	32,800	-28,700	
			Maximum	36.2	232%	1.172	38.41	0	13,400	27,800	41,800	0	30	5,300	1	82,700	1.127	400	610	26,600	260	27,900	7,100	5,300	0	38,000	45,400	Basin Yield
			Average	**15.6**	**100%**	**1.023**	**16.01**	**0**	**2,300**	**4,200**	**8,200**	**0**	**20**	**5,000**	**1**	**19,700**	**1.057**	**336**	**510**	**24,900**	**220**	**26,000**	**6,900**	**2,100**	**0**	**35,000**	**-15,300**	*10,700*
							% of Total:	0%	12%	21%	42%	0%	0%	25%	0%			1%	1%	71%	1%		20%	6%	0%			

Water Budget	Year Count	Index WY	WY	DWR Streamflow Factors [Adjusted]	Casmalia Stream Gage (AFY)	Proj. Casmalia Stream Gage (AFY)	Surface Runoff Contribution between Casmalia Gage and Slough (AFY)	D/S Crop ET [consumed water] (AFY)	Total SW Discharge from Slough (AFY)	Total SW Flow Entering Slough [BCM]	GW Discharge to Slough that contributes to SW flow[raw]	GW Discharge to Slough that contributes to SW flow [Adjusted]	Adjustment remainder	SW Flow Entering Slough [Adjusted]	Slough ET (includes capture of portion of GW discharge)	VAFB pumping (AF)
Projected Water Budget 2042	1	1981	2023	0.9839	2,667	2,624	34	331	2,921	0	2,921	2,921	0	0	6,834	411
	2	1982	2024	0.9657	1,221	1,179	27	334	1,486	0	1,486	1,486	0	0	6,702	415
	3	1983	2025	1.0273	28,732	29,516	1,557	331	28,291	16,281	12,010	5,322	6,688	22,968	6,712	419
	4	1984	2026	1.0091	1,010	1,019	15	331	1,335	0	1,335	1,335	0	0	6,849	423
	5	1985	2027	1.0195	812	828	18	331	1,141	0	1,141	1,141	0	0	6,689	427
	6	1986	2028	0.9435	1,582	1,493	82	332	1,743	296	1,447	1,447	0	296	6,740	431
	7	1987	2029	0.9837	724	712	21	332	1,024	0	1,024	1,024	0	0	6,739	435
	8	1988	2030	1.0512	747	785	23	329	1,091	0	1,091	1,091	0	0	6,706	439
	9	1989	2031	1.0338	479	496	16	333	812	0	812	812	0	0	6,780	443
	10	1990	2032	1.0561	338	357	15	331	673	0	673	673	0	0	6,758	447
	11	1991	2033	1.0680	5,312	5,673	29	332	5,977	0	5,977	4,470	1,507	1,507	6,655	451
	12	1992	2034	1.1319	4,928	5,578	134	333	5,777	1,227	4,550	4,176	375	1,602	6,902	455
	13	1993	2035	1.0083	6,910	6,967	435	333	6,865	3,556	3,309	3,309	0	3,556	6,812	459
	14	1994	2036	1.0639	833	887	24	335	1,197	0	1,197	1,197	0	0	6,831	463
	15	1995	2037	1.0623	15,039	15,976	1,354	334	14,956	13,014	1,942	1,942	0	13,014	6,728	467
	16	1996	2038	1.0656	2,716	2,895	40	336	3,190	0	3,190	3,190	0	0	6,958	471
	17	1997	2039	0.9847	2,334	2,298	59	334	2,573	0	2,573	2,573	0	0	6,871	475
	18	1998	2040	1.1328	18,978	21,499	2,061	337	19,774	24,457	-4,682	300	-4,982	19,474	6,753	479
	19	1999	2041	0.9522	1,614	1,536	118	337	1,755	239	1,516	1,516	0	239	6,667	483
	20	2000	2042	1.0717	5,478	5,871	60	338	6,149	0	6,149	4,502	1,647	1,647	6,923	487
	21	2001	2043	0.9767	8,835	8,629	236	336	8,729	1,625	7,104	4,668	2,436	4,062	6,807	491
	22	2002	2044	0.9654	858	828	13	337	1,153	0	1,153	1,153	0	0	6,845	495
	23	2003	2045	1.0003	949	949	21	338	1,266	0	1,266	1,266	0	0	6,877	499
	24	2004	2046	1.0305	617	635	17	337	956	0	956	956	0	0	6,906	503
	25	2005	2047	1.1064	13,242	14,651	556	340	14,435	4,637	9,798	5,058	4,740	9,377	6,850	507
	26	2006	2048	0.9375	4,950	4,641	36	338	4,943	0	4,943	4,263	680	680	6,912	511
	27	2007	2049	0.9986	48	48	10	340	378	0	378	378	0	0	6,924	516
	28	2008	2050	1.1371	3,883	4,416	47	339	4,709	0	4,709	4,212	497	497	6,903	520
	29	2009	2051	1.0211	830	847	17	339	1,169	0	1,169	1,169	0	0	6,923	524
	30	2010	2052	1.0262	4,367	4,481	91	341	4,732	187	4,545	4,174	371	558	6,796	528
	31	2011	2053	0.9809	7,758	7,610	935	343	7,018	6,285	733	733	0	6,285	6,866	532
	32	1984	2054	0.9509	1,010	960	15	331	1,276	0	1,276	1,276	0	0	7,070	536
	33	1985	2055	0.9736	812	791	18	331	1,103	0	1,103	1,103	0	0	6,962	540
	34	1986	2056	0.9870	1,582	1,562	82	332	1,811	310	1,502	1,502	0	310	6,947	544
	35	1987	2057	1.0194	724	738	21	332	1,049	0	1,049	1,049	0	0	6,967	548
	36	1988	2058	1.0120	747	755	23	329	1,062	0	1,062	1,062	0	0	6,911	552
	37	1989	2059	1.0014	479	480	16	333	797	0	797	797	0	0	6,888	556
	38	1990	2060	1.0841	338	367	15	331	683	0	683	683	0	0	6,865	560
	39	1991	2061	1.1290	5,312	5,997	29	332	6,301	0	6,301	4,530	1,771	1,771	6,851	564
	40	1992	2062	1.1954	4,928	5,891	134	333	6,090	1,296	4,794	4,231	564	1,860	7,094	568
	41	1991	2063	1.1333	5,312	6,020	29	332	6,324	0	6,324	4,534	1,790	1,790	6,881	572
	42	1990	2064	1.0881	338	368	15	331	684	0	684	684	0	0	7,054	576
	43	1989	2065	0.9944	479	477	16	333	793	0	793	793	0	0	6,981	580
	44	1988	2066	1.0008	747	747	23	329	1,054	0	1,054	1,054	0	0	7,012	584
	45	1987	2067	1.0326	724	748	21	332	1,059	0	1,059	1,059	0	0	6,861	588
	46	1986	2068	1.0071	1,582	1,594	82	332	1,843	316	1,527	1,527	0	316	6,942	592
	47	1985	2069	0.9479	812	770	18	331	1,083	0	1,083	1,083	0	0	7,121	596
	48	1998	2070	1.1716	18,978	22,234	2,061	337	20,510	25,293	-4,784	300	-5,084	20,210	7,070	600
	49	1999	2071	0.9404	1,614	1,517	118	337	1,736	236	1,500	1,500	0	236	7,140	604
	50	2000	2072	1.0879	5,478	5,960	60	338	6,238	0	6,238	4,518	1,720	1,720	6,972	608
			Average	1.0311	4,016	4,278	218	334	4,394	1,985	2,409	2,115	294	2,279	6,876	509
			Min	0.9375	48	48	10	329	378	0	-4,784	300	-5,084	0	6,655	411
			Max	1.1954	28,732	29,516	2,061	343	28,291	25,293	12,010	5,322	6,688	22,968	7,140	608

San Antonio Creek Valley Groundwater Basin Water Budget

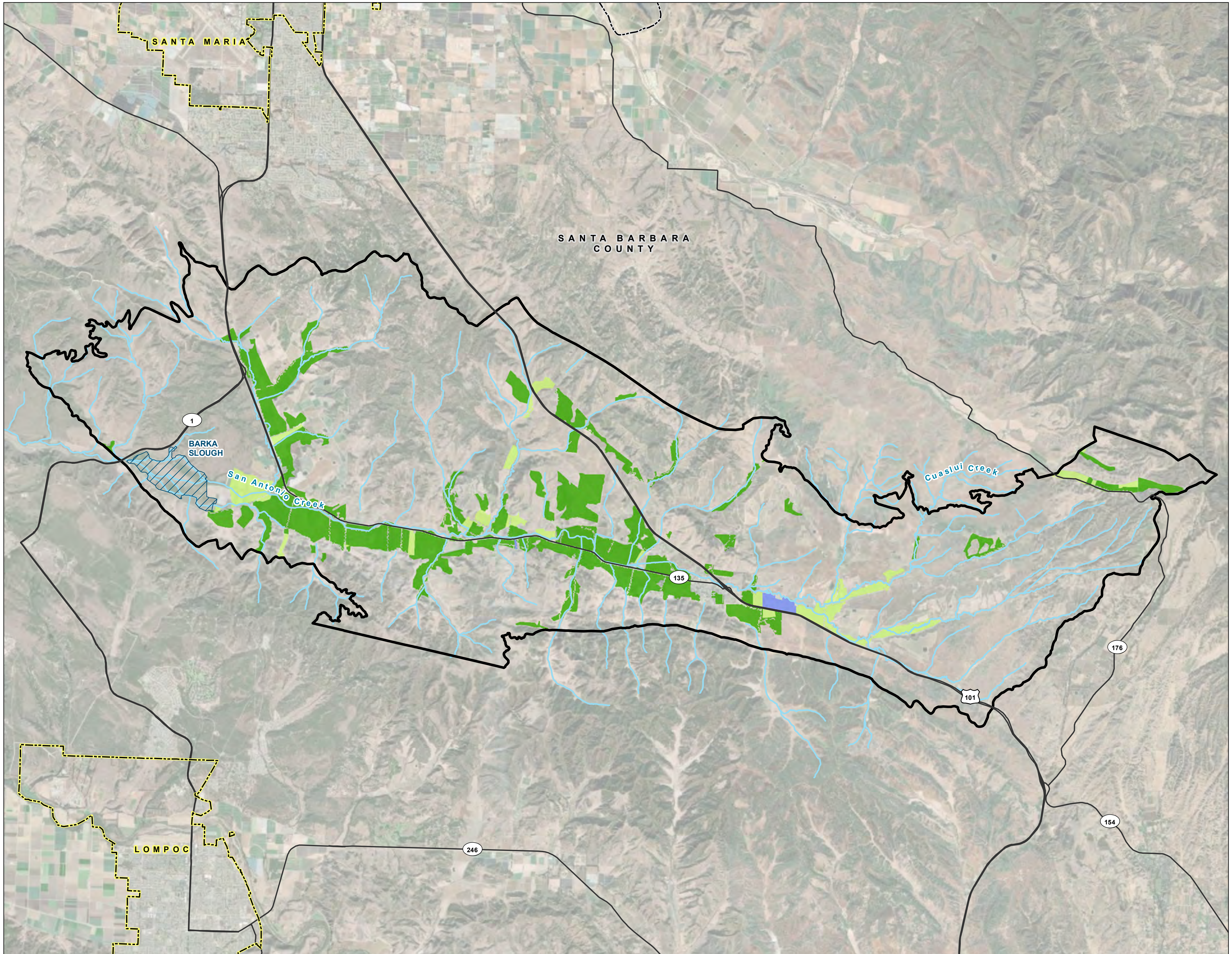
Values in acre-feet

= Component of Inflow

= Component of Outflow

Water Budget	Year Count	Historical Index Year	Water Year	Rainfall				Components of Inflow								Total Inflow	2070 DWR ET Factor	Components of Outflow								Total Outflow	Change in Storage	Cumulative Change in Storage
								Subsurface Inflow	Mountain Front Recharge	Streamflow Percolation	Percolation of Direct Precipitation	LACSD WWTP Effluent	Septic Return Flows	Ag Irrigation Return Flows	Urban Irrigation Return Flows			Groundwater Pumping					Riparian Evapotranspiration	Groundwater Discharge to Surface Water	Subsurface Outflow			
				Inches	% of Average	2070 DWR Precip Factors	2070 Inches											LACSD Pumping	VAFB Pumping	Ag Irrigation Pumping	Rural Domestic Pumping	Total Pumping						
Projected Water Budget 2072	1	1981	2023	13.3	85%	1.031	13.71	0	1,300	2,200	4,600	0	20	5,100	1	13,200	1.085	270	410	25,600	180	26,500	7,200	3,200	0	36,900	-23,700	-23,700
	2	1982	2024	14.4	93%	0.959	13.85	0	1,400	1,400	4,100	0	20	5,100	1	12,000	1.075	270	410	25,400	180	26,300	6,900	1,500	0	34,700	-22,700	-46,400
	3	1983	2025	35.7	229%	1.038	37.06	0	13,000	23,100	39,700	0	20	5,100	1	80,900	1.089	280	420	25,700	180	26,600	7,100	5,200	0	38,900	42,000	-4,400
	4	1984	2026	9.7	62%	0.854	8.25	0	200	500	500	0	20	5,100	1	6,300	1.088	280	420	25,600	180	26,500	7,200	1,300	0	35,000	-28,700	-33,100
	5	1985	2027	10.4	67%	0.998	10.42	0	400	600	1,400	0	20	5,100	1	7,500	1.081	280	430	25,500	180	26,400	7,000	1,100	0	34,500	-27,000	-60,100
	6	1986	2028	15.9	102%	1.008	15.99	0	2,600	3,900	8,300	0	20	5,000	1	19,800	1.052	280	430	24,800	180	25,700	6,800	1,500	0	34,000	-14,200	-74,300
	7	1987	2029	11.7	75%	0.984	11.52	0	600	800	2,200	0	20	5,100	1	8,700	1.088	290	430	25,600	190	26,500	7,100	1,100	0	34,700	-26,000	-100,300
	8	1988	2030	15.1	97%	1.005	15.13	0	1,000	1,000	3,100	0	20	5,100	1	10,200	1.083	290	440	25,500	190	26,400	7,100	1,100	0	34,600	-24,400	-124,700
	9	1989	2031	8.2	53%	0.943	7.77	0	0	500	200	0	20	5,100	1	5,800	1.076	290	440	25,400	190	26,300	7,000	800	0	34,100	-28,300	-153,000
	10	1990	2032	8.1	52%	0.963	7.77	0	0	500	200	0	20	5,100	1	5,800	1.074	290	450	25,300	190	26,200	7,000	700	0	33,900	-28,100	-181,100
	11	1991	2033	16.5	106%	0.922	15.20	0	600	2,100	4,000	0	20	5,100	1	11,800	1.078	300	450	25,400	190	26,300	6,900	4,400	0	37,600	-25,800	-206,900
	12	1992	2034	17.0	109%	1.020	17.33	0	3,600	5,300	13,700	0	20	5,100	1	27,700	1.076	300	460	25,400	190	26,400	7,100	4,100	0	37,600	-9,900	-216,800
	13	1993	2035	24.7	158%	1.082	26.74	0	6,900	9,800	22,700	0	20	5,100	1	44,500	1.080	300	460	25,500	200	26,500	7,100	3,700	0	37,300	7,200	-209,600
	14	1994	2036	13.4	86%	1.007	13.46	0	500	1,000	1,800	0	20	5,100	1	8,400	1.088	310	460	25,600	200	26,600	7,100	1,200	0	34,900	-26,500	-236,100
	15	1995	2037	29.2	187%	0.981	28.65	0	6,900	19,400	30,400	0	20	5,100	1	61,800	1.078	310	470	25,400	200	26,400	7,000	2,500	0	35,900	25,900	-210,200
	16	1996	2038	15.5	99%	1.007	15.61	0	1,200	1,800	4,900	0	20	5,100	1	13,000	1.082	310	470	25,500	200	26,500	7,200	3,300	0	37,000	-24,000	-234,200
	17	1997	2039	13.2	84%	0.962	12.66	0	2,200	2,600	6,200	0	20	5,100	1	16,100	1.077	310	480	25,400	200	26,400	7,100	2,600	0	36,100	-20,000	-254,200
	18	1998	2040	36.2	232%	1.047	37.95	0	7,200	28,000	36,500	0	20	5,100	1	76,800	1.086	320	480	25,600	200	26,600	7,000	300	0	33,900	42,900	-211,300
	19	1999	2041	16.2	104%	0.988	15.96	0	2,500	3,700	8,100	0	20	5,200	1	19,500	1.098	320	480	25,900	210	26,900	7,000	1,500	0	35,400	-15,900	-227,200
	20	2000	2042	17.5	112%	0.974	17.05	0	3,000	3,200	9,700	0	20	5,200	1	21,100	1.092	320	490	25,800	210	26,800	7,200	4,300	0	38,300	-17,200	-244,400
	21	2001	2043	18.3	118%	0.989	18.13	0	4,100	6,400	11,200	0	20	5,100	1	26,800	1.078	320	490	25,400	210	26,400	7,000	4,600	0	38,000	-11,200	-255,600
	22	2002	2044	7.7	49%	0.968	7.43	0	0	500	400	0	20	5,100	1	6,000	1.082	330	500	25,500	210	26,500	7,000	1,100	0	34,600	-28,600	-284,200
	23	2003	2045	14.8	95%	0.947	14.05	0	1,000	1,100	3,100	0	20	5,200	1	10,400	1.094	330	500	25,800	210	26,800	7,100	1,200	0	35,100	-24,700	-308,900
	24	2004	2046	9.4	60%	1.001	9.37	0	800	1,100	2,300	0	20	5,100	1	9,300	1.078	330	500	25,400	210	26,400	7,100	1,000	0	34,500	-25,200	-334,100
	25	2005	2047	28.3	181%	0.989	27.95	0	7,000	9,100	21,500	0	20	5,200	1	42,800	1.092	330	510	25,800	220	26,900	7,000	4,900	0	38,800	4,000	-330,100
	26	2006	2048	18.3	117%	0.930	17.03	0	2,700	2,500	7,000	0	20	5,100	1	17,300	1.085	340	510	25,600	220	26,700	7,100	4,100	0	37,900	-20,600	-350,700
	27	2007	2049	6.3	40%	0.936	5.89	0	0	300	100	0	20	5,100	1	5,500	1.083	340	520	25,500	220	26,600	7,100	400	0	34,100	-28,600	-379,300
	28	2008	2050	17.0	109%	1.033	17.60	0	2,100	3,100	9,500	0	20	5,100	1	19,800	1.081	340	520	25,500	220	26,600	7,000	4,100	0	37,700	-17,900	-397,200
	29	2009	2051	10.5	67%	1.002	10.53	0	200	700	800	0	20	5,100	1	6,800	1.081	350	520	25,500	220	26,600	7,100	1,200	0	34,900	-28,100	-425,300
	30	2010	2052	17.6	113%	1.104	19.43	0	3,000	4,100	12,600	0	20	5,100	1	24,800	1.087	350	530	25,600	230	26,700	6,900	4,000	0	37,600	-12,800	-438,100
	31	2011	2053	21.7	139%	0.965	20.92	0	6,600	11,700	26,200	0	20	5,200	1	49,700	1.092	350	530	25,800	230	26,900	7,000	800	0	34,700	15,000	-423,100
	32	1984	2054	9.7	62%	0.904	8.74	0	200	500	600	0	20	5,100	1	6,400	1.090	350	540	25,700	230	26,800	7,200	1,300	0	35,300	-28,900	-452,000
	33	1985	2055	10.4	67%	0.985	10.28	0	400	600	1,300	0	20	5,200	1	7,500	1.097	360	540	25,900	230	27,000	7,100	1,100	0	35,200	-27,700	-479,700
	34	1986	2056	15.9	102%	0.985	15.63	0	2,400	4,000	8,400	0	20	5,100	1	19,900	1.081	360	540	25,500	230	26,600	7,000	1,500	0	35,100	-15,200	-494,900
	35	1987	2057	11.7	75%	0.976	11.43	0	600	900	2,200	0	20	5,100	1	8,800	1.089	360	550	25,700	230	26,800	7,100	1,100	0	35,000	-26,200	-521,100
	36	1988	2058	15.1	97%	0.970	14.61	0	1,000	1,100	3,000	0	20	5,100	1	10,200	1.075	360	550	25,300	240	26,500	7,000	1,100	0	34,600	-24,400	-545,500
	37	1989	2059	8.2	53%	0.862	7.10	0	0	500	200	0	30	5,000	1	5,700	1.066	370	560	25,100	240	26,300	6,900	800	0	34,000	-28,300	-573,800
	38	1990	2060	8.1	52%	0.963	7.77	0	0	500	200	0	30	5,000	1	5,700	1.058	370	560	25,000	240	26,200	6,900	700	0	33,800	-28,100	-601,900
	39	1991	2061	16.5	106%	0.980	16.15	0	600	2,100	4,000	0	30	5,100	1	11,800	1.081	370	560	25,500	240	26,700	6,900	4,400	0	38,000	-26,200	-628,100
	40	1992	2062	17.0	109%	1.035	17.60	0	3,700	4,700	14,300	0	30	5,100	1	27,800	1.078	370	570	25,400	240	26,600	7,100	4,100	0	37,800	-10,000	-638,100
	41	1991	2063	16.5	106%	0.904	14.90	0	600	2,000	4,100	0	30	5,100	1	11,800	1.083	380	570	25,500	240	26,700	6,900	4,400	0	38,000	-26,200	-664,300
	42	1990	2064	8.1	52%	1.056	8.53	0	0	500	200	0	30	5,100	1	5,800	1.088	380	580	25,700	250	26,900	7,100	700	0	34,700	-28,900	-693,200
	43	1989	2065	8.2	53%	1.014	8.35	0	0	500	200	0	30	5,100	1	5,800	1.075	380	580	25,400	250	26,600	7,000	800	0	34,400	-28,600	-721,800
	44	1988	2066	15.1	97%	0.988	14.87	0	1,000	900	3,000	0	30	5,100	1	10,000	1.081	390	580	25,500	250	26,700	7,000	1,100	0	34,800	-24,800	-746,600
	45	1987	2067	11.7	75%	0.934	10.93	0	600	900	2,100	0	30	5,000	1	8,600	1.059	390	590	25,000	250	26,200	6,900	1,100	0	34,200	-25,600	-772,200
	46	1986	2068	15.9	102%	1.028	16.32	0	2,500	4,000	8,400	0	30	5,000	1	19,900	1.068	390	590	25,200	250	26,400	7,000	1,500	0	34,900	-15,000	-787,200
	47	1985	2069	10.4	67%	1.050	10.97	0	400	600	1,500	0	30	5,200	1	7,700	1.101	390	600	26,000	250	27,200	7,100	1,100	0	35,400	-27,700	-814,900
	48	1998	2070	36.2	232%	1.060	38.41	0	7,200	26,200	34,600	0	30	5,200	1	73,200	1.100	400	600	25,900	260	27,200	7,100	300	0	34,600	38,600	-776,300
	49	1999	2071	16.2	104%	1.028	16.60	0	2,500	3,200	8,400	0	30	5,300	1	19,400	1.127	400	600	26,600	260	27,900	7,100	1,500	0	36,500	-17,100	-793,400
	50	2000	2072	17.5	112%	1.172	20.53	0	3,800	2,800	8,700	0	30	5,000	1	20,300	1.064	400	610	25,100	260	26,400	7,000	4,300	0	37,700	-17,400	-810,800
			Minimum	6.3	40%	0.854	5.89	0	0	300	100	0	20	5,000	1	5,500	1.052	270	410	24,800	180	25,700	6,800	300	0	33,800	-28,900	
			Maximum	36.2	232%	1.172	38.41	0	13,000	28,000	39,700	0	30	5,300	1	80,900	1.127	400	610	26,600	260	27,900	7,200	5,200	0	38,900	42,900	**Basin Yield**
			Average	**15.6**	**100%**	**0.991**	**15.60**	**0**	**2,200**	**4,200**	**8,000**	**0**	**20**	**5,100**	**1**	**19,500**	**1.082**	**336**	**510**	**25,500**	**220**	**26,600**	**7,000**	**2,100**	**0**	**35,700**	**-16,200**	***10,400***
							% of Total:	0%	11%	22%	41%	0%	0%	26%	0%			1%	1%	71%	1%		20%	6%	0%			

Water Budget	Year Count	Index WY	WY	DWR Streamflow Factors 2070	Casmalia Stream Gage (AFY)	Proj. Casmalia Stream Gage (AFY)	Surface Runoff Contribution between Casmalia Gage and Slough (AFY)	D/S Crop ET [consumed water] (AFY)	Total SW Discharge from Slough (AFY)	Total SW Flow Entering Slough [BCM]	GW Discharge to Slough that contributes to SW flow[raw]	GW Discharge to Slough that contributes to SW flow [Adjusted]	Adjustment remainder	SW Flow Entering Slough [Adjusted]	Slough ET (includes capture of portion of GW discharge)	VAFB pumping (AF)
Projected Water Budget 2072	1	1981	2023	1.0647	2,667	2,840	34	347	3,153	0	3,153	3,153	0	0	7,171	411
	2	1982	2024	1.0049	1,221	1,227	27	344	1,544	0	1,544	1,544	0	0	6,903	415
	3	1983	2025	1.0949	28,732	31,458	1,585	349	30,221	17,352	12,870	5,196	7,674	25,025	7,062	419
	4	1984	2026	0.9121	1,010	921	13	348	1,257	0	1,257	1,257	0	0	7,212	423
	5	1985	2027	0.9460	812	768	16	346	1,098	0	1,098	1,098	0	0	7,000	427
	6	1986	2028	1.0104	1,582	1,599	81	337	1,855	317	1,538	1,538	0	317	6,845	431
	7	1987	2029	1.0365	724	751	19	348	1,079	0	1,079	1,079	0	0	7,060	435
	8	1988	2030	0.9952	747	743	22	347	1,068	0	1,068	1,068	0	0	7,060	439
	9	1989	2031	0.9886	479	474	14	345	804	0	804	804	0	0	7,011	443
	10	1990	2032	1.0941	338	370	14	344	700	0	700	700	0	0	7,016	447
	11	1991	2033	1.1486	5,312	6,101	26	345	6,421	0	6,421	4,367	2,054	2,054	6,912	451
	12	1992	2034	1.2135	4,928	5,980	130	345	6,195	1,315	4,879	4,077	802	2,118	7,136	455
	13	1993	2035	1.1233	6,910	7,762	413	346	7,695	3,961	3,734	3,734	0	3,961	7,076	459
	14	1994	2036	1.0996	833	916	23	348	1,241	0	1,241	1,241	0	0	7,112	463
	15	1995	2037	1.2346	15,039	18,568	1,318	345	17,594	15,125	2,469	2,469	0	15,125	6,960	467
	16	1996	2038	1.1061	2,716	3,004	39	346	3,312	0	3,312	3,312	0	0	7,168	471
	17	1997	2039	0.9886	2,334	2,307	58	345	2,593	0	2,593	2,593	0	0	7,089	475
	18	1998	2040	1.1716	18,978	22,234	2,079	348	20,503	25,293	-4,790	300	-5,090	20,203	6,981	479
	19	1999	2041	0.9404	1,614	1,517	118	352	1,752	236	1,516	1,516	0	236	6,958	483
	20	2000	2042	1.0879	5,478	5,960	58	350	6,251	0	6,251	4,338	1,913	1,913	7,156	487
	21	2001	2043	1.0938	8,835	9,663	238	345	9,770	1,820	7,950	4,606	3,343	5,164	6,986	491
	22	2002	2044	0.9254	858	794	12	346	1,128	0	1,128	1,128	0	0	7,025	495
	23	2003	2045	0.9533	949	904	20	350	1,234	0	1,234	1,234	0	0	7,128	499
	24	2004	2046	1.0462	617	645	16	345	974	0	974	974	0	0	7,075	503
	25	2005	2047	1.1573	13,242	15,325	542	350	15,133	4,850	10,282	4,912	5,370	10,220	7,049	507
	26	2006	2048	0.9659	4,950	4,781	36	347	5,093	0	5,093	4,121	972	972	7,091	511
	27	2007	2049	0.9922	48	48	10	347	385	0	385	385	0	0	7,052	516
	28	2008	2050	1.2152	3,883	4,719	43	346	5,022	0	5,022	4,107	916	916	7,040	520
	29	2009	2051	1.0181	830	845	17	346	1,174	0	1,174	1,174	0	0	7,062	524
	30	2010	2052	1.0565	4,367	4,613	88	348	4,874	192	4,681	4,035	646	839	6,932	528
	31	2011	2053	1.0169	7,758	7,889	902	350	7,337	6,515	822	822	0	6,515	7,004	532
	32	1984	2054	0.9121	1,010	921	13	348	1,257	0	1,257	1,257	0	0	7,230	536
	33	1985	2055	0.9460	812	768	16	346	1,098	0	1,098	1,098	0	0	7,103	540
	34	1986	2056	1.0104	1,582	1,599	81	337	1,855	317	1,538	1,538	0	317	7,034	544
	35	1987	2057	1.0365	724	751	19	348	1,079	0	1,079	1,079	0	0	7,072	548
	36	1988	2058	0.9952	747	743	22	347	1,068	0	1,068	1,068	0	0	7,006	552
	37	1989	2059	0.9886	479	474	14	345	804	0	804	804	0	0	6,944	556
	38	1990	2060	1.0941	338	370	14	344	700	0	700	700	0	0	6,916	560
	39	1991	2061	1.1486	5,312	6,101	26	345	6,421	0	6,421	4,367	2,054	2,054	6,928	564
	40	1992	2062	1.2135	4,928	5,980	130	345	6,195	1,315	4,879	4,077	802	2,118	7,147	568
	41	1991	2063	1.1486	5,312	6,101	26	345	6,421	0	6,421	4,367	2,054	2,054	6,943	572
	42	1990	2064	1.0941	338	370	14	344	700	0	700	700	0	0	7,111	576
	43	1989	2065	0.9886	479	474	14	345	804	0	804	804	0	0	7,008	580
	44	1988	2066	0.9952	747	743	22	347	1,068	0	1,068	1,068	0	0	7,049	584
	45	1987	2067	1.0365	724	751	19	348	1,079	0	1,079	1,079	0	0	6,872	588
	46	1986	2068	1.0104	1,582	1,599	81	337	1,855	317	1,538	1,538	0	317	6,952	592
	47	1985	2069	0.9460	812	768	16	346	1,098	0	1,098	1,098	0	0	7,132	596
	48	1998	2070	1.1716	18,978	22,234	2,079	348	20,503	25,293	-4,790	300	-5,090	20,203	7,070	600
	49	1999	2071	0.9404	1,614	1,517	118	352	1,752	236	1,516	1,516	0	236	7,140	604
	50	2000	2072	1.0879	5,478	5,960	58	350	6,251	0	6,251	4,338	1,913	1,913	6,972	608
			Average	1.0493	4,016	4,479	216	346	4,609	2,089	2,520	2,114	407	2,496	7,039	509
			Min	0.9121	48	48	10	337	385	0	-4,790	300	-5,090	0	6,845	411
			Max	1.2346	28,732	31,458	2,079	352	30,221	25,293	12,870	5,196	7,674	25,025	7,230	608



Land Use - 1959

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Truck and Berry Crops

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

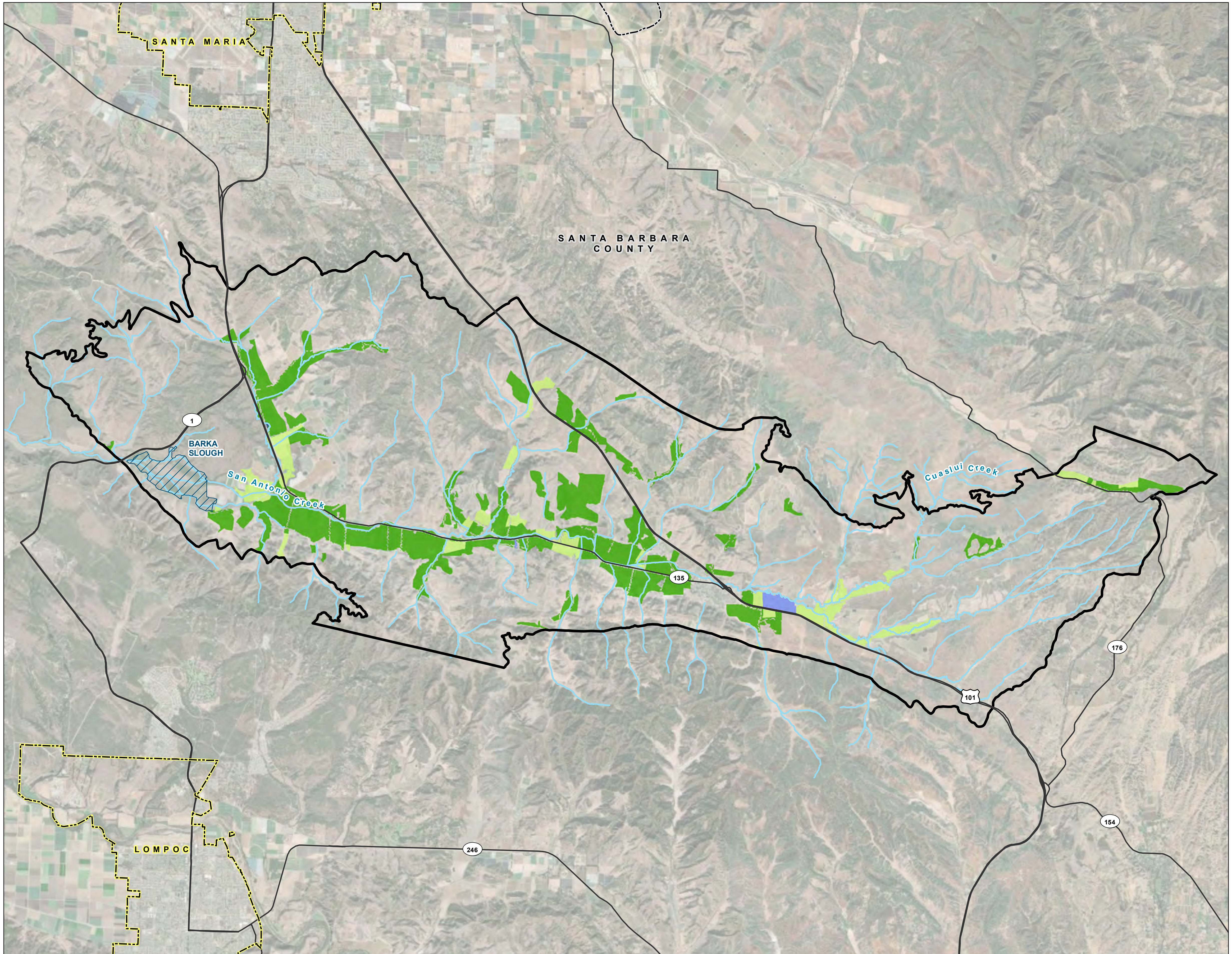
N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\AppendixE\LandUse1959.mxd, abarry



Land Use - 1968

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

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Feet

GSI Water Solutions, Inc.

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

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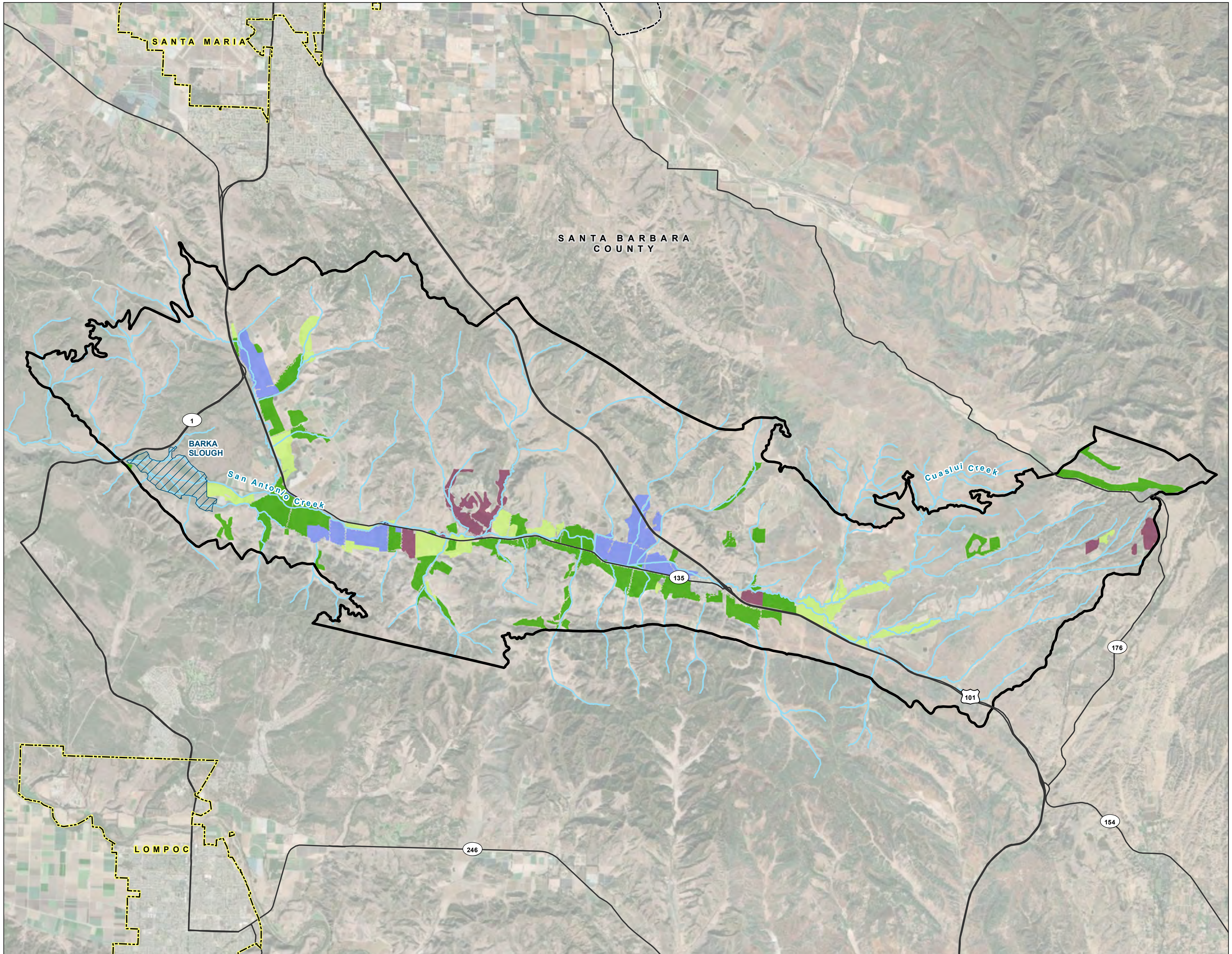

Land Use - 1977

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

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Feet

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

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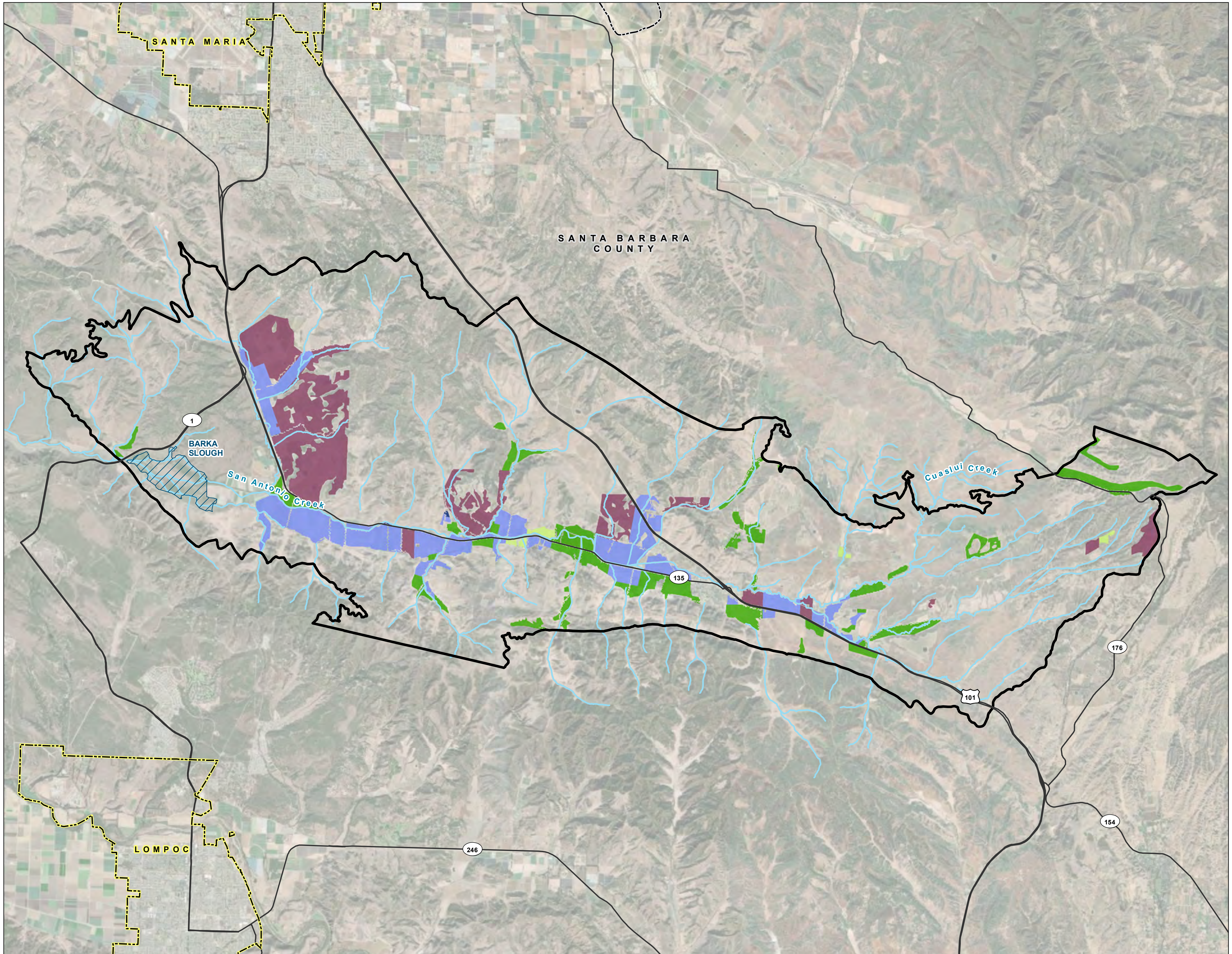

Land Use - 1986

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

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Feet

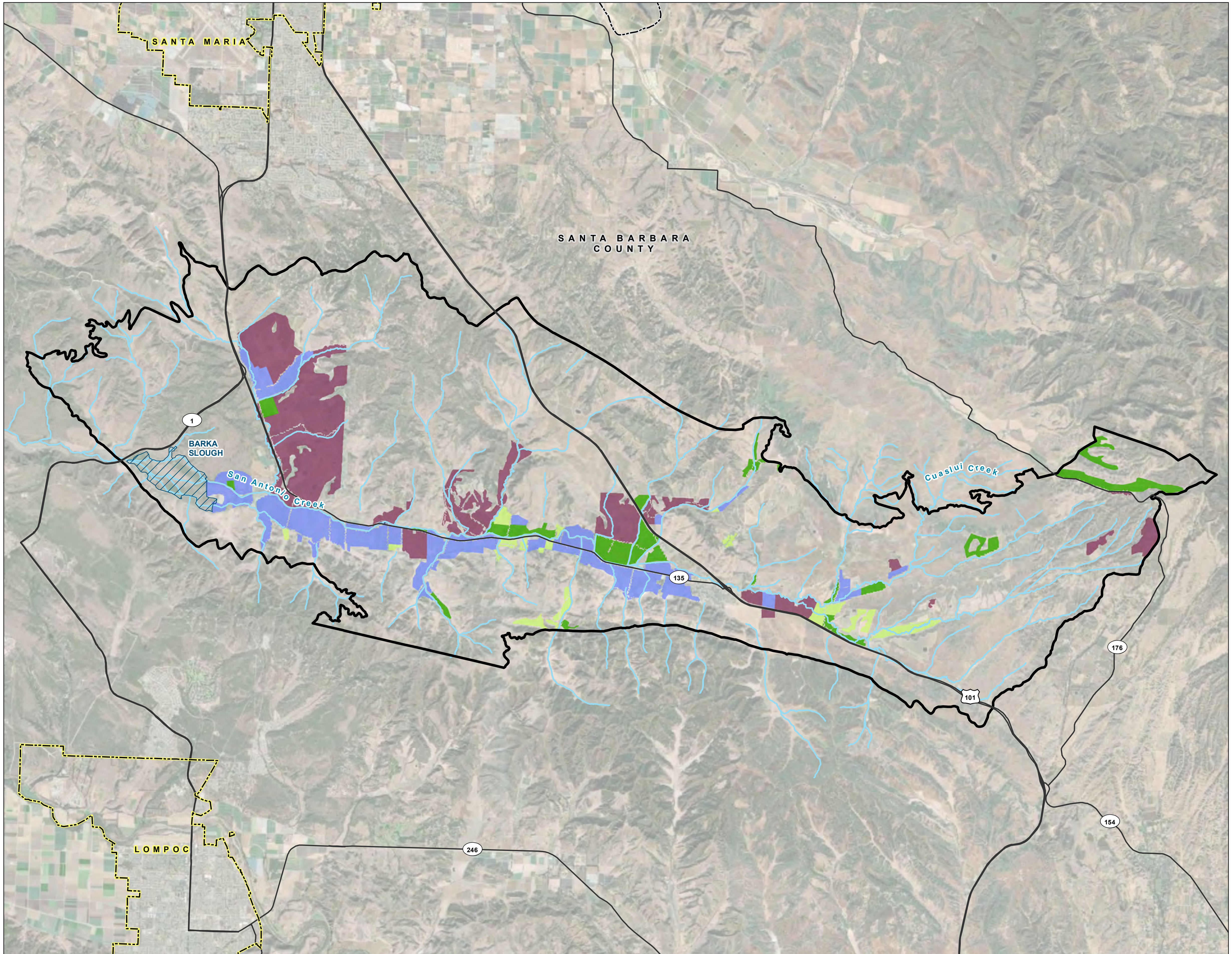
Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\AppendixE\LandUse1986.mxd, abarry

Land Use - 1996

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin



LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

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Feet

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

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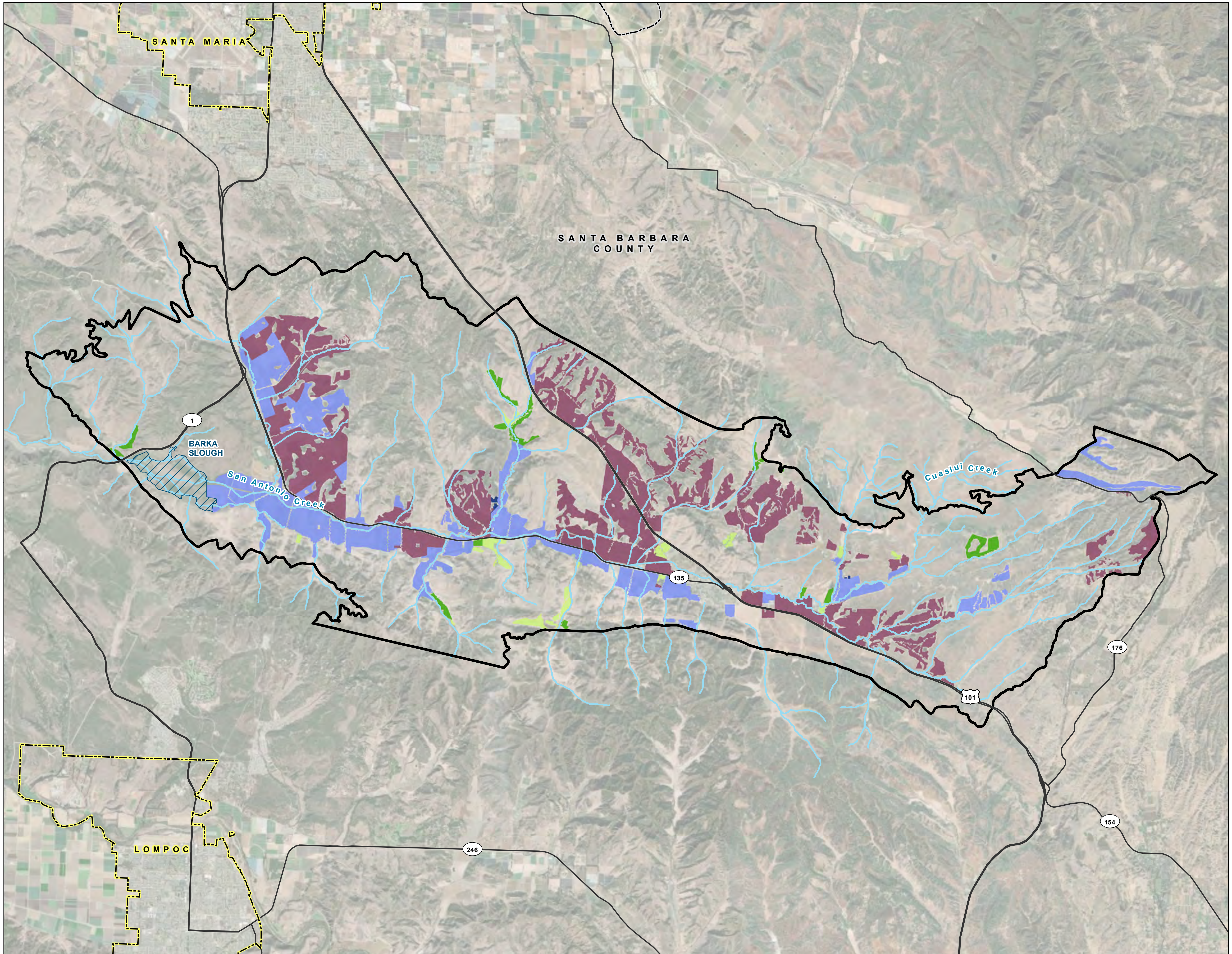

Land Use - 2006

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.

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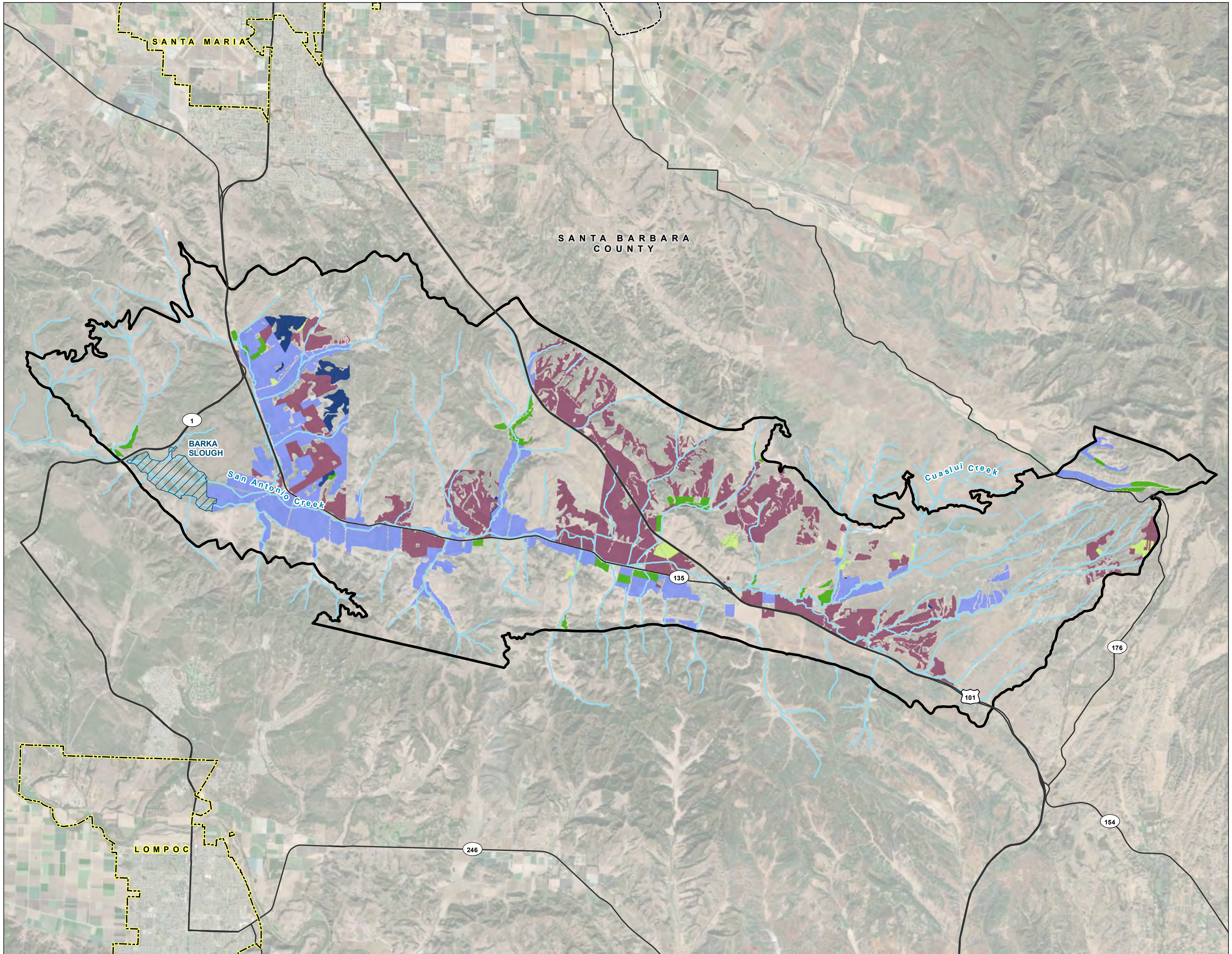

Land Use - 2016

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

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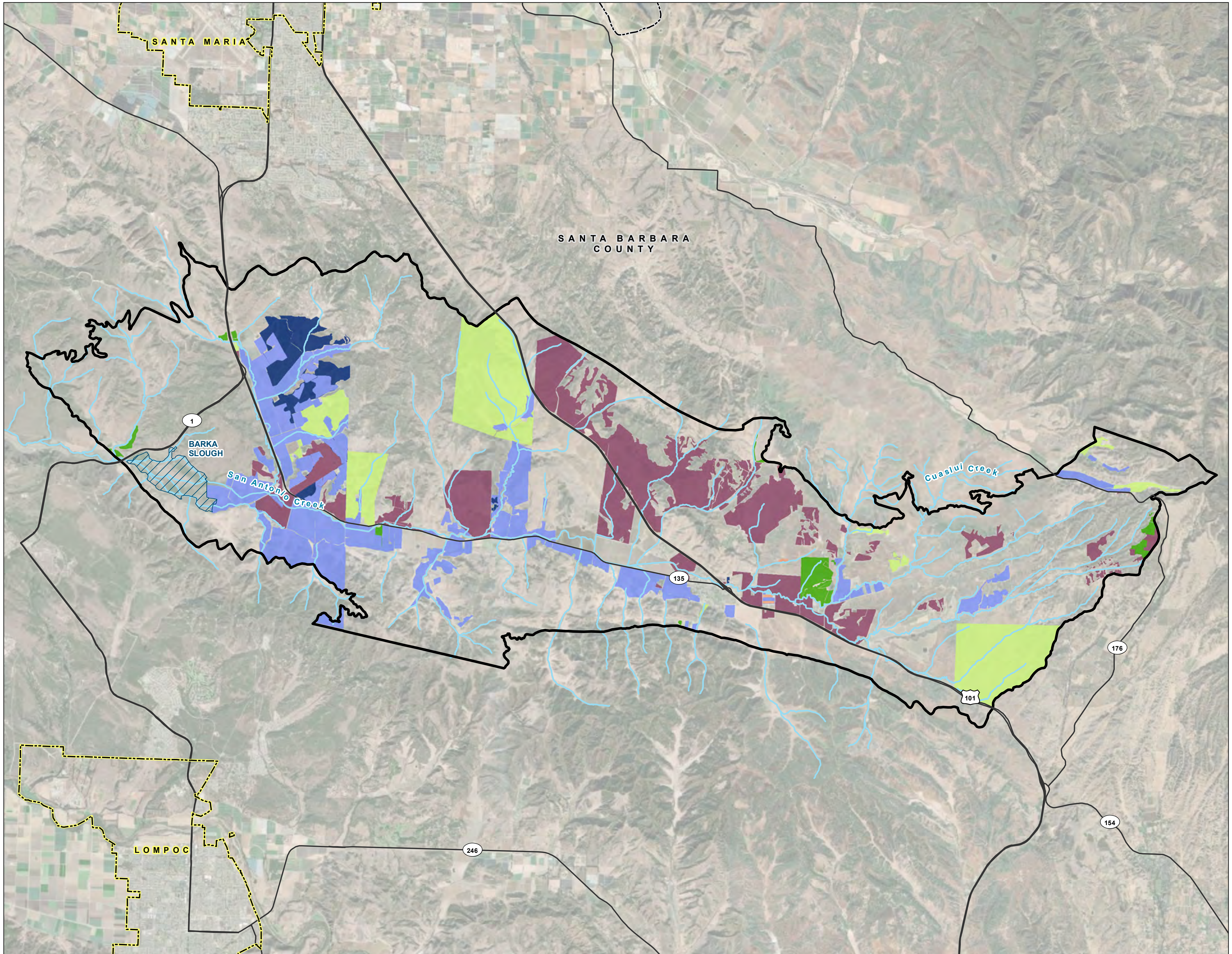
Feet

Date: November 19, 2021
Data Sources: USGS (2020b, 2020e), ESRI, DWR (2018a), Maxar imagery (2020)

GSI Water Solutions, Inc.



Land Use - 2020

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Crop Type

- Field Crops
- Pasture
- Cannabis/Hemp
- Tree Crops
- Truck and Berry Crops
- Vineyards

All Other Features

- Barka Slough
- San Antonio Creek Valley Groundwater Basin
- County Boundary
- City Boundary
- Major Road
- San Antonio Creek or Adjacent Tributary

NOTE

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

Date: November 19, 2021
Data Sources: USGS (2020b), ESRI, DWR (2018a), Maxar imagery (2020), SB County (2020)

GSI Water Solutions, Inc.

Document Path: Y:\0748_San_Antonio_GSP\Source_Figures\001_SanAntonio_Basin_GSA\GW_Sustainability_Plan\AppendixE\LandUse2020.mxd, abarry

APPENDIX F

Map and Hydrographs of Wells in the San Antonio Creek Valley Groundwater Basin with Minimum Thresholds and Measurable Objectives

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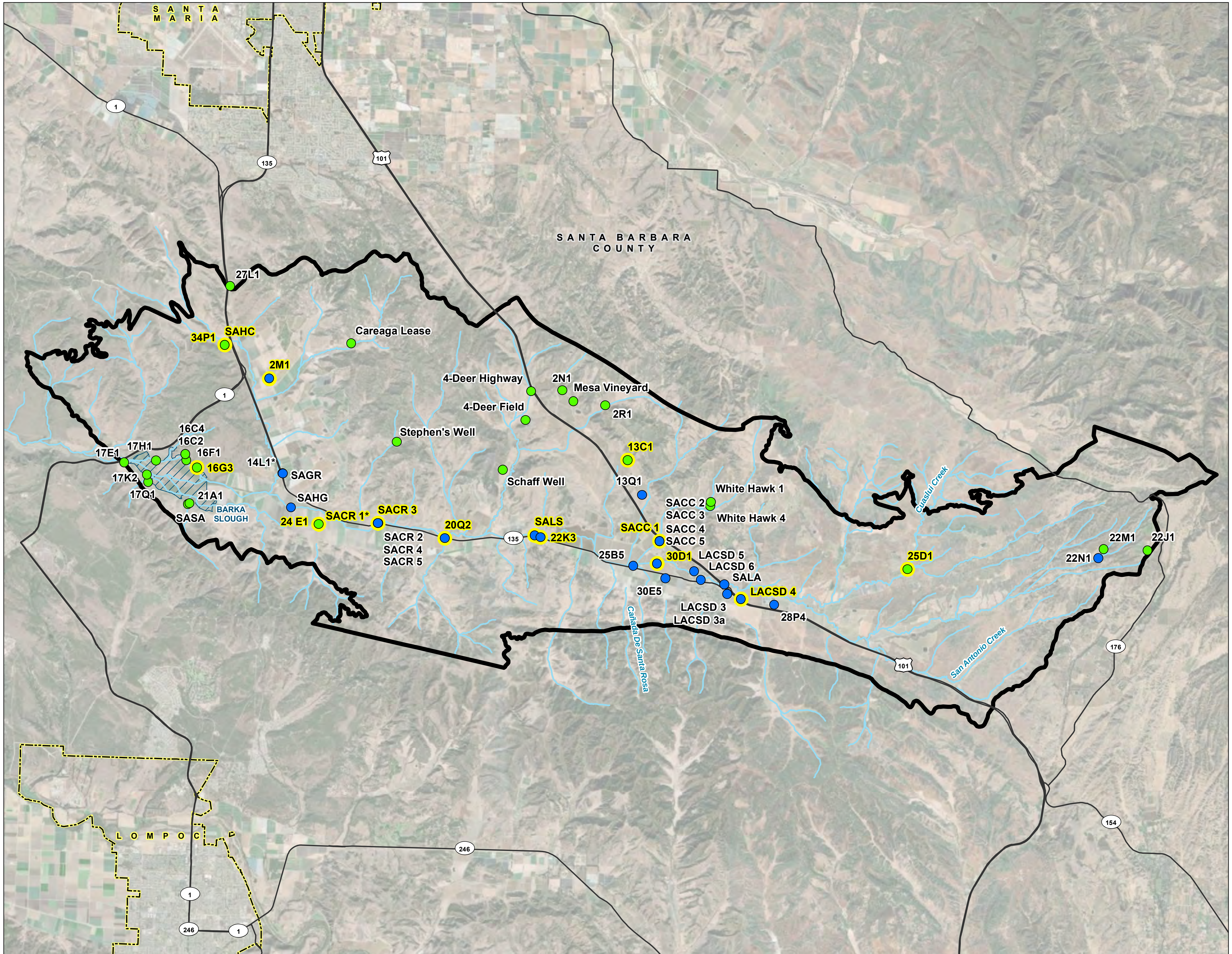

Wells Included in the San Antonio Creek Valley Groundwater Basin Groundwater Monitoring Network

Groundwater Sustainability Plan
San Antonio Creek Valley
Groundwater Basin

LEGEND

Representative Well

Wells (by screened aquifer)

Paso Robles Formation

Careaga Sand

All Other Features

San Antonio Creek or Tributary

Major Road

San Antonio Creek Valley Groundwater Basin

Barka Slough

City Boundary

NOTES

*SACR 1 and 14L1 are screened in the Careaga Sand.

San Antonio Creek Valley Groundwater Basin Boundary as defined in the California Department of Water Resources Bulletin 118.

N

0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: September 16, 2021
Data Sources: USGS (2020b), ESRI, DWR (2019a), Maxar imagery (2020)

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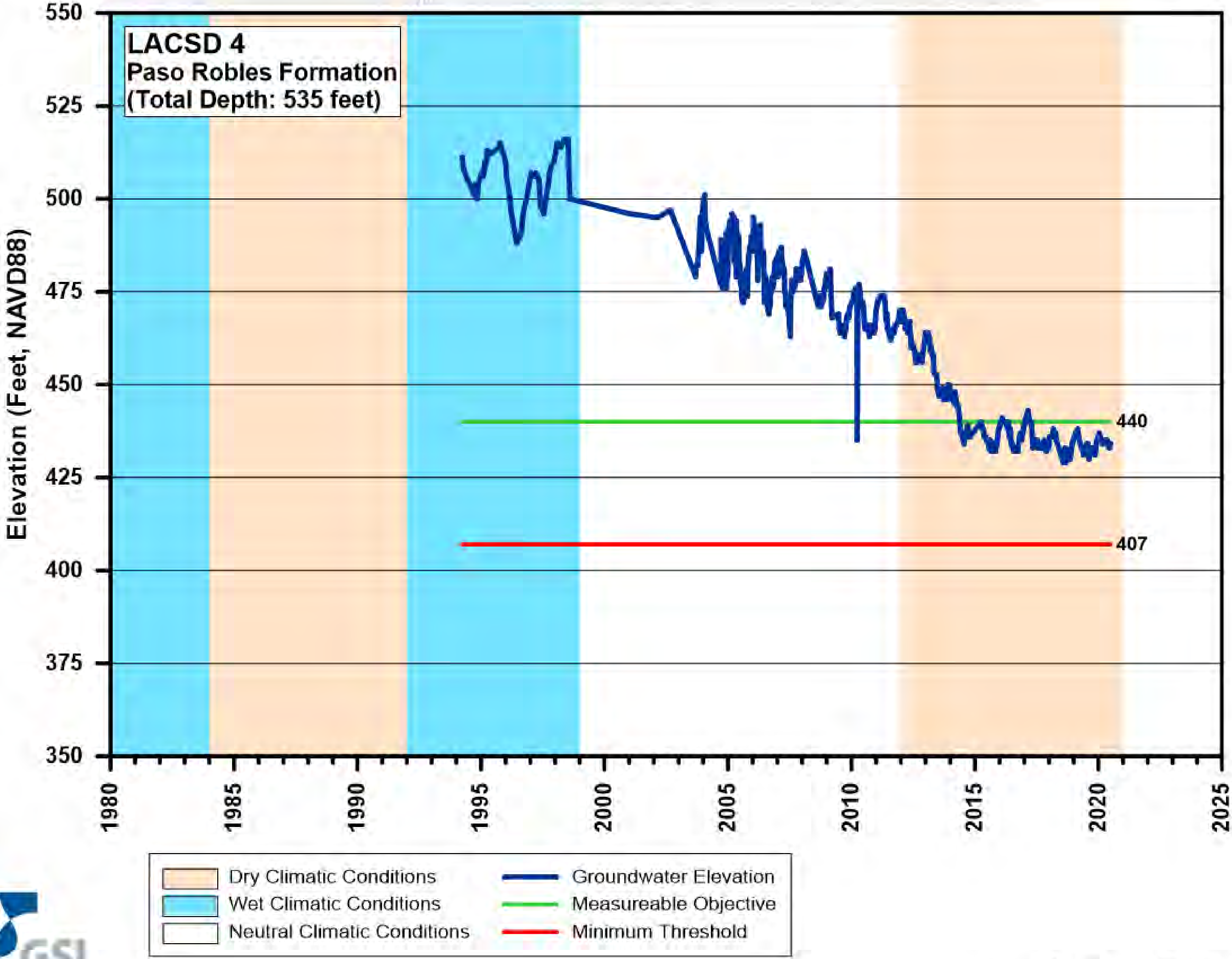
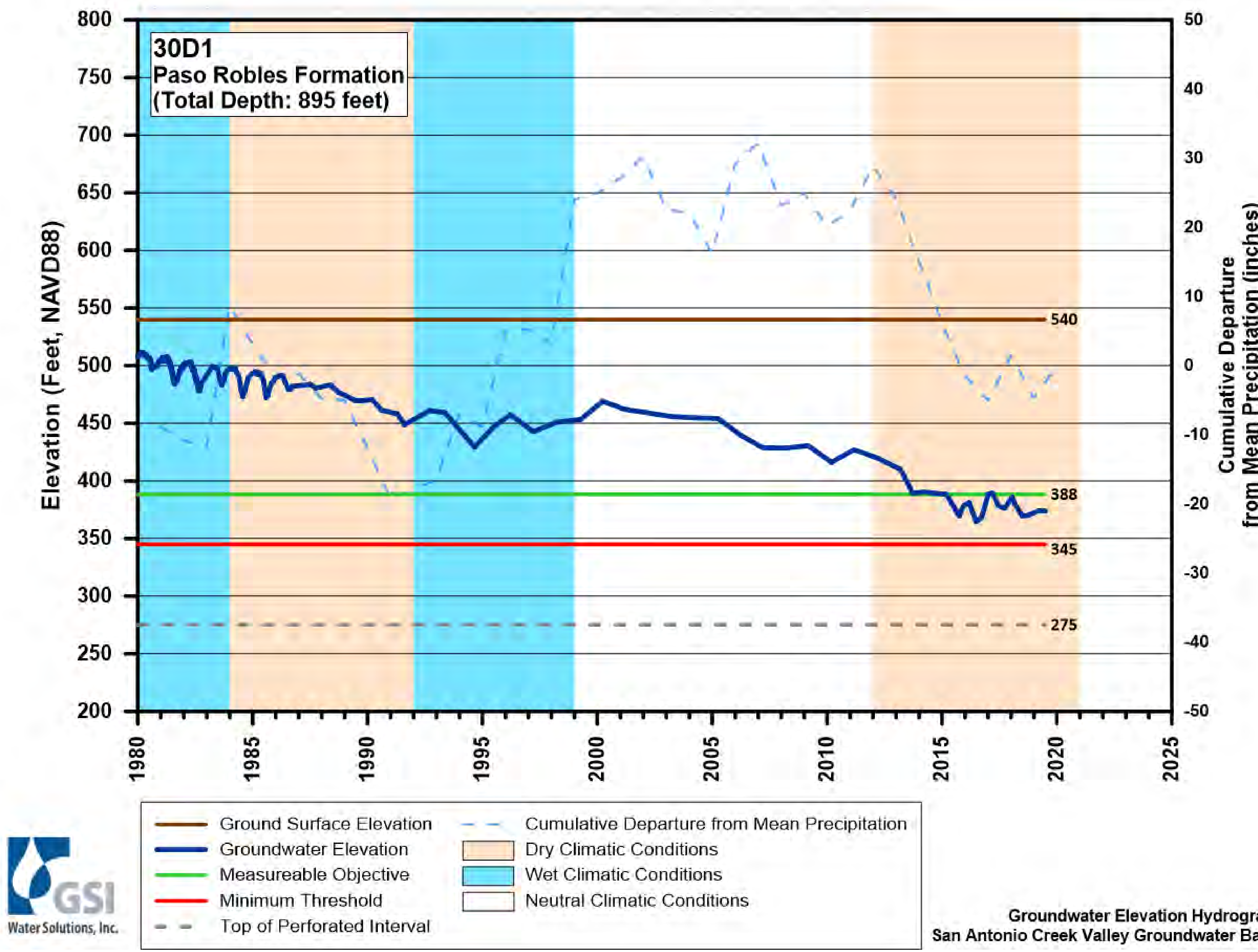
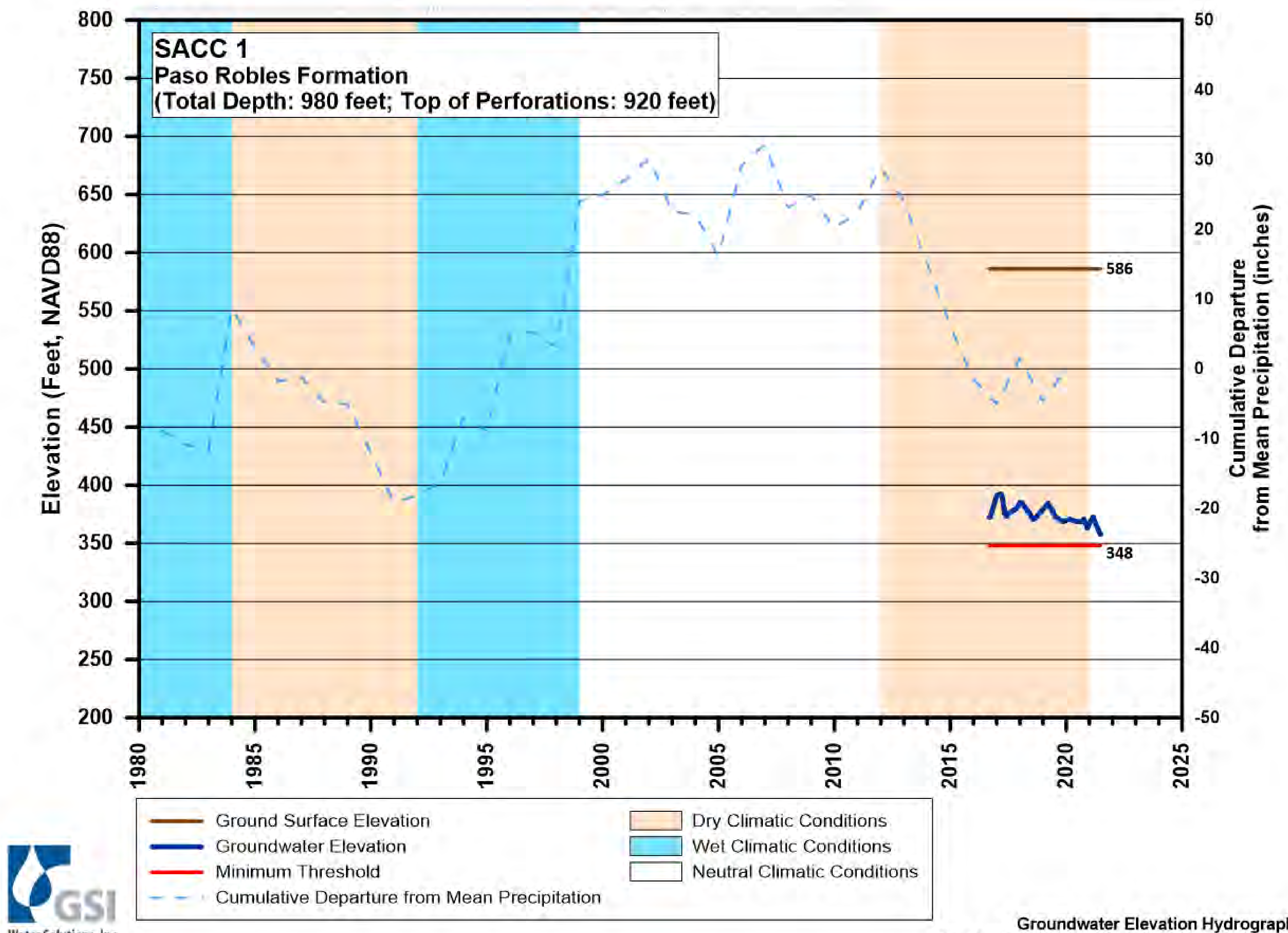


GSI Water Solutions, Inc.

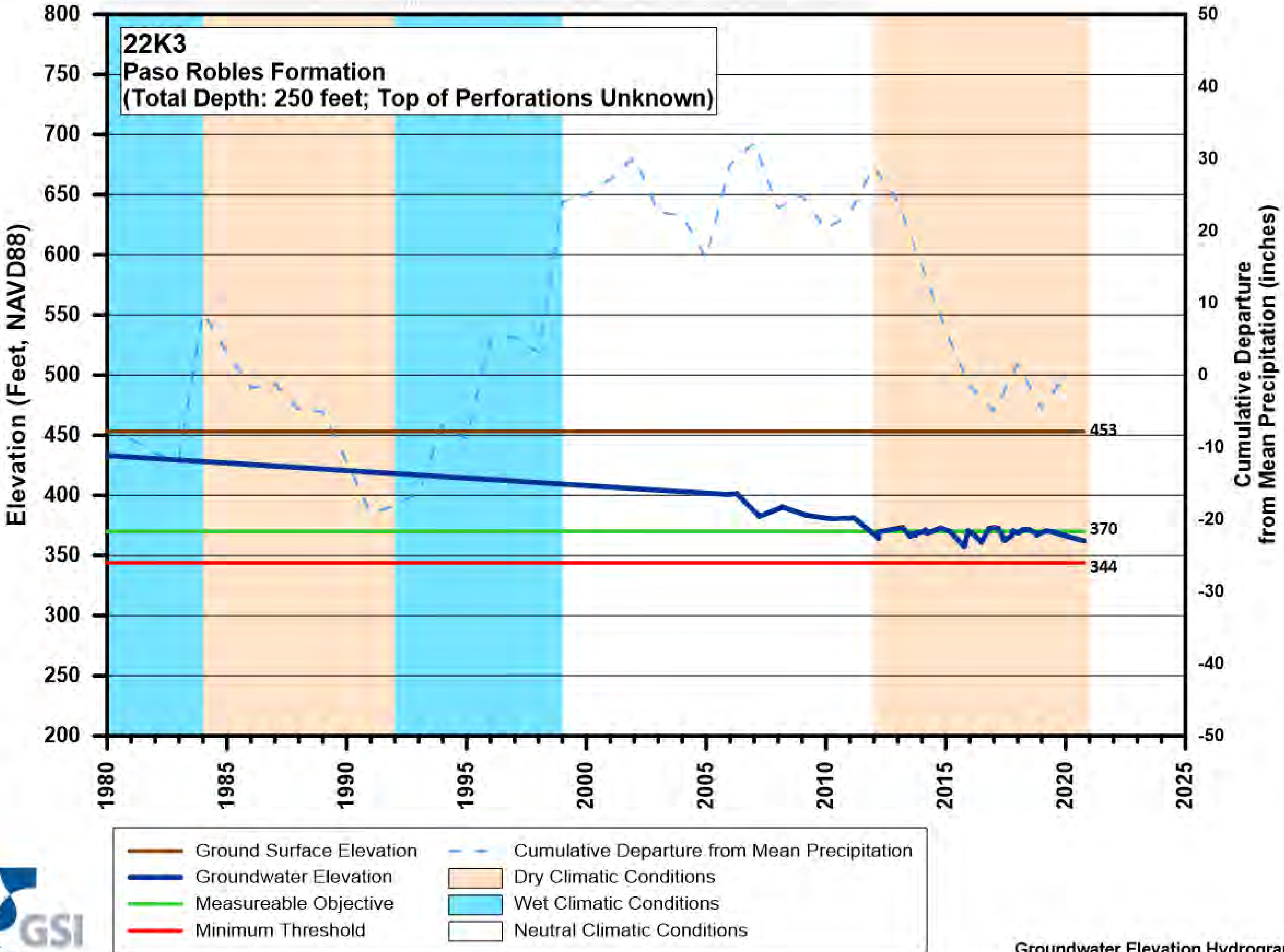
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

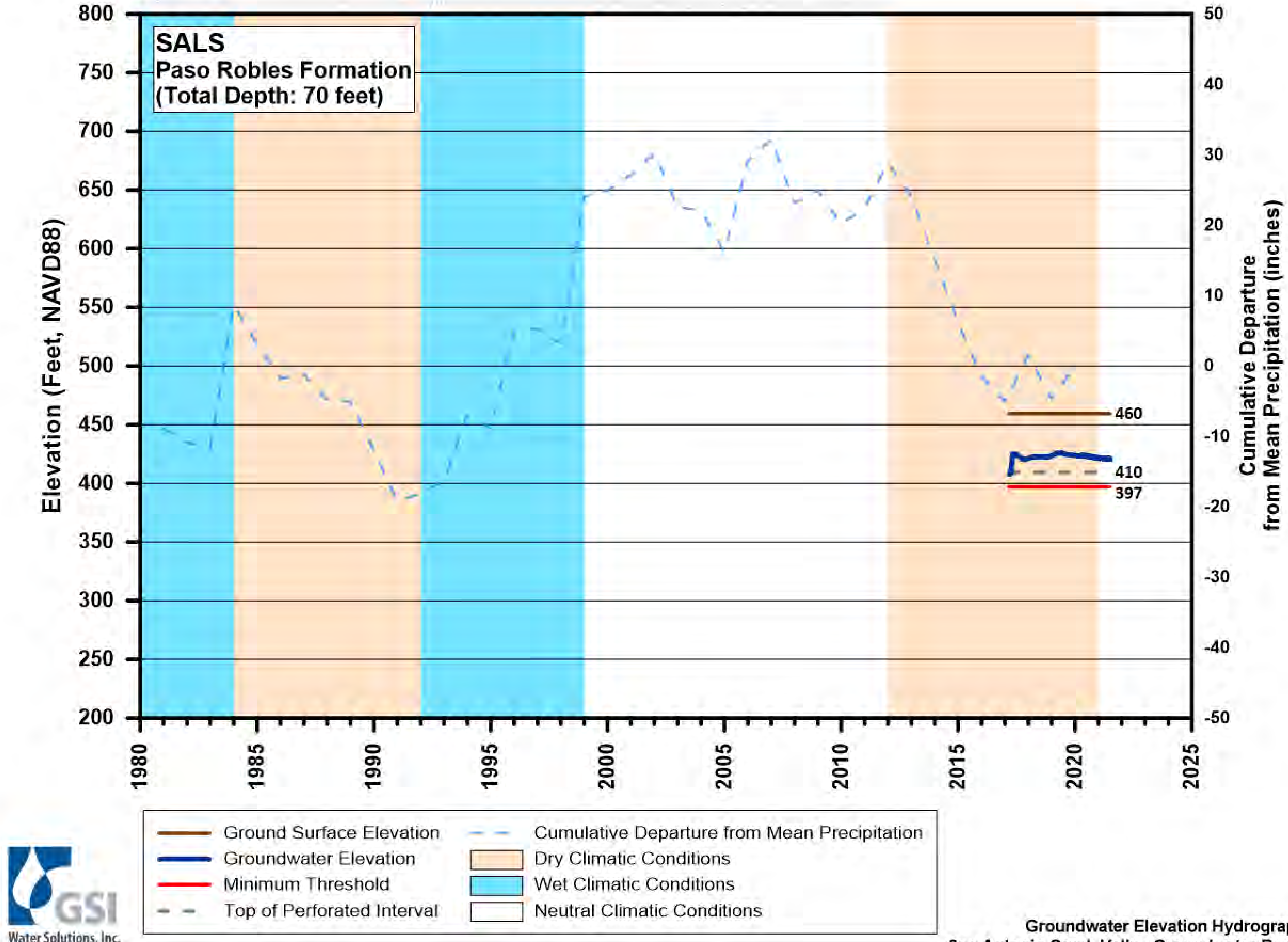


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

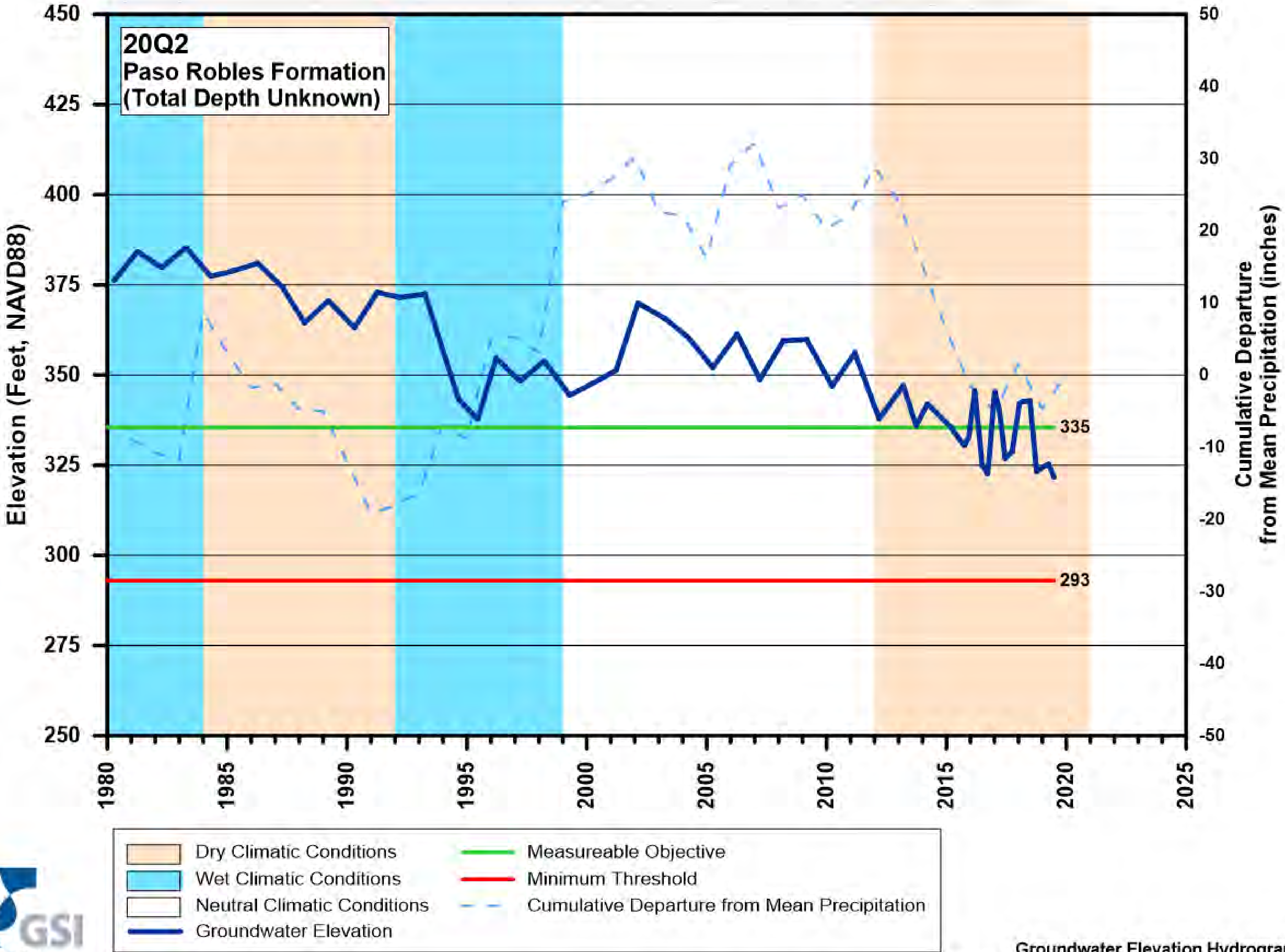


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

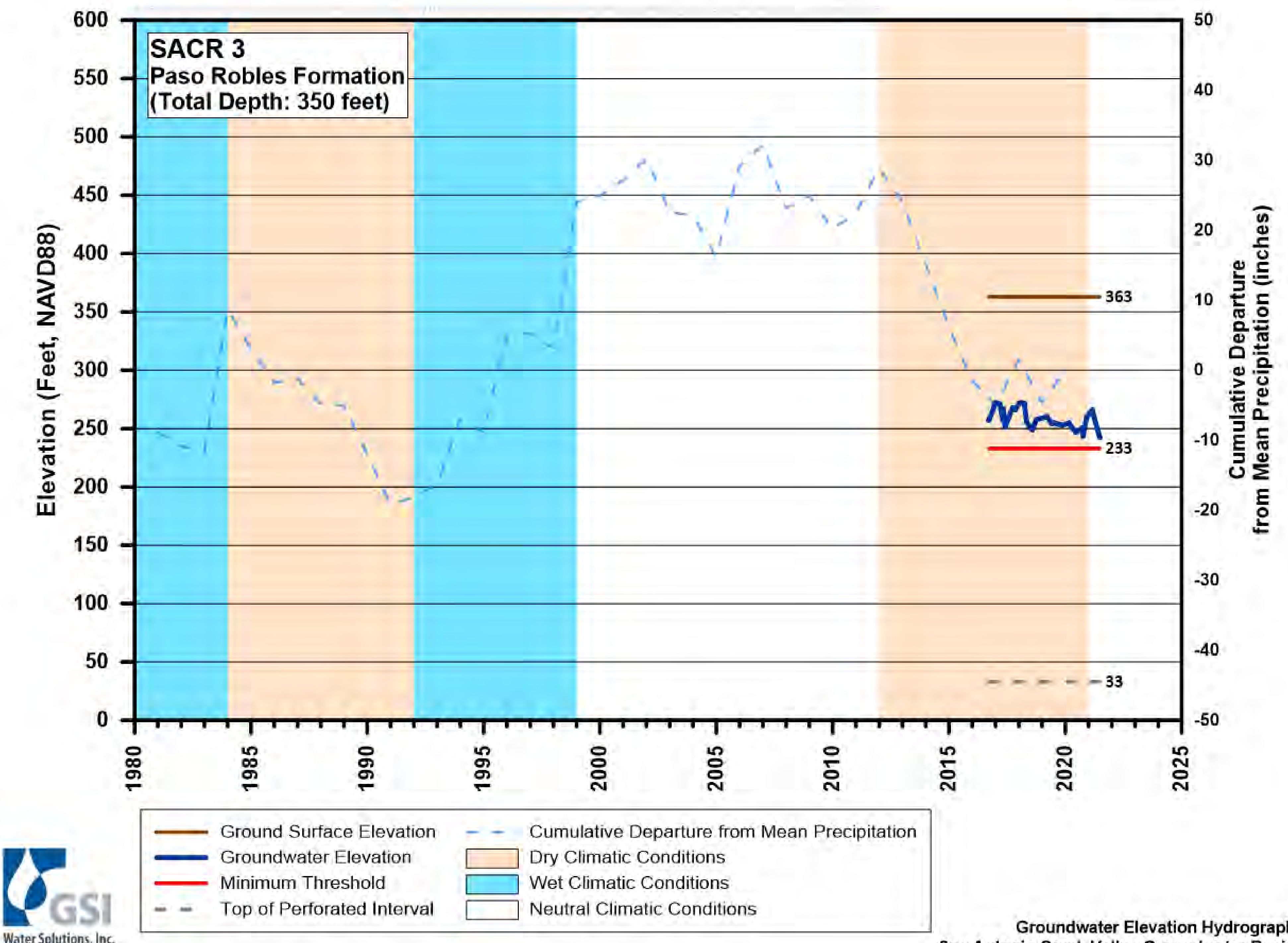


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

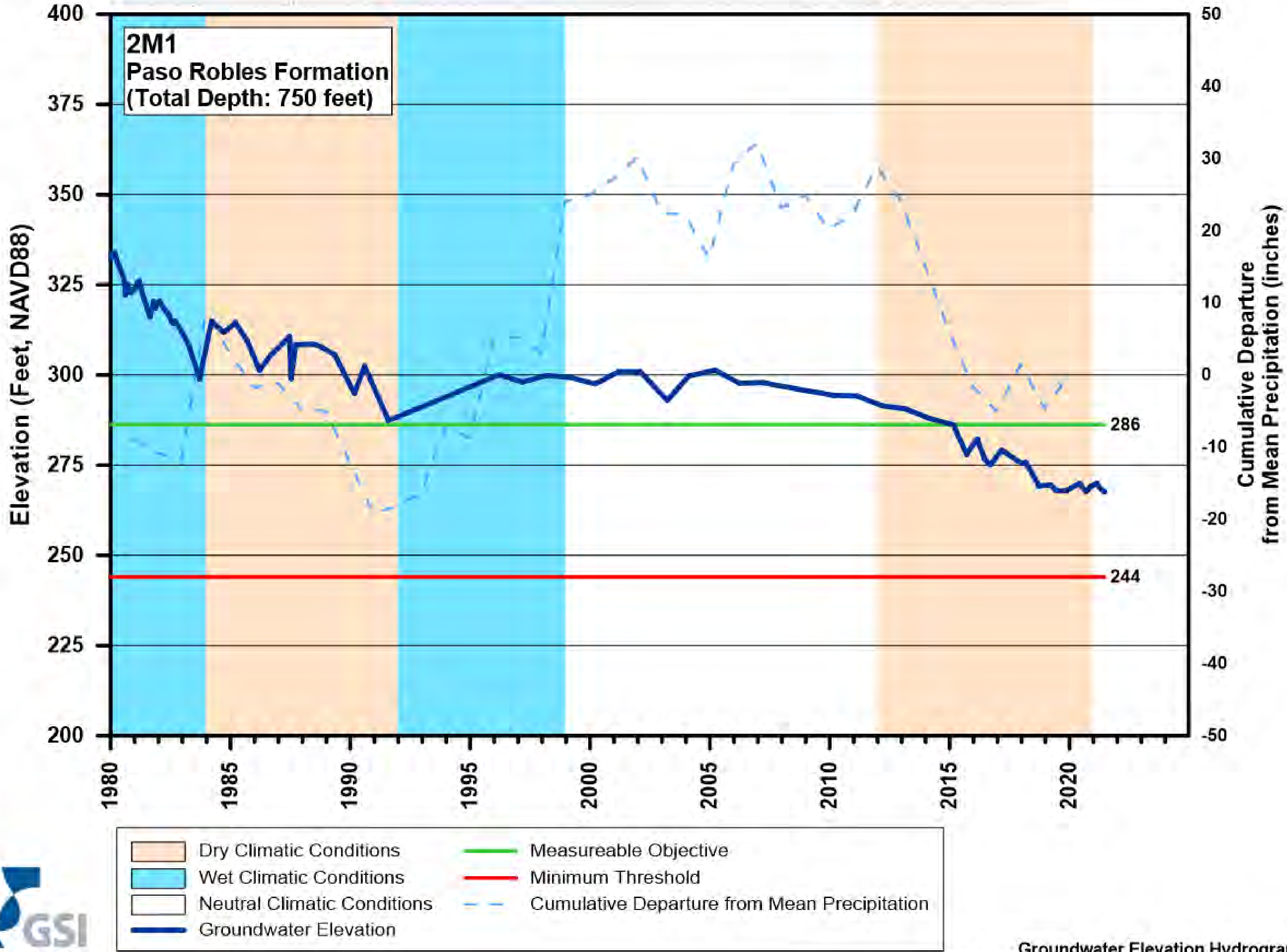


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

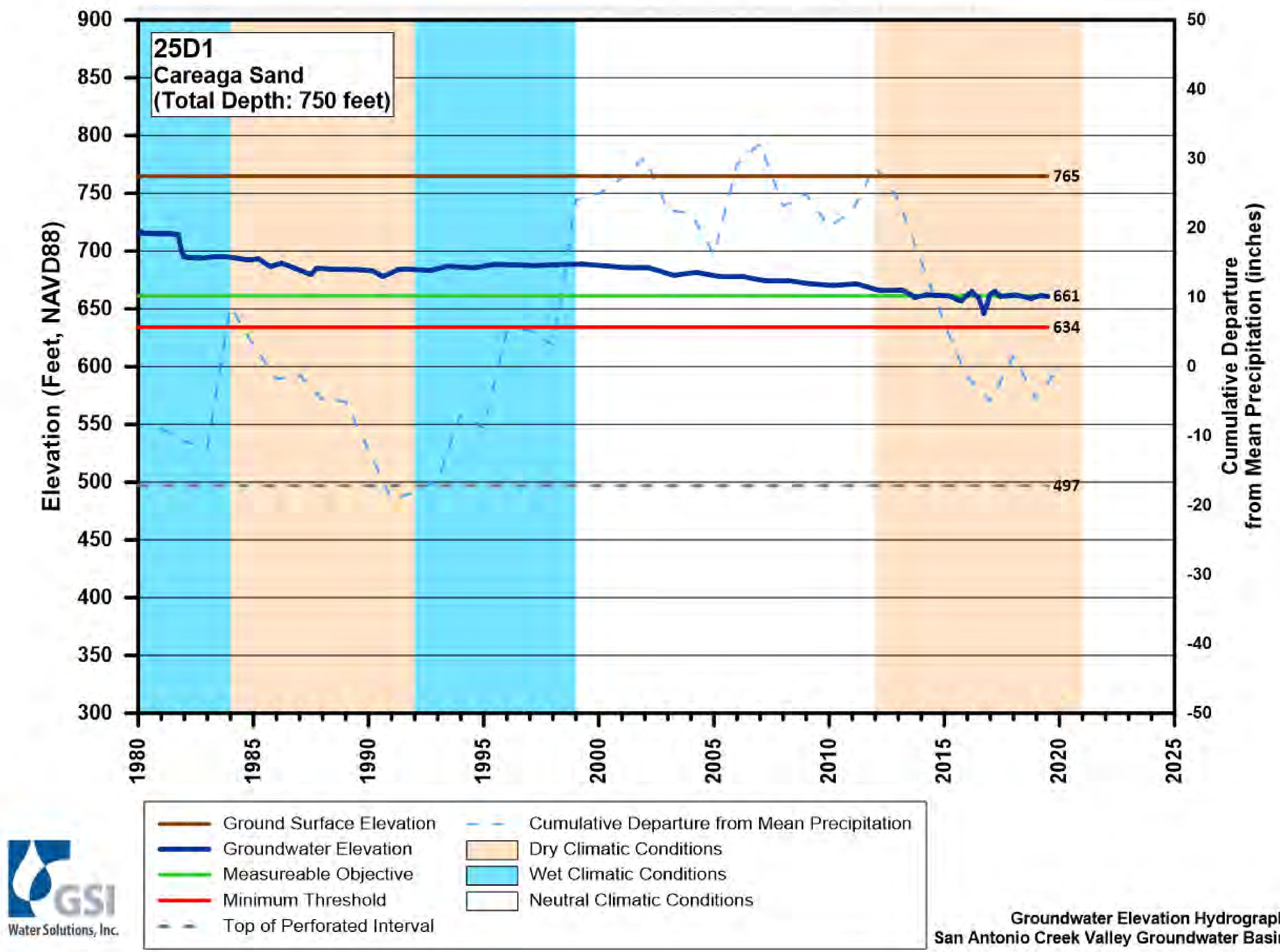


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

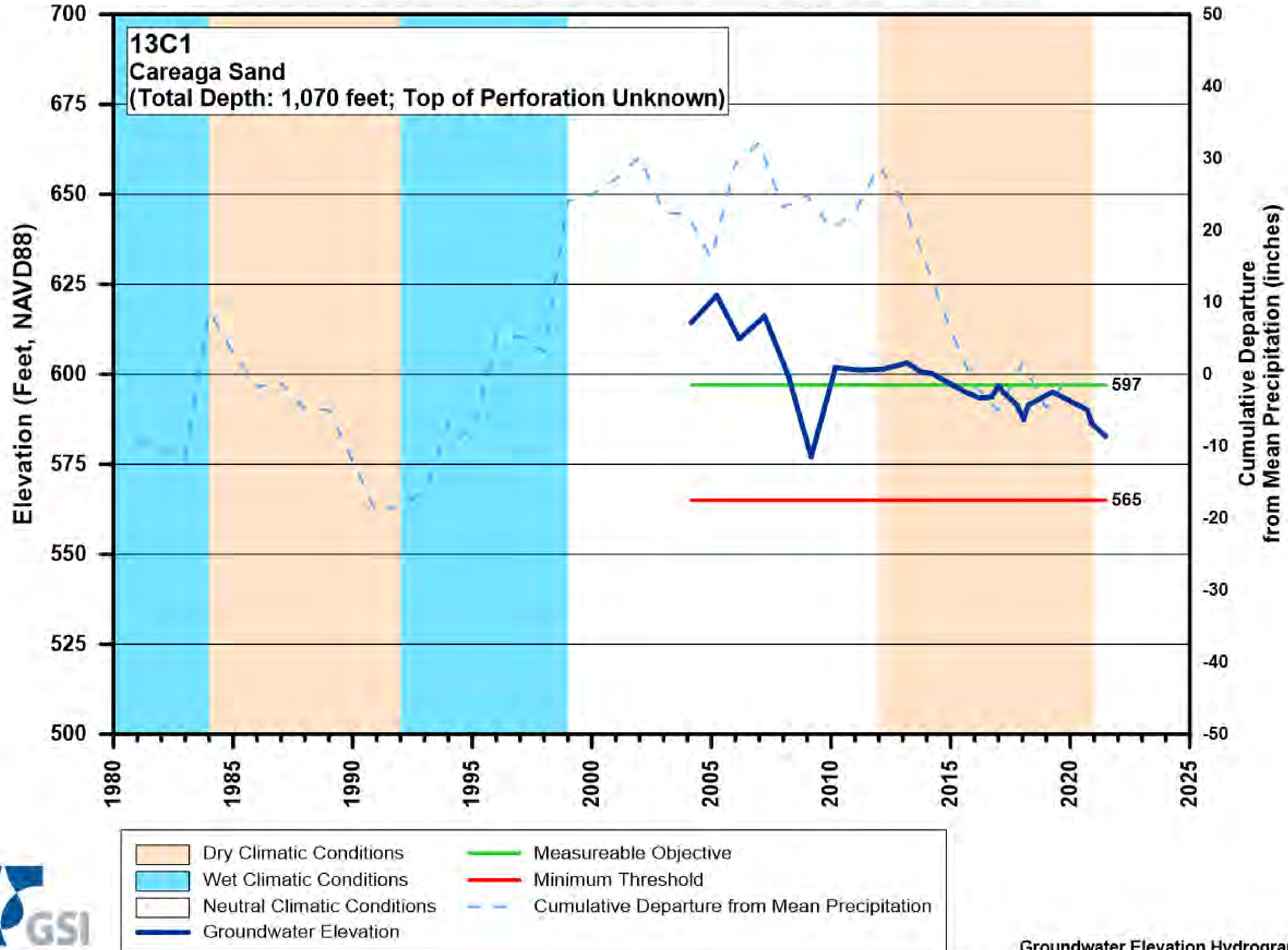


GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

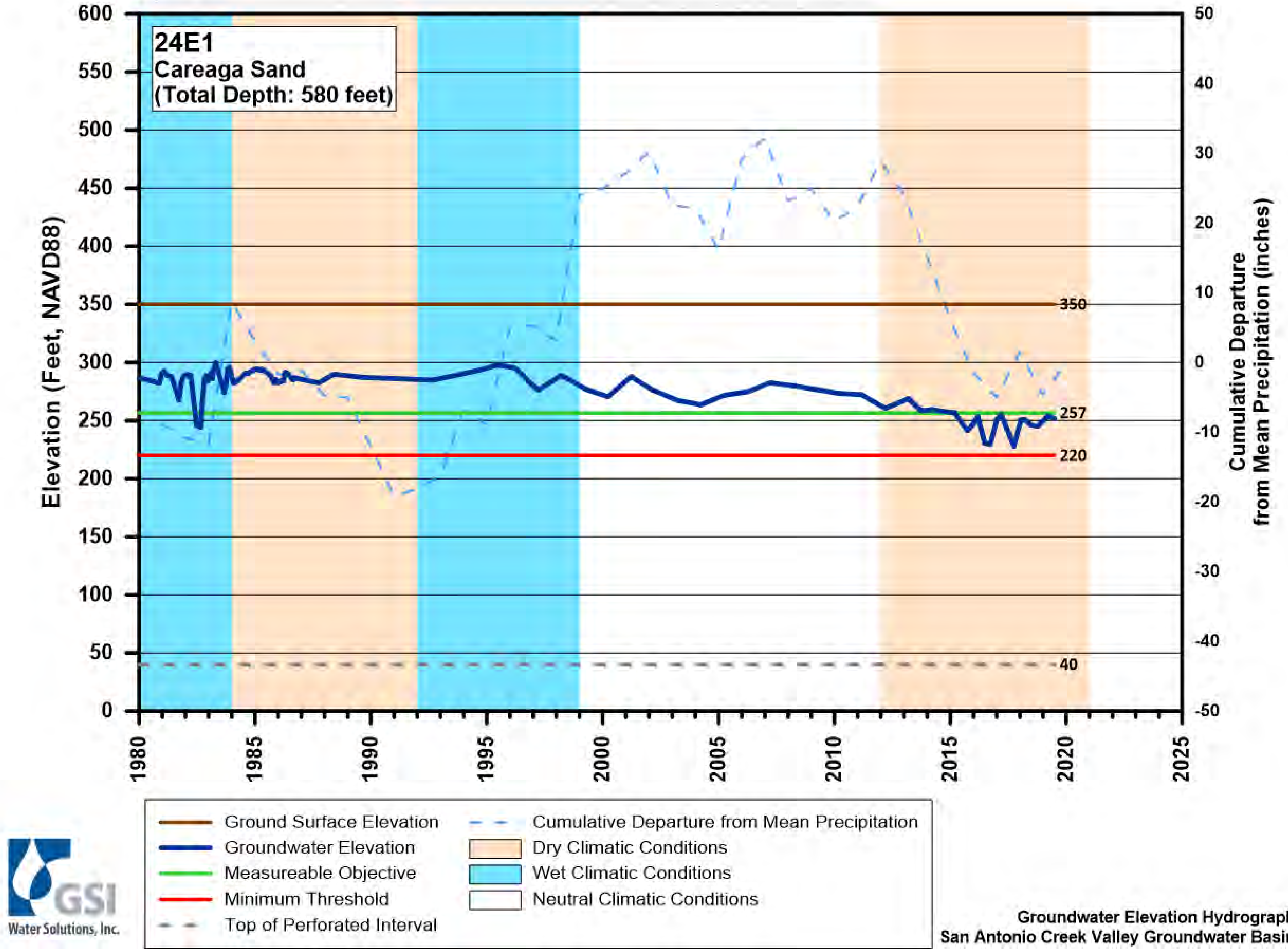


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

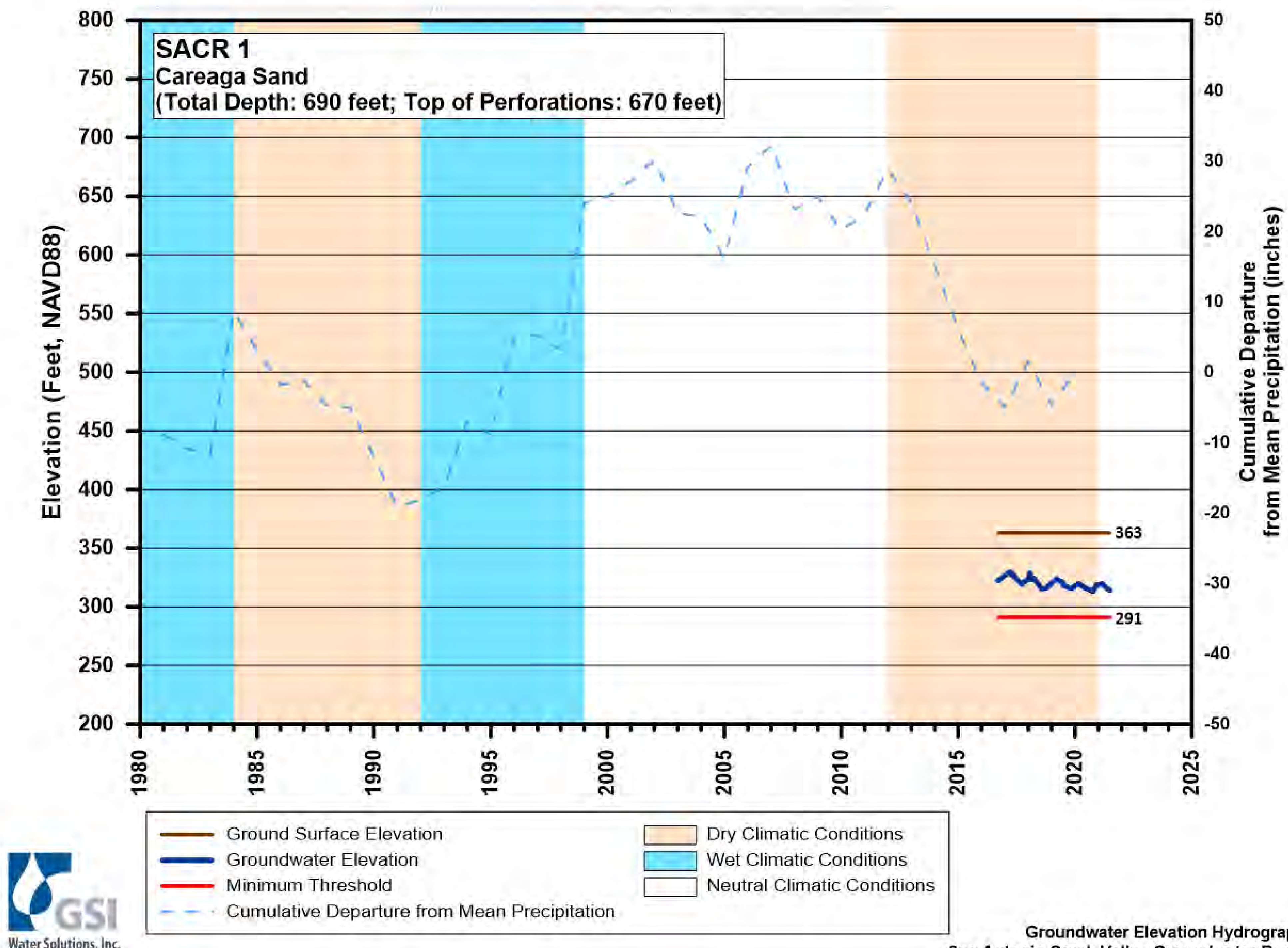


GSI Water Solutions, Inc.

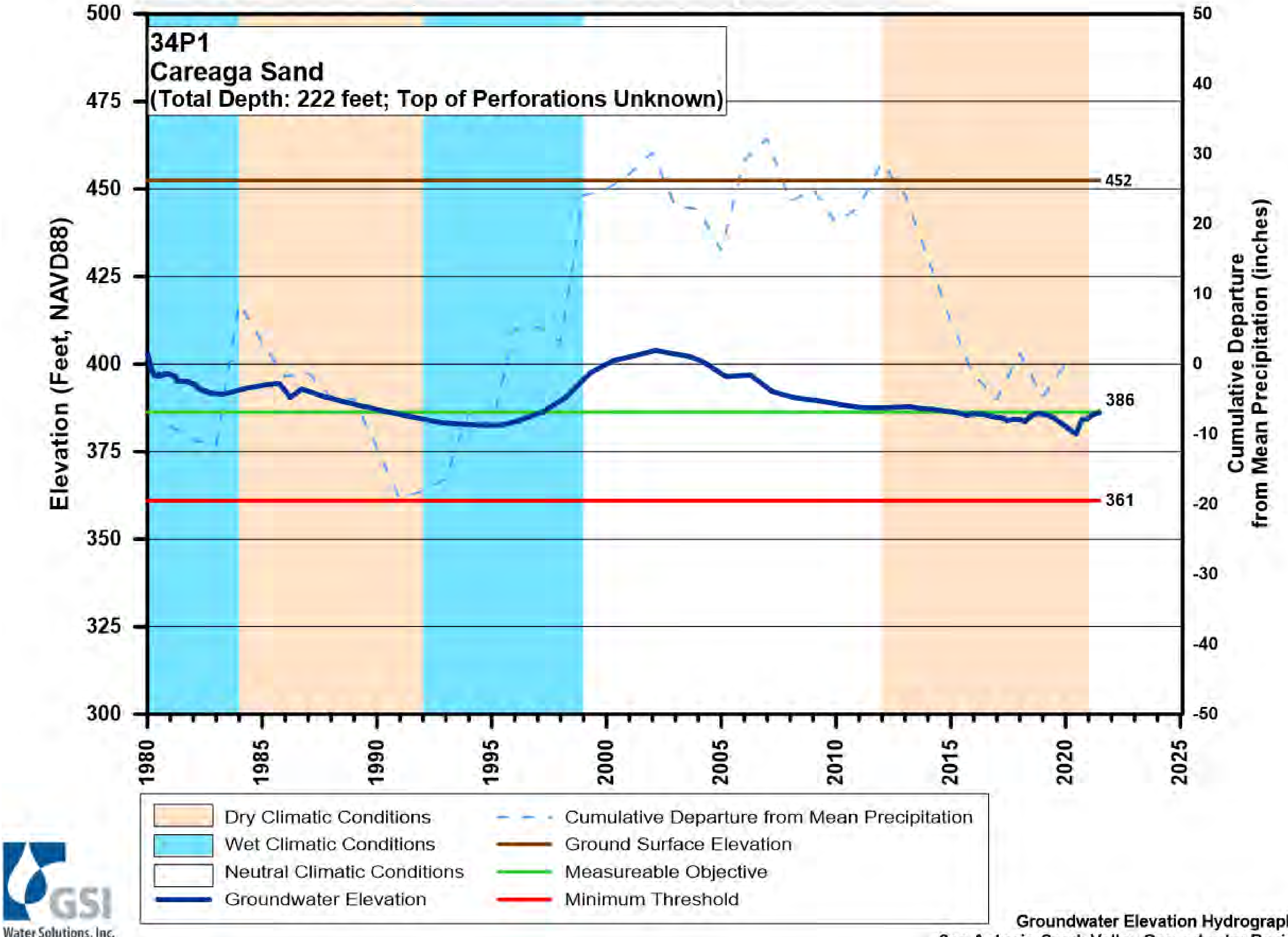
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



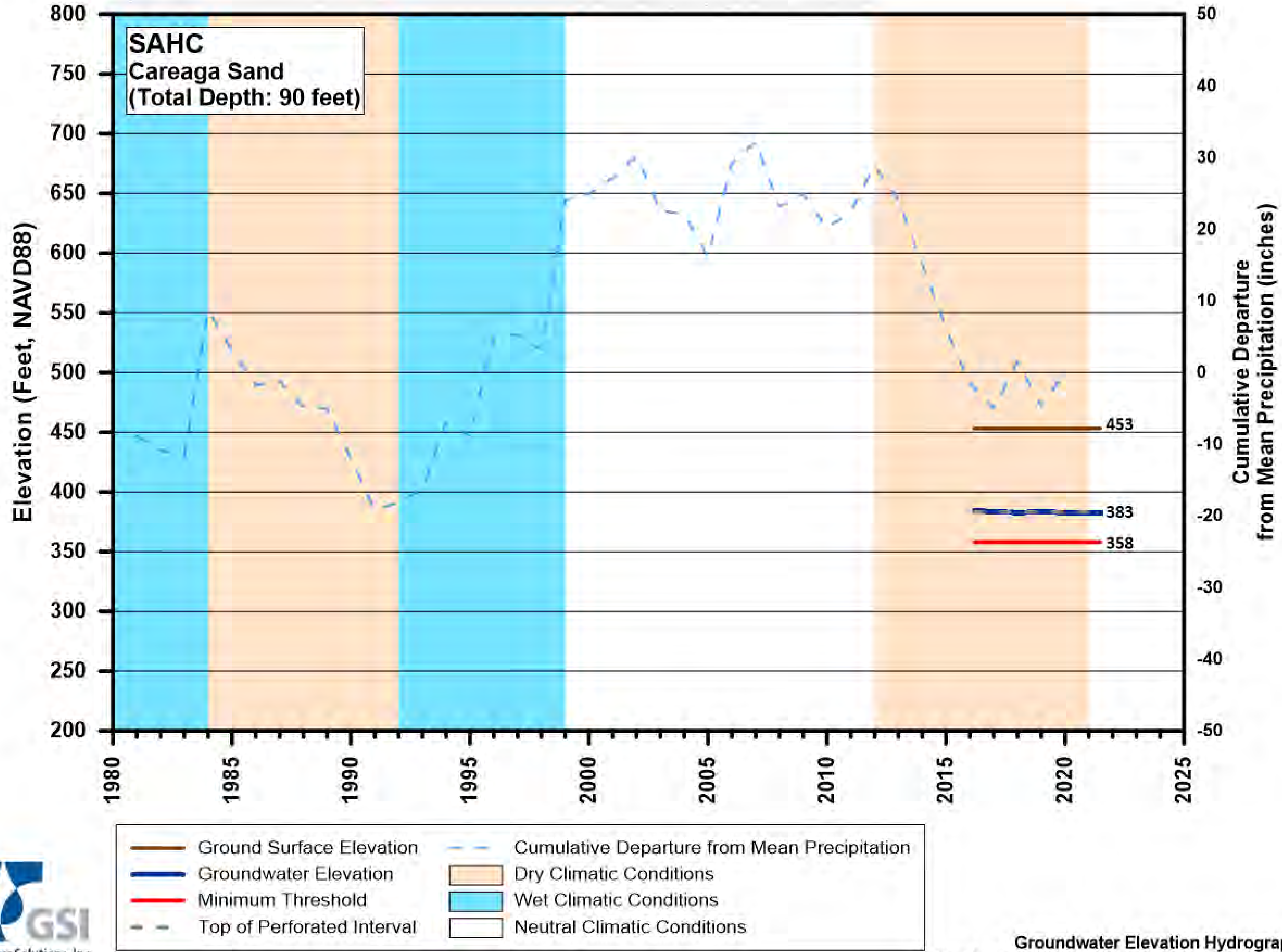
Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

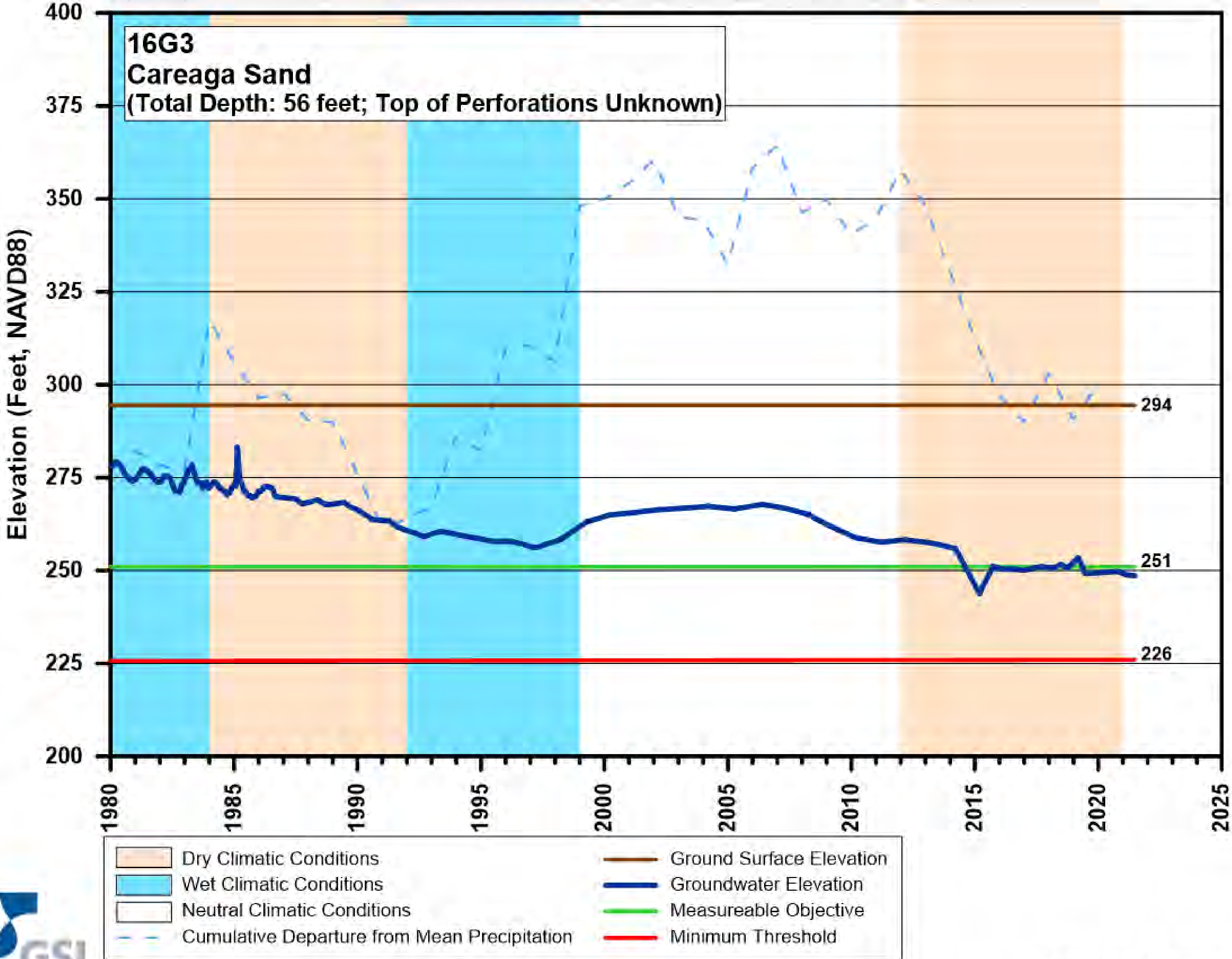


Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin



GSI Water Solutions, Inc.

Groundwater Elevation Hydrograph
San Antonio Creek Valley Groundwater Basin

APPENDIX G-1

Standard Operating Procedures:
Monitoring Protocols, Standards, and Sites Best Management Practice; Van Essen Instruments Diver Product Manual;
Van Essen Instruments Diver Barometric Compensation Quick Reference Guide

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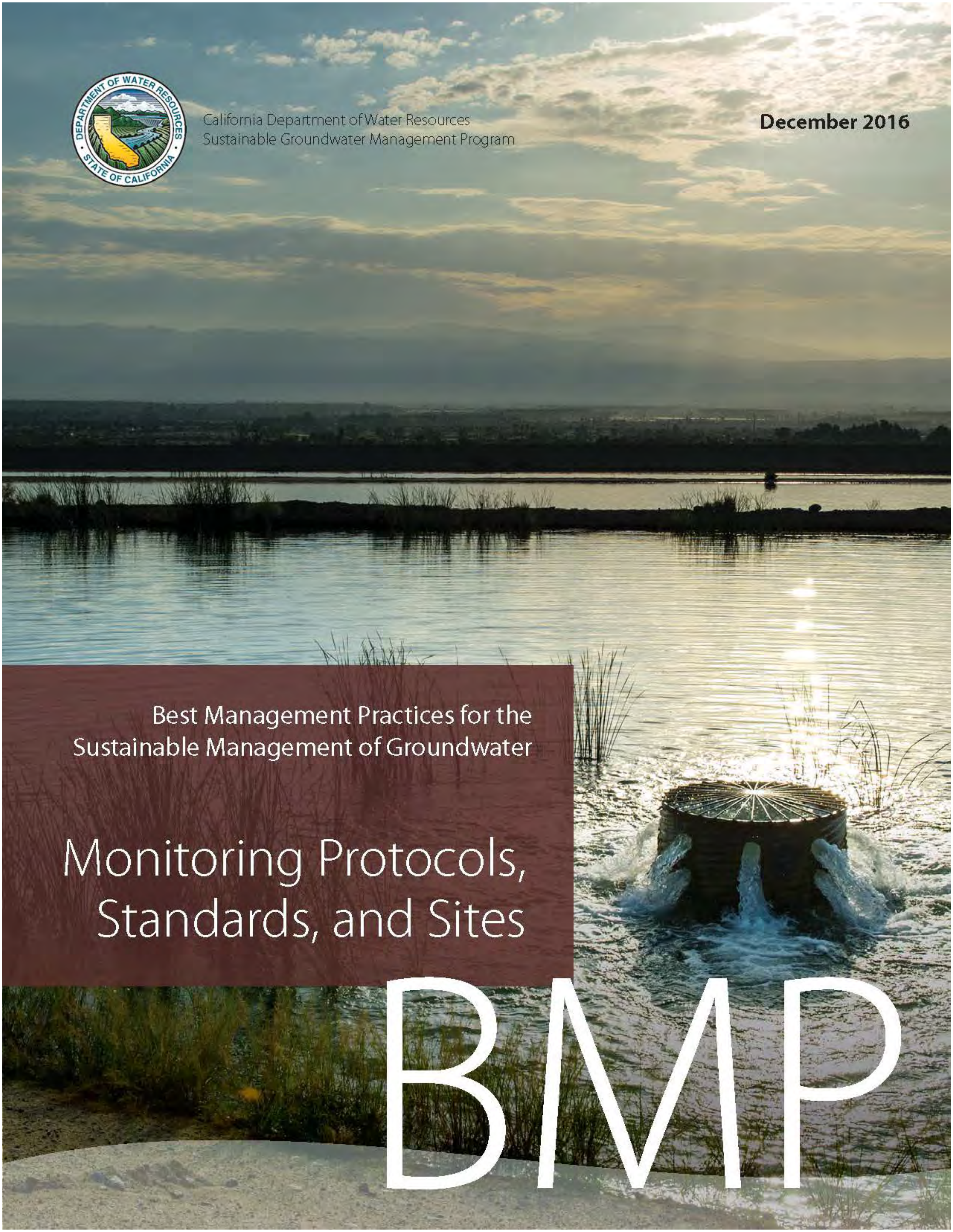

California Department of Water Resources
Sustainable Groundwater Management Program

December 2016

Best Management Practices for the Sustainable Management of Groundwater

Monitoring Protocols, Standards, and Sites

BMP

Prepared under the direction of:

David Gutierrez, Sustainable Groundwater Management Program Manager
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Prepared by:

Trevor Joseph, BMP Project Manager

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With assistance from:

DWR Region Office Staff

Groundwater Monitoring Protocols, Standards, and Sites Best Management Practice

1. Objective

The objective of this *Best Management Practice* (BMP) is to assist in the development of Monitoring Protocols. The California Department of Water Resources (the Department or DWR) has developed this document as part of the obligation in the Technical Assistance chapter (Chapter 7) of the Sustainable Groundwater Management Act (SGMA) to support the long-term sustainability of California's groundwater *basins*. Information provided in this BMP provides technical assistance to Groundwater Sustainability Agencies (GSAs) and other stakeholders to aid in the establishment of consistent data collection processes and procedures. In addition, this BMP can be used by GSAs to adopt a set of sampling and measuring procedures that will yield similar data regardless of the monitoring personnel. Finally, this BMP identifies available resources to support the development of monitoring protocols.

This BMP includes the following sections:

1. Objective. A brief description of how and where monitoring protocols are required under SGMA and the overall objective of this BMP.
2. Use and Limitations. A brief description of the use and limitations of this BMP.
3. Monitoring Protocol Fundamentals. A description of the general approach and background of groundwater monitoring protocols.
4. Relationship of Monitoring Protocols to other BMPs. A description of how this BMP is connected with other BMPS.
5. Technical Assistance. Technical content providing guidance for regulatory sections.
6. Key Definitions. Descriptions of definitions identified in the GSP Regulations or SGMA.
7. Related Materials. References and other materials that provide supporting information related to the development of Groundwater Monitoring Protocols.

2. USE AND LIMITATIONS

BMPs developed by the Department provide technical guidance to GSAs and other stakeholders. Practices described in these BMPs do not replace the GSP Regulations, nor do they create new requirements or obligations for GSAs or other stakeholders. In addition, using this BMP to develop a GSP does not equate to an approval determination by the Department. All references to GSP Regulations relate to Title 23 of the California Code of Regulations (CCR), Division 2, Chapter 1.5, and Subchapter 2. All references to SGMA relate to California Water Code sections in Division 6, Part 2.74.

3. MONITORING PROTOCOL FUNDAMENTALS

Establishing data collection protocols that are based on best available scientific methods is essential. Protocols that can be applied consistently across all basins will likely yield comparable data. Consistency of data collection methods reduces uncertainty in the comparison of data and facilitates more accurate communication within basins as well as between basins.

Basic minimum technical standards of accuracy lead to quality data that will better support implementation of GSPs.

4. RELATIONSHIP OF MONITORING PROTOCOL TO OTHER BMPS

Groundwater monitoring is a fundamental component of SGMA, as each GSP must include a sufficient network of data that demonstrates measured progress toward the achievement of the sustainability goal for each basin. For this reason, a standard set of protocols need to be developed and utilized.

It is important that data is developed in a manner consistent with the basin setting, planning, and projects/management actions steps identified on **Figure 1** and the GSP Regulations. The inclusion of monitoring protocols in the GSP Regulations also emphasizes the importance of quality empirical data to support GSPs and provide comparable information from basin to basin.

Figure 1 provides a logical progression for the development of a GSP and illustrates how monitoring protocols are linked to other related BMPs. This figure also shows the context of the BMPs as they relate to various steps to sustainability as outlined in the GSP Regulations. The monitoring protocol BMP is part of the Monitoring step identified in **Figure 1**.

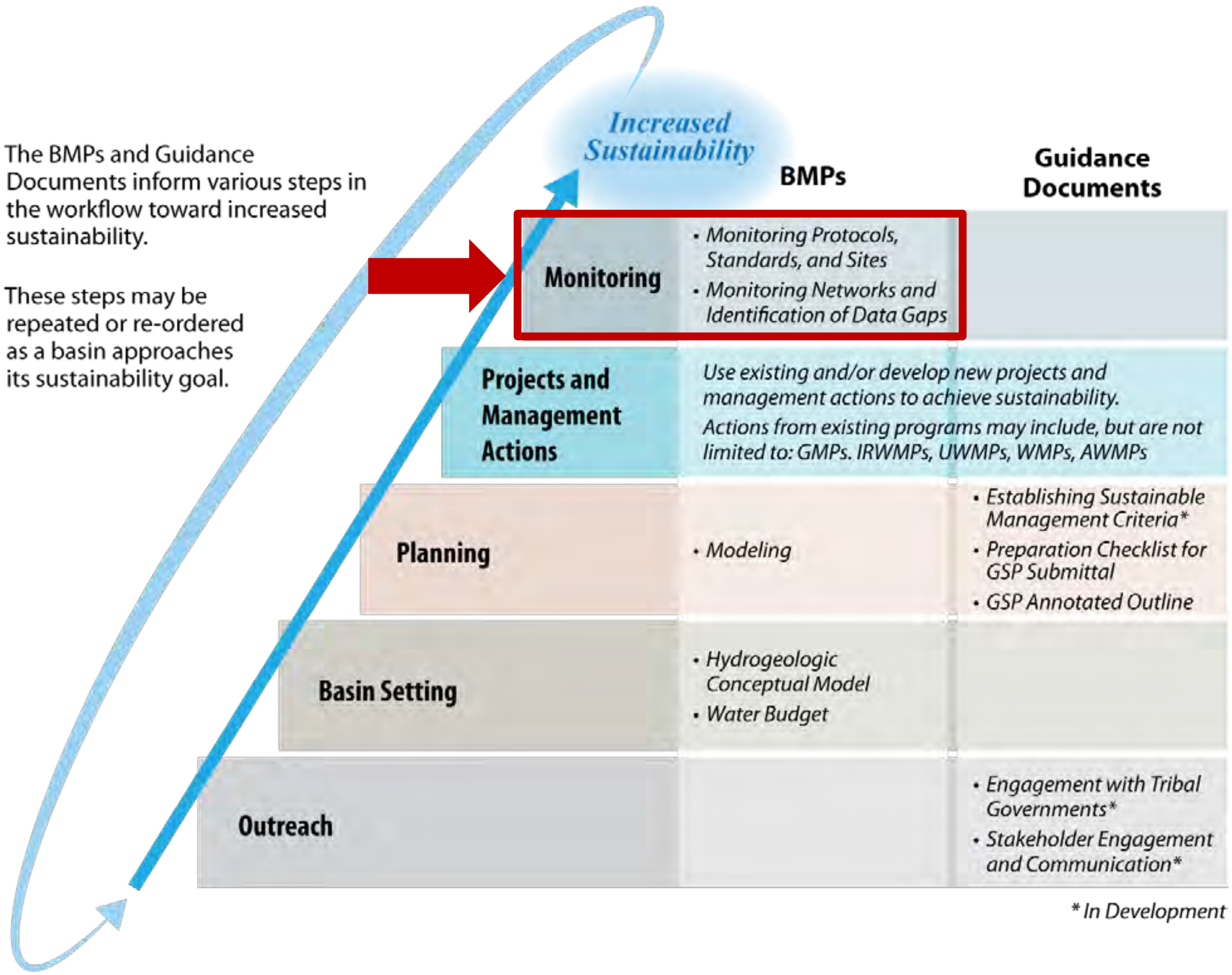


Figure 1 – Logical Progression of Basin Activities Needed to Increase Basin Sustainability

5. TECHNICAL ASSISTANCE

23 CCR §352.2. Monitoring Protocols. Each Plan shall include monitoring protocols adopted by the Agency for data collection and management, as follows:
(a) Monitoring protocols shall be developed according to best management practices.
(b) The Agency may rely on monitoring protocols included as part of the best management practices developed by the Department, or may adopt similar monitoring protocols that will yield comparable data.
(c) Monitoring protocols shall be reviewed at least every five years as part of the periodic evaluation of the Plan, and modified as necessary.

The GSP Regulations specifically call out the need to utilize protocols identified in this BMP, or develop similar protocols. The following technical protocols provide guidance based upon existing professional standards and are commonly adopted in various groundwater-related programs. They provide clear techniques that yield quality data for use in the various components of the GSP. They can be further elaborated on by individual GSAs in the form of standard operating procedures which reflect specific local requirements and conditions. While many methodologies are suggested in this BMP, it should be understood that qualified professional judgment should be used to meet the specific monitoring needs.

The following BMPs may be incorporated into a GSP's monitoring protocols section for collecting groundwater elevation data. A GSP that adopts protocols that deviate from these BMPs must demonstrate that they will yield comparable data.

PROTOCOLS FOR ESTABLISHING A MONITORING PROGRAM

The protocol for establishment of a monitoring program should be evaluated in conjunction with the *Monitoring Network and Identification of Data Gaps* BMP and other BMPs. Monitoring protocols must take into consideration the *Hydrogeologic Conceptual Model, Water Budget, and Modeling* BMPs when considering the data needs to meet GSP objectives and the sustainability goal.

It is suggested that each GSP incorporate the Data Quality Objective (DQO) process following the U.S. EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). Although strict adherence to this method is not required, it does provide a robust approach to consider and assures that data is collected with a specific purpose in mind, and efforts for monitoring are as efficient as possible to achieve the objectives of the GSP and compliance with the GSP Regulations.

The DQO process presents a method that can be applied directly to the sustainability criteria quantitative requirements through the following steps.

1. State the problem – Define sustainability indicators and planning considerations of the GSP and sustainability goal.
2. Identify the goal – Describe the quantitative measurable objectives and minimum thresholds for each of the sustainability indicators.
3. Identify the inputs – Describe the data necessary to evaluate the sustainability indicators and other GSP requirements (i.e. water budget).
4. Define the boundaries of the study – This is commonly the extent of the Bulletin 118 groundwater basin or subbasin, unless multiple GSPs are prepared for a given basin. In that case, evaluation of the coordination plan and specifically how the monitoring will be comparable and meet the sustainability goals for the entire basin.
5. Develop an analytical approach – Determine how the quantitative sustainability indicators will be evaluated (i.e. are special analytical methods required that have specific data needs).
6. Specify performance or acceptance criteria – Determine what quality the data must have to achieve the objective and provide some assurance that the analysis is accurate and reliable.
7. Develop a plan for obtaining data – Once the objectives are known determine how these data should be collected. Existing data sources should be used to the greatest extent possible.

These steps of the DQO process should be used to guide GSAs to develop the most efficient monitoring process to meet the measurable objectives of the GSP and the sustainability goal. The DQO process is an iterative process and should be evaluated regularly to improve monitoring efficiencies and meet changing planning and project needs. Following the DQO process, GSAs should also include a data quality control and quality assurance plan to guide the collection of data.

Many monitoring programs already exist as part of ongoing groundwater management or other programs. To the extent possible, the use of existing monitoring data and programs should be utilized to meet the needs for characterization, historical record documentation, and continued monitoring for the SGMA program. However, an evaluation of the existing monitoring data should be performed to assure the data being collected meets the DQOs, regulatory requirements, and data collection protocol described in this BMP. While this BMP provides guidance for collection of various regulatory based requirements, there is flexibility among the various methodologies available to meet the DQOs based upon professional judgment (local conditions or project needs).

At a minimum, for each monitoring site, the following information or procedure should be collected and documented:

- Long-term access agreements. Access agreements should include year-round site access to allow for increased monitoring frequency.
- A unique identifier that includes a general written description of the site location, date established, access instructions and point of contact (if necessary), type of information to be collected, latitude, longitude, and elevation. Each monitoring location should also track all modifications to the site in a modification log.

PROTOCOLS FOR MEASURING GROUNDWATER LEVELS

This section presents considerations for the methodology of collection of groundwater level data such that it meets the requirements of the GSP Regulations and the DQOs of the specific GSP. Groundwater levels are a fundamental measure of the status of groundwater conditions within a basin. In many cases, relationships of the sustainability indicators may be able to be correlated with groundwater levels. The quality of this data must consider the specific aquifer being monitored and the methodology for collecting these levels.

The following considerations for groundwater level measuring protocols should ensure the following:

- Groundwater level data are taken from the correct location, well ID, and screen interval depth
- Groundwater level data are accurate and reproducible
- Groundwater level data represent conditions that inform appropriate basin management DQOs
- All salient information is recorded to correct, if necessary, and compare data
- Data are handled in a way that ensures data integrity

General Well Monitoring Information

The following presents considerations for collection of water level data that include regulatory required components as well as those which are recommended.

- Groundwater elevation data will form the basis of basin-wide water-table and piezometric maps, and 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.
- Depth to groundwater must be measured relative to an established Reference Point (RP) on the well casing. The RP is usually identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention in open casing monitoring wells, the RP reference point is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing.
- The elevation of the RP of each well must be surveyed to the North American Vertical Datum of 1988 (NAVD88), or a local datum that can be converted to NAVD88. The elevation of the RP must be accurate to within 0.5 foot. It is preferable for the RP elevation to be accurate to 0.1 foot or less. Survey grade global navigation satellite system (GNSS) global positioning system (GPS) equipment can achieve similar vertical accuracy when corrected. Guidance for use of GPS can be found at USGS http://water.usgs.gov/osw/gps/. Hand-held GPS units likely will not produce reliable vertical elevation measurement accurate enough for the casing elevation consistent with the DQOs and regulatory requirements.
- The sampler should remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.
- Depth to groundwater must be measured to an accuracy of 0.1 foot below the RP. It is preferable to measure depth to groundwater to an accuracy of 0.01 foot. Air lines and acoustic sounders may not provide the required accuracy of 0.1 foot.
- The water level meter should be decontaminated after measuring each well.

Where existing wells do not meet the base standard as described in the GSP Regulations or the considerations provided above, new monitoring wells may need to be constructed to meet the DQOs of the GSP. The design, installation, and documentation of new monitoring wells must consider the following:

- Construction consistent with California Well Standards as described in Bulletins 74-81 and 74-90, and local permitting agency standards of practice.
- Logging of borehole cuttings under the supervision of a California Professional Geologist and described consistent with the Unified Soil Classification System methods according to ASTM standard D2487-11.
- Written criteria for logging of borehole cuttings for comparison to known geologic formations, principal aquifers and aquitards/aquicludes, or specific marker beds to aid in consistent stratigraphic correlation within and across basins.
- Geophysical surveys of boreholes to aid in consistency of logging practices. Methodologies should include resistivity, spontaneous potential, spectral gamma, or other methods as appropriate for the conditions. Selection of geophysical methods should be based upon the opinion of a professional geologist or professional engineer, and address the DQOs for the specific borehole and characterization needs.
- Prepare and submit State well completion reports according to the requirements of §13752. Well completion report documentation should include geophysical logs, detailed geologic log, and formation identification as attachments. An example well completion as-built log is illustrated in **Figure 2.** DWR well completion reports can be filed directly at the Online System for Well Completion Reports (OSWCR) http://water.ca.gov/oswcr/index.cfm.

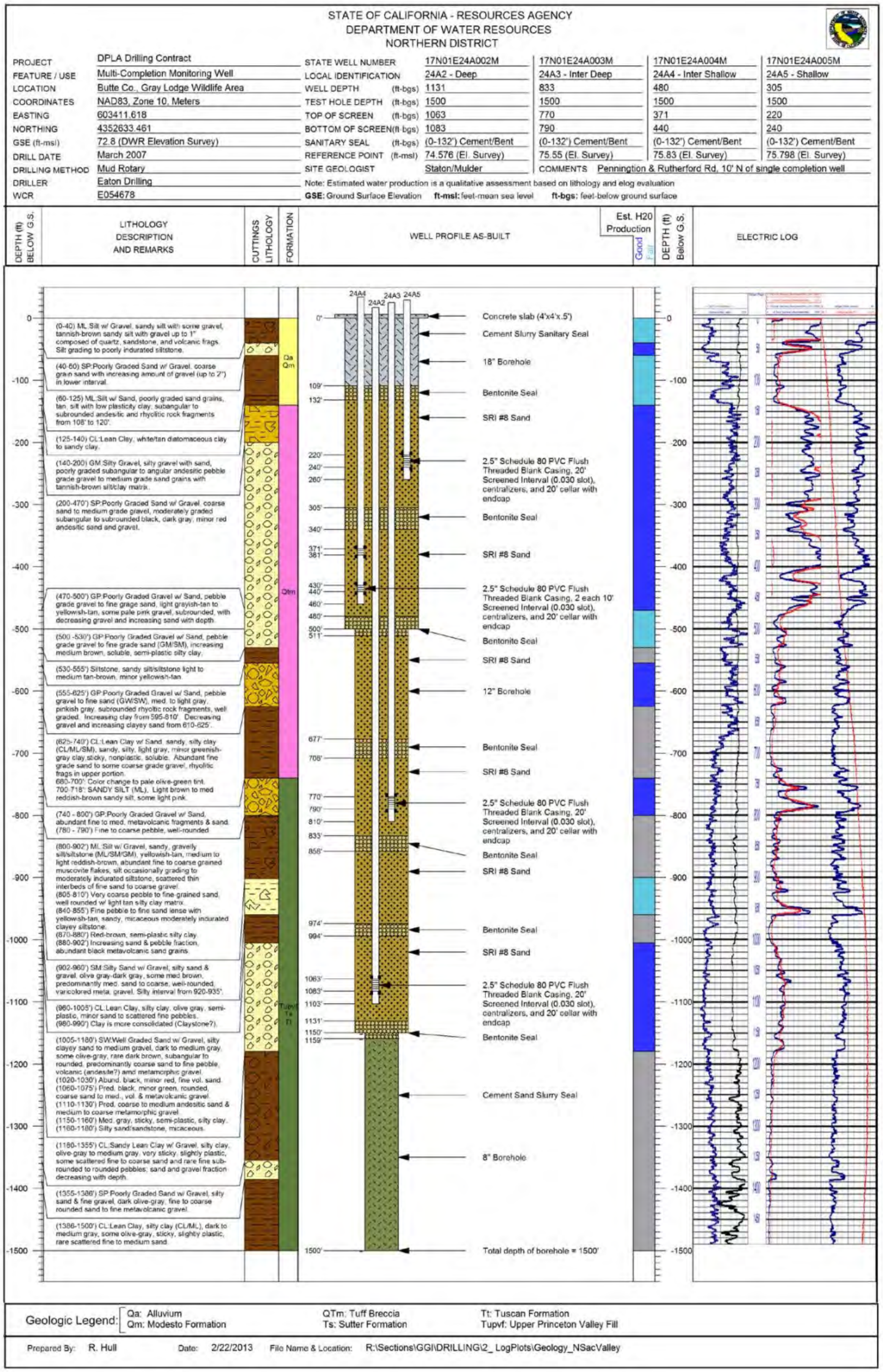


Figure 2 – Example As-Built Multi-Completion Monitoring Well Log

Measuring Groundwater Levels

Well construction, anticipated groundwater level, groundwater level measuring equipment, field conditions, and well operations should be considered prior collection of the groundwater level measurement. The USGS *Groundwater Technical Procedures* (Cunningham and Schalk, 2011) provide a thorough set of procedures which can be used to establish specific Standard Operating Procedures (SOPs) for a local agency. **Figure 3** illustrates a typical groundwater level measuring event and simultaneous pressure transducer download.

Figure 3 – Collection of Water Level Measurement and Pressure Transducer Download

The following points provide a general approach for collecting groundwater level measurements:

- Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.01 foot relative to the RP.
- For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a

questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.

- The sampler should calculate the groundwater elevation as:

$$GWE = RPE - DTW$$

Where:

GWE = Groundwater Elevation
RPE = Reference Point Elevation
DTW = Depth to Water

The sampler must ensure that all measurements are in consistent units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.

<u>Recording Groundwater Levels</u>

- The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, potential for tidal influence, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. An example of a field sheet with the required information is shown in **Figure 4**. It includes questionable measurement and no measurement codes that should be noted. This field sheet is provided as an example. Standardized field forms should be used for all data collection. The aforementioned USGS *Groundwater Technical Procedures* offers a number of example forms.
- The sampler should replace any well caps or plugs, and lock any well buildings or covers.
- All data should be entered into the GSA data management system (DMS) as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person for compliance with the DQOs.

STATE OF CALIFORNA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WELL DATA

STATE WELL NUMBER	COUNTY	REFERENCE POINT ELEV.	MEASURING AGENCY
			DWR

NO MEASUREMENT	QUESTIONABLE MEASUREMENT
0. Measurement discontinued	0. Caved or deepened
1. Pumping	1. Pumping
2. Pump house locked	2. Nearby pump operating
3. Tape hung up	3. Casing leaky or wet
4. Can't get tape in casing	4. Pumped recently
5. Unable to locate well	5. Air or pressure gauge measurement
6. Well has been destroyed	6. Other
7. Special	7. Recharge operation at or nearby well
8. Casing leaky or wet	8. Oil in casing
9. Temporarily inaccessible	

DATE	NM	QM	TAPE AT RP	TAPE AT WS	RP to WS	OBSR VR	COMMENTS

DWR 1213

Figure 4 – Example of Water Level Well Data Field Collection Form

Pressure Transducers

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitoring wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements.

The following general protocols must be followed when installing a pressure transducer in a monitoring well:

- The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.
- The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.
- Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment should be exercised to ensure that the data being collected is meeting the DQO and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.
- The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.
- Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.
- Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.
- The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually or as necessary to maintain data integrity.

- The data should be downloaded as necessary to ensure no data is lost and entered into the basin's DMS following the QA/QC program established for the GSP. Data collected with non-vented data logger cables should be corrected for atmospheric barometric pressure changes, as appropriate. After the sampler is confident that the transducer data have been safely downloaded and stored, the data should be deleted from the data logger to ensure that adequate data logger memory remains.

PROTOCOLS FOR SAMPLING GROUNDWATER QUALITY

The following protocols can be incorporated into a GSP's monitoring protocols for collecting groundwater quality data. More detailed sampling procedures and protocols are included in the standards and guidance documents listed at the end of this BMP. A GSP that adopts protocols that deviate from these BMPs must demonstrate that the adopted protocols will yield comparable data.

In general, the use of existing water quality data within the basin should be done to the greatest extent possible if it achieves the DQOs for the GSP. In some cases it may be necessary to collect additional water quality data to support monitoring programs or evaluate specific projects. The USGS *National Field Manual for the Collection of Water Quality Data* (Wilde, 2005) should be used to guide the collection of reliable data. **Figure 5** illustrates a typical groundwater quality sampling setup.

Figure 5 – Typical Groundwater Quality Sampling Event

1 Introduction

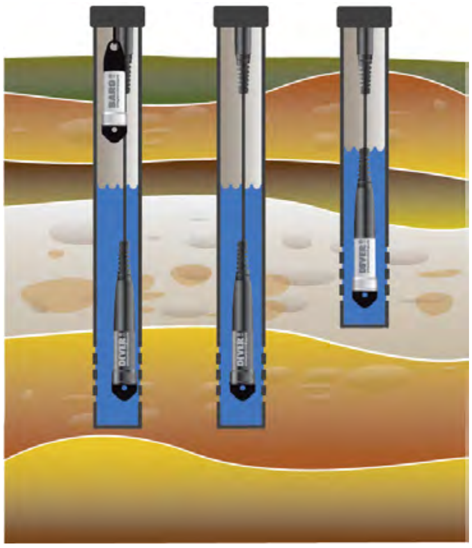
1.1 About this Manual

This manual contains information about Van Essen Instruments' Divers®. It contains a description of the Mini-Diver (DI5xx), Micro-Diver (DI6xx), Cera-Diver (DI7xx), Baro-Diver (DI500) and the CTD-Diver (DI27x). The number in brackets designates the Diver part number.

This section contains a brief introduction to the Diver's measurement principles, an instrument designed to measure groundwater levels and temperatures. Furthermore, a brief description of the software that can be used in combination with the Divers is provided. The next section contains the technical specifications for each type of Diver. The following section covers the installation of Divers in monitoring wells and in surface waters. This is followed by a description of how to maintain a Diver. The next section discusses conductivity measurements using the CTD-Diver and conductivity calibration. The last section includes the answers to frequently asked questions.

1.2 Operating Principle

The Diver is a datalogger designed to measure water pressure and temperature. Measurements are subsequently stored in the Diver's internal memory. The Diver consists of a pressure sensor designed to measure water pressure, a temperature sensor, memory for storing measurements and a battery. The Diver is an autonomous datalogger that can be programmed by the user. The Diver has a completely sealed enclosure. The communication between Divers and Laptops/field devices is based on optical communication.



The Divers measures the absolute pressure. This means that the pressure sensor not only measures the water pressure, but also the air pressure pushing on the water surface. If the air pressure varies, the measured water pressure will thus also vary, without having to vary the water level.

1.3 Measuring Water Levels

All Divers establish the height of a water column by measuring the water pressure using the built-in pressure sensor. As long as the Diver is not submerged in water it measures atmospheric pressure, just like a barometer. Once the Diver is submerged this is supplemented by the water's pressure: the higher the water column the higher the measured pressure. The height of the water column above the Diver's pressure sensor is determined on the basis of the measured pressure.

To measure these variations in atmospheric pressure a Baro-Diver is installed for each site being measured. The barometric compensation for these variations in atmospheric pressure can be done using the Diver-Office software. It is also possible to use alternative barometric data such as data made available online.

The compensated values can be related to a reference point such as the top of the monitoring well or a vertical reference datum, for example Mean Sea Level (MSL).

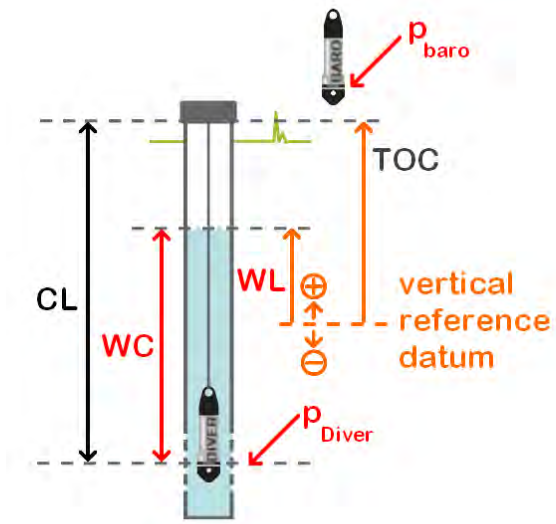
Theory

This section explains how to calculate the water level in relation to a vertical reference datum using the Diver and Baro-Diver's measurements.

The figure below represents an example of a monitoring well in which a Diver has been installed. In this case we are therefore interested in the height of the water level (WL) in relation to the vertical reference datum. If the water level is situated above the reference datum it has a positive value and a negative value if it is situated below the reference datum.

The top of casing (TOC) is measured in relation to the vertical reference datum and is denoted in the diagram below as TOC cm. The Diver is suspended with a cable with a length equal to CL cm.

The Baro-Diver measures the atmospheric pressure (p_{baro}) and the Diver measures the pressure exerted by the water column (WC) and the atmospheric pressure (p_{Diver}).



The water column (WC) above the Diver can be expressed as:

$$WC = 9806.65 \frac{p_{Diver} - p_{baro}}{\rho \cdot g} \quad (1)$$

where p is the pressure in cmH_2O, g is the acceleration due to gravity (9.81 m/s^2) and ρ is the density of the water (1,000 kg/m^3).

The water level (WL) in relation to the vertical reference datum can be calculated as follows:

$$WL = TOC - CL + WC \quad (2)$$

By substituting WC from equation (1) in equation (2) we obtain:

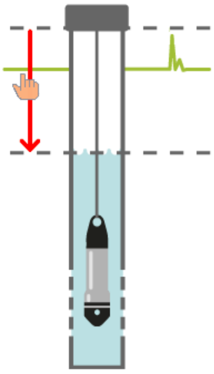
$$WL = TOC - CL + 9806.65 \frac{p_{Diver} - p_{baro}}{\rho \cdot g} \quad (3)$$

If the cable length is not exactly known, it can be determined using a manual measurement. From the figure below it is clear that the manual measurement (MM) is taken from the top of casing to the water level. The value of the water level is positive unless, in exceptional circumstances, the water level is situated above the top of casing.

The cable length can now be calculated as follows:

$$CL = MM + WC \qquad (4)$$

where the water column (WC) is calculated on the basis of the measurements taken by the Diver and the Baro-Diver.



Comments:

- If the pressure measured by the Diver and the Baro-Diver is measured at different points in time, it is necessary to interpolate. The software automatically performs this interpolation.
- It is possible to enter manual measurements into the software. The software subsequently automatically calculates the cable length.

Example:

The top of casing is measured to be 150 cm above the Mean Seal Level (MSL). TOC = 150 cm. The cable length is not exactly known and is therefore measured manually. It turns out to be 120 cm: MM = 120 cm.

The Diver measures a pressure of 1,170 cmH_2O and the Baro-Diver measures a pressure of 1,030 cmH_2O. Substituting these values into equation (1), results in a water column of 140 cm above the Diver: WC = 140 cm.

Substituting the values of the manual measurement and the water column in equation (4) results in the following cable length: CL = 120 + 140 = 260 cm.

The water level in relation to MSL can now be easily calculated using equation (2): WL = 150 – 260 + 140 = 30 cm above MSL.

1.4 Measuring Temperature

All Divers measure the groundwater temperature. This can, for example, provide information about groundwater flows. This also makes it possible to determine the diffusion of (polluted) water.

The temperature is measured using a semiconductor sensor. This sensor not only measures the temperature, but also uses the value of the temperature to at the same time compensate the pressure sensor and electronics (incl. the crystal clock) for the effects of temperature.

Quick Reference Guide

Barometric Compensation

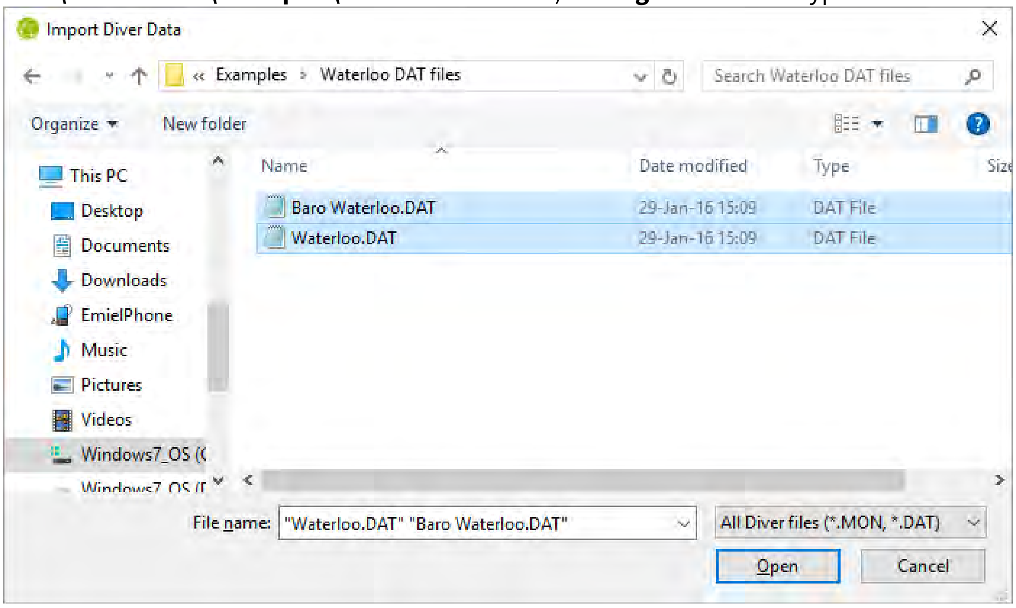
Introduction

This document outlines the basics to perform the barometric compensation. Please refer to the Diver-Office help for more details.

Importing Sample Data

Diver-Office comes with example data. The default folder is **C:\Program Files\Diver-Office\Examples**.

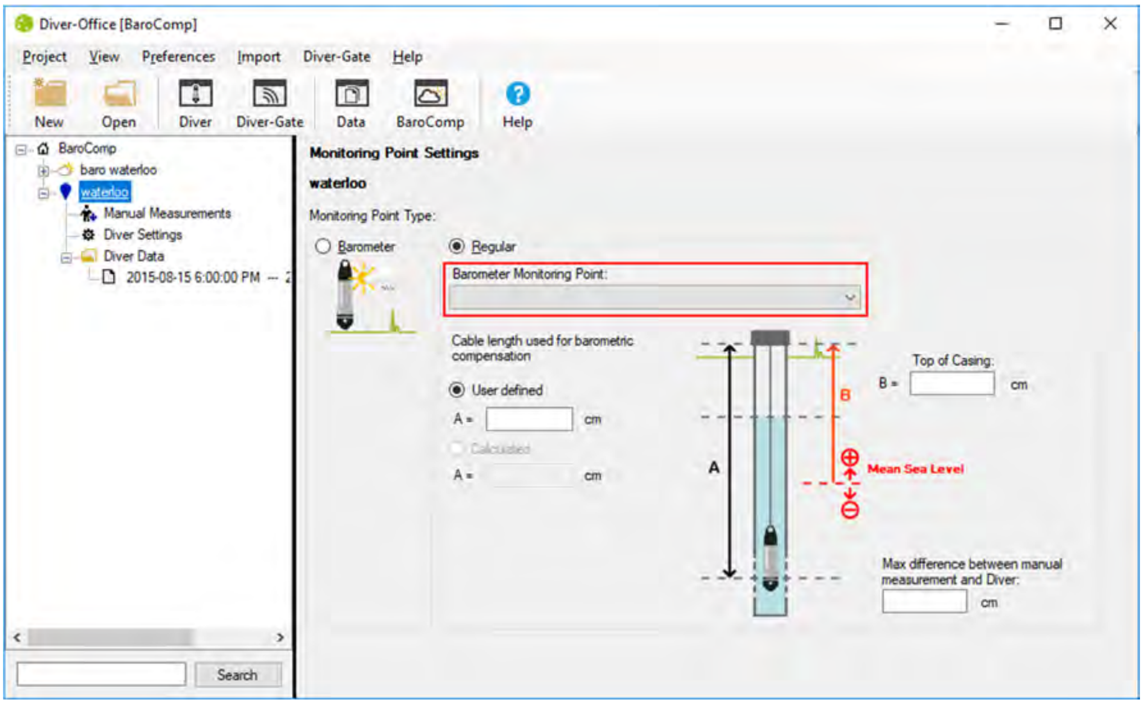
1. In Diver-Office click on the menu bar item **Import > Diver Data…** (CTRL+E). In the dialog that opens navigate to the **Waterloo DAT files** folder in the **Examples** folder (**C:\Program Files\Diver-Office\Examples\Waterloo DAT files**). **Change the Files** of type to **DAT**.



2. Select the two files and click **[Open]**.

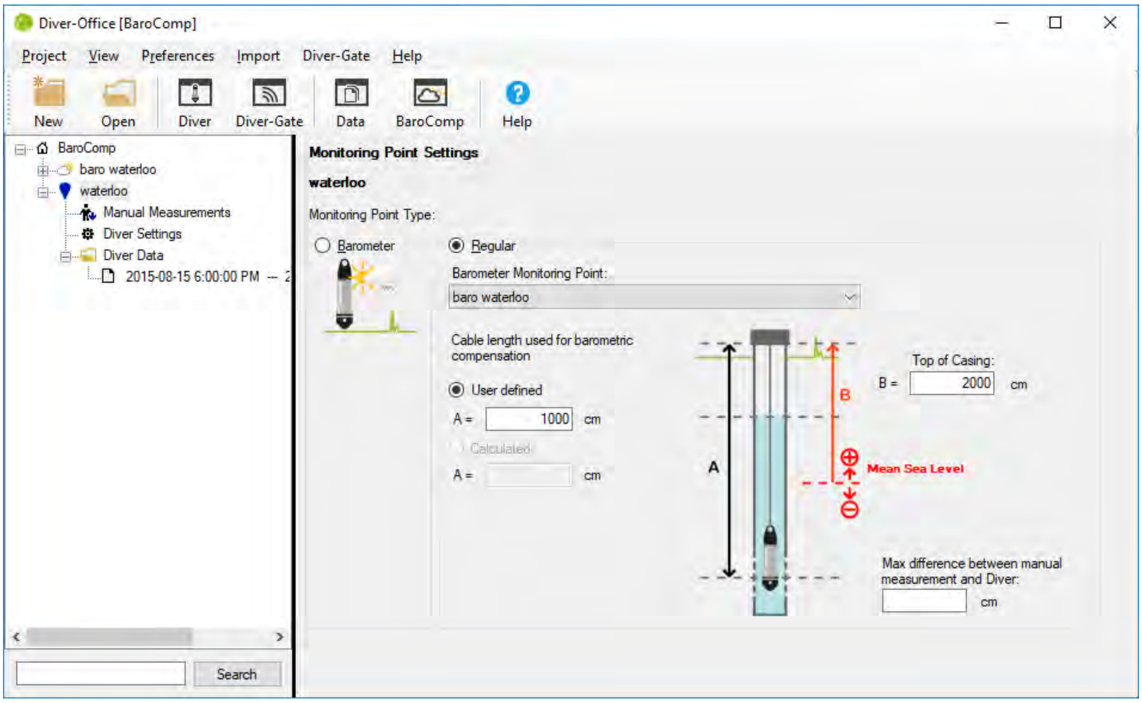
Setting the barometer

One of the imported data series is now shown. Click on **Waterloo** in the tree view on the left. The screen should no look something like the window shown below. Note that the **Barometer Monitoring Point** field is blank. To perform the barometric compensation this field must contain a value.



1. From the **Barometer Monitoring Point** dropdown list select **baro waterloo**.
2. Enter a value for the cable length (**A**) if the barometric compensation should calculate the depth to water
3. Enter a value both (**A**) and for the top of casing (**B**) if the barometric compensation should calculate the water level with respect to Mean Sea Level.

The window should now be similar to the window shown below:

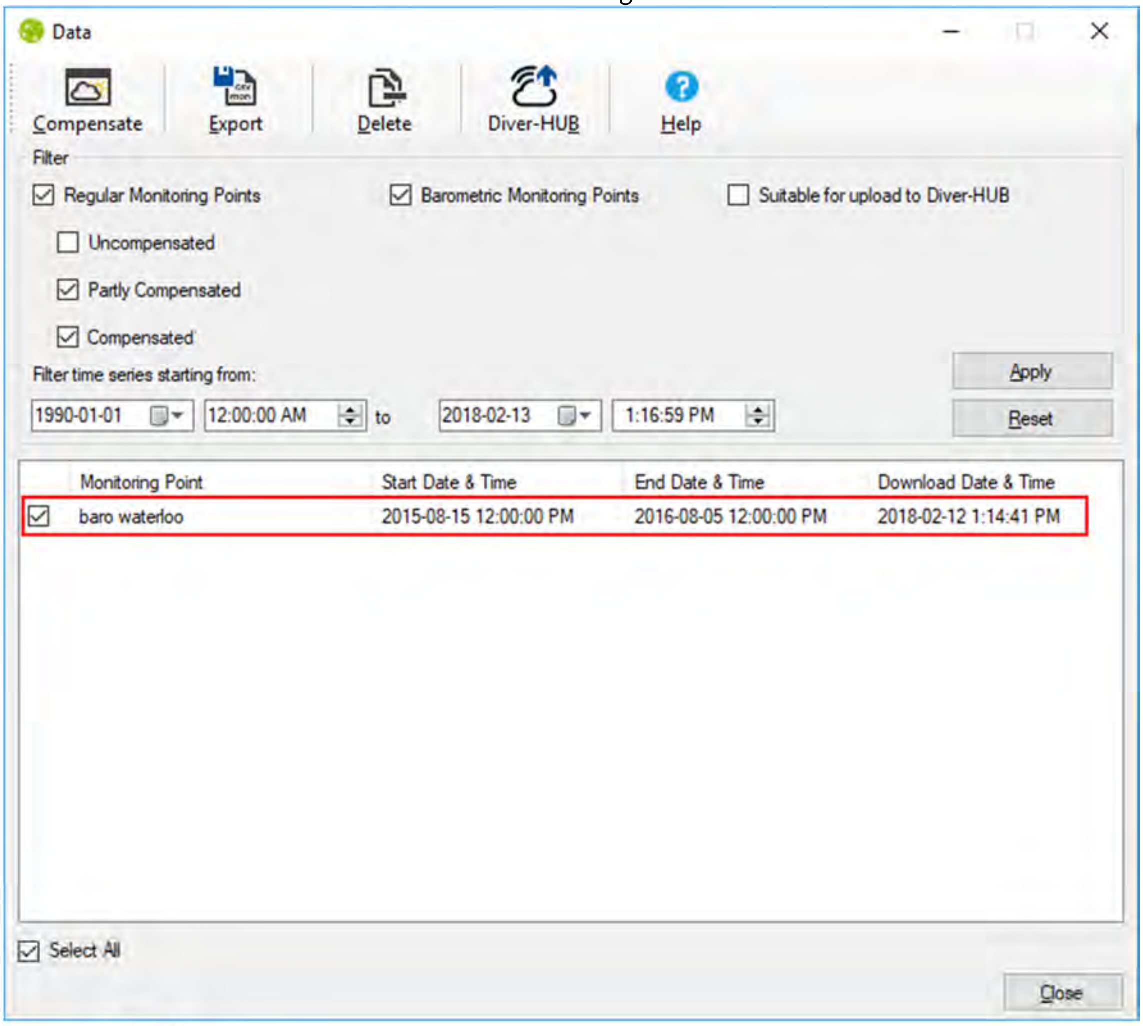


Compensating Diver Data

1. Click the  **BaroComp** button from the main toolbar.

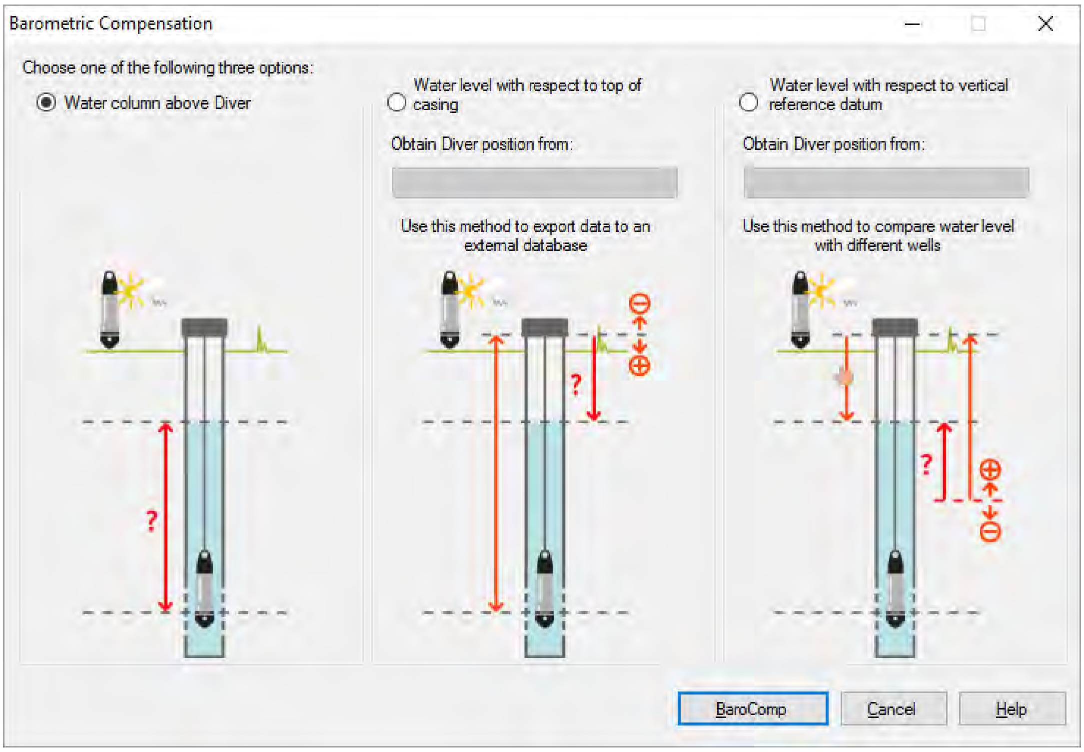
   *You may also right click on the data set in the project tree to go directly to the BaroCompensation dialog.

2. Select one or more time-series data from the Data dialog.



3. Select the  **BaroComp** button from the Data dialog toolbar.
4. Select the desired barometric compensation method from the **BaroComp** dialog (shown on following page). You may choose from five barometric compensation methods:
   a. Water Column above Diver
   b. Water level with respect to Top of Casing *using Cable Length*
   c. Water level with respect to Top of Casing *using Manual Measurement*
   d. Water Level with respect to VRD *using Cable Length*
   e. Water Level with respect to VRD *using Manual Measurement*

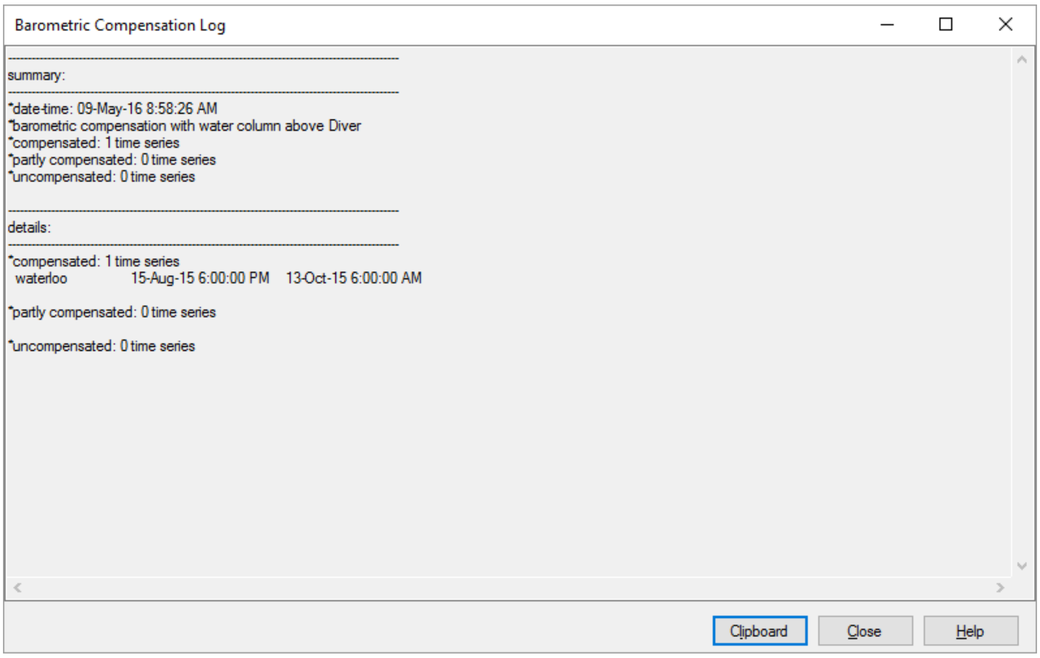
   Note: Each barometric compensation method requires that certain data be entered before the compensation can be performed. Please refer to the Diver-Office user's manual for more information on the data requirements for each compensation method.



5. Once the method is chosen, select the **[BaroComp]** button to perform the barometric compensation.

   Note: If the compensation fails, the type of missing information will be indicated in the log dialog.

6. When the compensation is complete, the barometric compensation log will show, displaying a summary with details.



7. Click the **[Close]** button to finish. You can now view the compensated data in the time series table and plot. You will notice that the time series symbol in the **Project Tree** will change once compensation has been performed:

    means that the data was Partially Compensated

    means that all the data in the time series was Compensated

    means that the data is Uncompensated.

APPENDIX G-2

Well Completion Reports

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*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR   08N 34W 02

State of California
Well Completion Report
Refer to Instruction Pamphlet
No. e0368151

DWR Use Only – Do Not Fill In	
State Well Number/Site Number	
Latitude N	Longitude W
APN/TRS/Other	

Page 1 of 1
Owner's Well Number Well 19
Date Work Began 08/10/2017   Date Work Ended 10/30/2017
Local Permit Agency Santa Barbara County Environmental Health Department
Permit Number WP#1495   Permit Date 8/22/16

Geologic Log

Orientation ⦿ Vertical ○ Horizontal ○ Angle Specify ___
Drilling Method Reverse Circulation Rotary   Drilling Fluid Bentonite mud

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	121	Sand
121	141	Clay / Sand / Rock
141	221	Sand
221	241	Sand / Rock
241	261	Sand / Clay
261	281	Rock / Sand
281	301	Sand
301	341	Sand / Clay / Rock
341	461	Sand
461	501	Sand / Rock
501	541	Sand
541	561	Sand / Rock
561	601	Sand
601	621	Sand / Clay / Rock
621	661	Sand
661	701	Clay
701	721	Clay / Sand
721	750	Clay

Total Depth of Boring 520 Feet
Total Depth of Completed Well 500 Feet

Well Location

Address 8385 Graciosa Rd.
City Santa Maria   County Santa Barbara
Latitude ___ Deg. ___ Min. ___ Sec. N   Longitude ___ Deg. ___ Min. ___ Sec. W
Datum ___ Dec. Lat. 34.801389   Dec. Long. -120.434444
APN Book 101   Page 080   Parcel 089
Township ___ Range ___ Section ___

Location Sketch
(Sketch must be drawn by hand after form is printed.)

North

West   See attached map   East

South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity
⦿ New Well
○ Modification/Repair
 ○ Deepen
 ○ Other ___
○ Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses
⦿ Water Supply
 ☐ Domestic ☐ Public
 ☑ Irrigation ☐ Industrial
○ Cathodic Protection
○ Dewatering
○ Heat Exchange
○ Injection
○ Monitoring
○ Remediation
○ Sparging
○ Test Well
○ Vapor Extraction
○ Other ___

Water Level and Yield of Completed Well
Depth to first water 147 (Feet below surface)
Depth to Static Water Level 147 (Feet) Date Measured 11/21/2018
Estimated Yield * 1,000 (GPM) Test Type Constant Rate
Test Length 12.0 (Hours) Total Drawdown 59 (Feet)
*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	50	40	Conductor	Low Carbon Steel	0.312	30		
0	200	26	Blank	Low Carbon Steel	0.312	16		
200	200	26	Coupler	Di-Electric	N/A	16		
200	240	26	Blank	304 Stainless Steel	0.312	16		
240	500	26	Scrn+cap	304 Stainless Steel	N/A	16	Wire Wrap	0.312

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments
☐ Geologic Log
☐ Well Construction Diagram
☐ Geophysical Log(s)
☐ Soil/Water Chemical Analyses
☐ Other ___
Attach additional information, if it exists.

Certification Statement
I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief
Name Tyson R. Davis, Pacific Coast Well Drilling, Inc.
Person, Firm or Corporation
PO Box 184   Templeton   CA   93465
Address   City   State   Zip
Signed [signature]   3-2-18   927400
C-57 Licensed Water Well Contractor   Date Signed   C-57 License Number

JUL 12 2018

ORIGINAL
File with DWR
Page 1 of 2
Owner's Well No. #3
Date Work Began 9/16/98, Ended 9/23/98
Local Permit Agency S.B. County Environmental Health
Permit No. SR100017 Permit Date 8/17/98

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 521842

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ___ VERTICAL X HORIZONTAL ___ ANGLE ___ (SPECIFY)
DEPTH TO FIRST WATER 186 (Ft.) BELOW SURFACE

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	75	Sand And Gravel
75	85	White Clay
85	140	Gravel And Brown Sand
140	160	Brown Clay Some Sand
160	190	Very Coarse Brown Sand
190	270	Brown Clay, Sand, With
		Streaks Of Gravel
270	480	Grey Clay, ~~Exxx~~ Fine Sand
480	650	Brown Clay Some Sand
650	740	Brown Sand Some Clay
740	800	Grey Sand And Clay
800	980	Careaga Sand With Clay
980	1100	Shale

TOTAL DEPTH OF BORING 1100 (Feet)
TOTAL DEPTH OF COMPLETED WELL 980 (Feet)

WELL OWNER

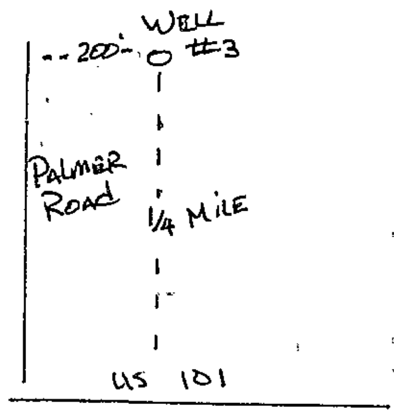
N
M
C

WELL LOCATION

Address Palmer Road and US 101
City
County Santa Barbara County
APN Book 137 Page 36 Parcel 101-060-45
Township 8N Range 33W Section 2
Latitude ___ NORTH DEG. MIN. SEC. Longitude ___ WEST DEG. MIN. SEC.

LOCATION SKETCH

NORTH



WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (*Describe Procedures and Materials Under "GEOLOGIC LOG"*)

PLANNED USE(S) (✓)

___ MONITORING
WATER SUPPLY
___ Domestic
___ Public
X Irrigation
___ Industrial
___ "TEST WELL"
___ CATHODIC PROTECTION
___ OTHER (Specify)

DRILLING METHOD Mud Rotary FLUID Bentonite

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 186 (Ft.) & DATE MEASURED 10/21/98
ESTIMATED YIELD* 1400 (GPM) & TEST TYPE 12HR Continuous
TEST LENGTH 12 (Hrs.) TOTAL DRAWDOWN 264 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
"SEE ATTACHED"									

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	55	x			6 Sack Slurry
55	980			x	Lapis #2

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
X Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Floyd V. Wells, Inc.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

1337 W. Betteravia Road Santa Maria CA 93455
ADDRESS CITY STATE ZIP

Signed [signature] 10-29-98 C57-229570
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

521842

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (INCHES)	CASING (S) TYPE (X) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (INCHES)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (INCHES)
0	55	38			X		Carbon Steel	30	0.250	
55	290	28	X				Carbon Steel	16	0.312	
290	490	28		X			Carbon Steel	16	xxx-Hvy	0.040
490	550	28	X				Carbon Steel	16	0.312	
550	620	28		X			Carbon Steel	16	xxx-Hvy	0.040
620	650	28	X				Carbon Steel	16	0.312	
650	960	28		X			Carbon Steel	16	xxx-Hvy	0.040
960	980	28	X				Carbon Steel	16	0.312	

Premiere Partners III Production Well Number 3

ORIGINAL
File with DWR

MAR 31 1977

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do Not Fill In
№ 105190
State Well No. 8N/34W-24E1
Other Well No.

(1) OWNER:
Name [redacted]
Address

(2) LOCATION OF WELL:
County Santa Barbara Owner's number, if any 6K
Township, Range, and Section T8N, R34W, Rancho Los Alamos
Distance from cities, roads, railroads, etc. 1/4 mi S of Harris Road or Hwy 1, 3/10 mi W of San Antonio Creek and Hwy 135, North side of Ranch reservoir

(3) TYPE OF WORK *(check)*:
New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE *(check)*:
Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:
Rotary [X]
Cable [ ]
Other [ ]

(6) CASING INSTALLED:
STEEL: X OTHER:
SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	If gravel packed From ft.	To ft.
0	580	16" od	.312	28"	35	580

Size of shoe or well ring: Size of gravel: 1/4 x 1/8
Describe joint butt

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen Vertical slot

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
310	570		32	.060 x 2½

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes [X] No [ ] To what depth 35 ft.
Were any strata sealed against pollution? Yes [ ] No [ ] If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing 35' of 30" surface pipe cemented in

(9) WATER LEVELS:
Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing ft.

(10) WELL TESTS:
Was pump test made? Yes [ ] No [ ] If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]
Was electric log made of well? Yes [ ] No [ ] If yes, attach copy

(11) WELL LOG:
Total depth ft. Depth of completed well ft.
Formation: *Describe by color, character, size of material, and structure*
ft. to ft.

SEE ATTACHED LOG

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

Work started 2/28 19 77, Completed 3/06 19 77

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Floyd V. Wells, Inc
(Person, firm, or corporation) *(Typed or printed)*
Address P. O. Box 1007
Santa Maira, Ca 93454
[SIGNED] [signature]
(Well Driller)
License No. C57-229570 Dated March 14, 1977

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

67139-750 8-72 30M TRIP OSP

105190

SANTA MARIA, CALIFORNIA

FLOYD V. WELLS, INC.

GOLETA, CALIFORNIA

MAR 31 1977

WATER WELL DRILLING LOG

Owner: [redacted] Company:

Well No.: #5 Rig: #5

Location of Well: 1/4 mi S. of Harris Rd or Hwy 1, 3/10 mi W of San Antonio Creek and Hwy 135
T8N, R34W, Rancho Los Alamos, North side of Ranch reservoir

Surface Pipe or Seal: 35' cemented in Size: 30" Depth: 35' Gauge: .250

Well Bore Diameter: 28" Depth of Casing Set: 580'

Casing Size: 16" OD Gauge: .312 Type: steel

Perforations: Size: .060 Type: 2½" vertical slots Number: 32 rows

Perforation Location from Ground Level: From: G.L. 0' To: 310' blank
310' 570' perf
570' 580' blank
Bull nose on bottom

Gravel Pack: Type: Pumped in Size: 1/4 x 1/8 Quantity: 128.84 ton

Bits: No. Used: 4 Size: (1) 9 7/8; (1) 20"; (1) 28"; (1) 36"

CONFIDENTIAL – NOT FOR PUBLIC RELEASE

Drilling Method: Air: Foam: Mud: X

Material Used: Gel.: 350 gel P-95: 50 clay Foam:

Well Started: 2/28/77 Well Completed: 3/06/77 Driller: Frank & Clarence

TEST PUMPING INFORMATION:

Production Test:

Standing Water Level: Pumping Level:

G.P.M.: Pumping Level

REMARKS:

SANTA MARIA, CALIFORNIA

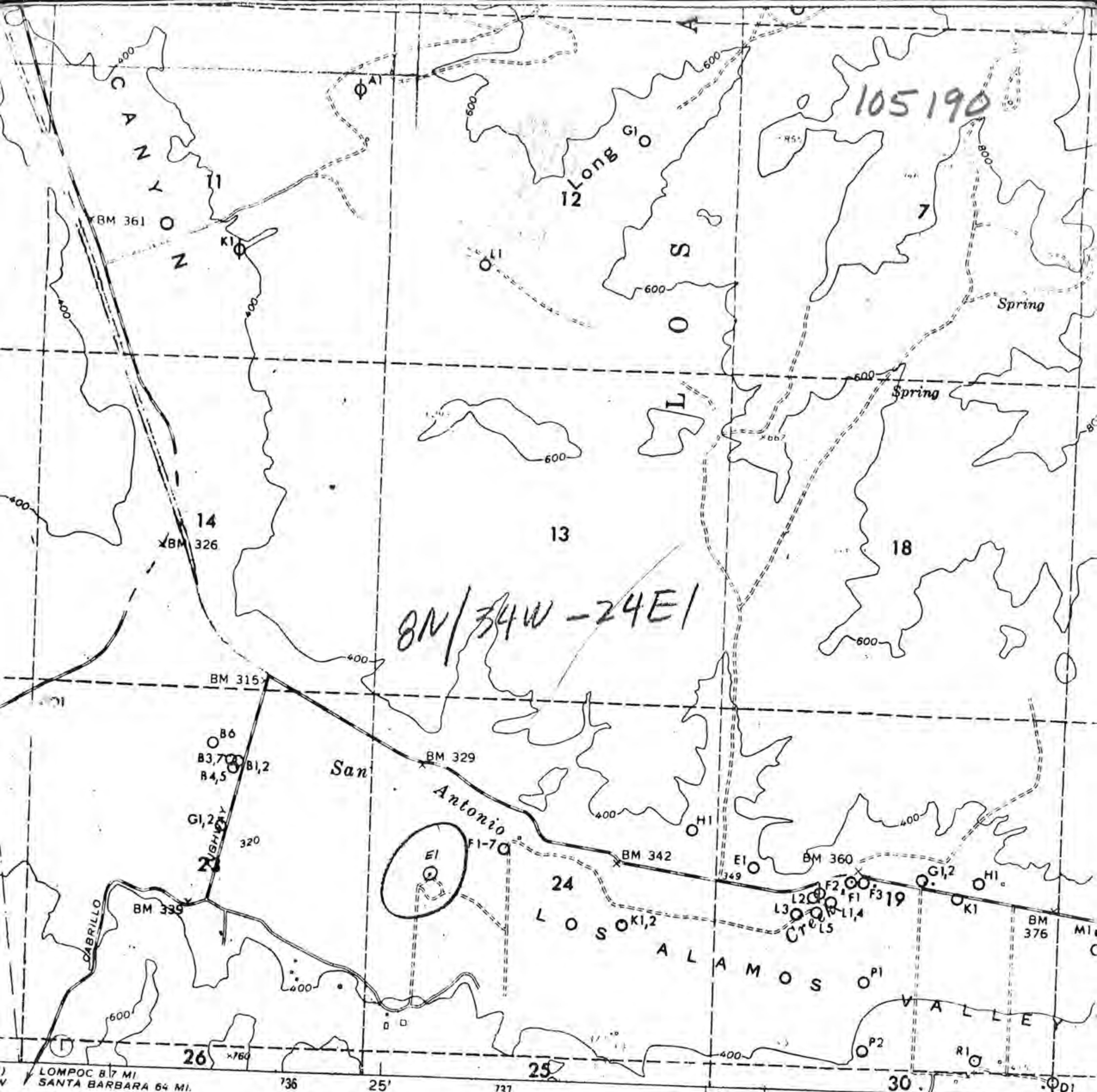
FLOYD V. WELLS, INC.

105190

GOLETA, CALIFORNIA

FORMATION LOG

FROM	TO	DESCRIPTION
0	15	Top soil, fine sand and gravel
15	25	Fine brown sand with some brown clay
25	83	Yellow clay with gravel imbedded strips
83	102	Brown clay with some gravel
102	113	White clay with gravel imbedded
113	122	White and blue clay strips
122	133	Blue clay
133	180	Fine sand
180	212	Fine white sand with yellow clay strips
212	222	Fine white sand
222	253	Fine blue sandy clay
253	263	Fine sand and gravel
263	304	Fine gray sand silty
304	314	Blue clay
314	320	Coarse sand and gravel
320	345	Large gravel with fine sand
345	355	Coarse sand and gravel
355	375	Blue clay
375	385	Blue sandy clay
385	396	Blue clay with coarse sand
396	406	Light brown sandy clay with gravel
406	415	Coarse sand and gravel
415	546	Coarse sand and gravel
546	565	Fine and coarse sand packed
565	607	Blue clay
607	640	Blue mushy clay and silty sand



ORCUTT QUAD

1 MILE
4000 5000 6000 7000 FEET
1 KILOMETER

L 40 FEET
20-FOOT CONTOURS
EA LEVEL

MAP SYMBOLS

O[R1] WELL

Φ[D1] DRY, DESTROYED, OR FILLED WELL

Q[S1] SPRING, DRY

ROAD CLASSIFICATION

Heavy-duty — Light-duty

Medium-duty — Unimproved

U. S. Route — State

MAP ACCURACY STANDARDS
LORADO 80225, OR WASHINGTON, D. C. 20242
SYMBOLS IS AVAILABLE ON REQUEST

DATA COMPILED BY USGS WRD
GARDEN GROVE, CALIF. 2-74

ORCUTT, C
SW/4 SANTA MARIA 15
N3445—W120.
1959

AMS 1953 IV SW–S

√

py

...tent No.

...ermit No. or Date

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

08N33W25B004S

Do not fill in

No. 068870

State Well No.

Other Well No.

...d

...y

(...) LOCATION OF WELL (See instructions):

...unty Santa Barbra Owner's Well Number

...ll address if different from above Hy 135 Los Alamos

...wnship Range Section

...stance from cities, roads, railroads, fences, etc.

Parcel 101-090-18-00

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well XX Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic X
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

EQUIPMENT:
...ary XX Reverse ☐
...le ☐ Air ☐
...er ☐ Bucket ☐

(6) GRAVEL PACK:
Yes XX No ☐ Size ¼ +
Diameter of bore 10
Packed from 30 to 100 ft.

CASING INSTALLED:
...l ☐ Plastic X Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen saw cut 1/16 x 4

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
	60	6	200	60	m100	1/16

(...) WELL SEAL:
...s surface sanitary seal provided? Yes X No ☐ If yes, to depth 30 ft.
...re strata sealed against pollution? Yes X No ☐ Interval 5-30 ft.
...hod of sealing concrete (pumped in)

(...) WATER LEVELS:
...th of first water, if known 5ft. ft.
...ding level after well completion 5ft. ft.

(...) WELL TESTS:
...well test made? Yes ☐ No ☐ If yes, by whom?
...e of test Pump ☐ Bailer ☐ Air lift ☐
...th to water at start of test ft. At end of test ft.
...harge gal/min after hours Water temperature
...nical analysis made? Yes ☐ No ☐ If yes, by whom?
...electric log made? Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 100 ft. Depth of completed well 100 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	20	top soil
20	40	coarse gravel (caving)
40	100	clay + gravel

Work started May 13 1983 Completed 20 1983

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED [signature]
(Well Driller)

NAME Enloe Well Drilling
(Person, firm, or corporation) (Typed or printed)

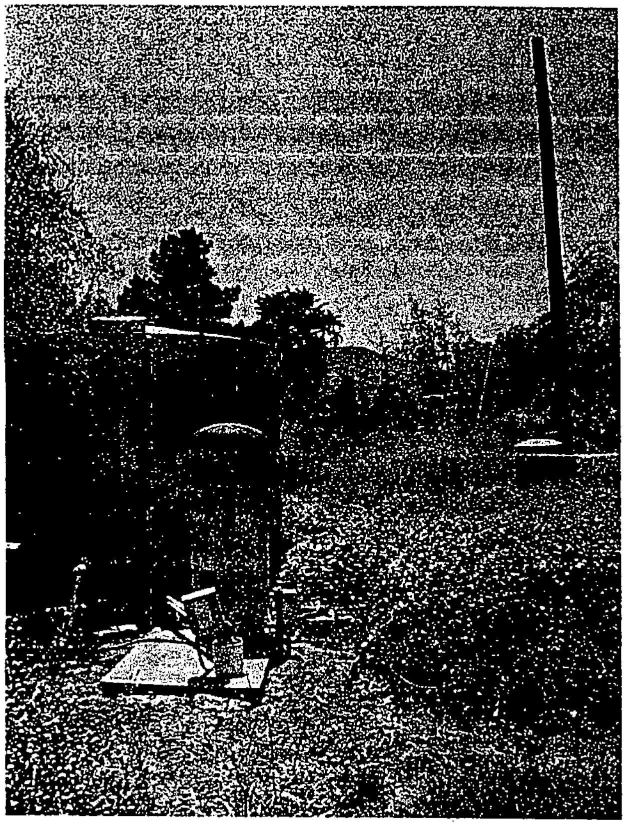
Address Rt. 1 Box 199 B

City Santa Maria Zip 93455

License No. 318877 Date of this report June 9 83

...R 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

068870



8N/33W-25B (4?)

068870

ENLOE WELL DRILLING

Rotary or Cable Tool

DOUG ENLOE

RT. 3
MESA ROAD
NIPOMO, CA 93444

805-929-1063

Att. Carl Abeloe

April 11, 1983

As we discussed we intend to drill a one hundred foot gravel packed well on your property in Los Alomos, This well will have class 200 P.V.C. casing and a 20ft. cement seal conforming to county codes.

We will also instale a submersiable pump, Goulds 1 hp. modle 25EL this pump will deliver 30 gallons per minute into a 5000 gal. storage tank . A Goulds modle XSH10 boster pump will deliver 30 gallons per minute into a presure tank , Well-X-Trol 252, .

This will give you 50 PSI. water presure and will be plumbed into the existing water line.

The above ground electrial hook up will be the responsibility of the owner

Thank You

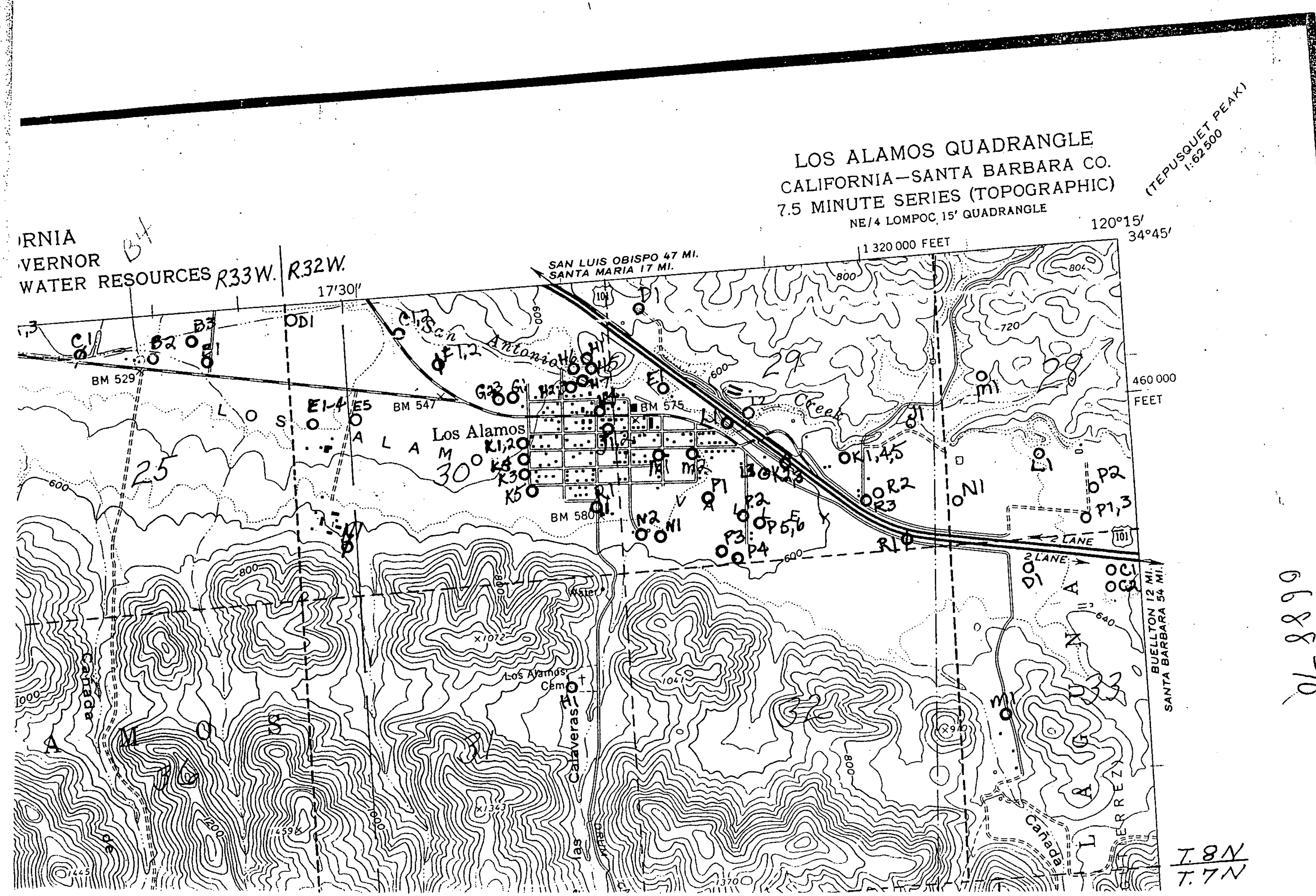
Doug Enloe

Cal. Licence # 318877

Doug Enloe

Ph 343 1698
Cell 448 5365

Dennee
Just a reminder. Carl Abeloe is our brother who lives in SLO. The well is actually on his section of this property. But the well also services the house (Laura Abeloe) and the farming field (Butch Abeloe)



LOS ALAMOS QUADRANGLE
CALIFORNIA—SANTA BARBARA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 LOMPOC 15' QUADRANGLE
(TEPUSQUET PEAK)
1:62 500
120°15'
34°45'
1 320 000 FEET
460 000
FEET
RNIA
VERNOR
WATER RESOURCES
R33W.
R32W.
17'30"
SAN LUIS OBISPO 47 MI.
SANTA MARIA 17 MI.
BUELLTON 12 MI.
SANTA BARBARA 54 MI.
Los Alamos
San Antonio Creek
BM 529
BM 547
BM 575
BM 580
Los Alamos Cem
Calaveras
Cañada
2 LANE
101
T.8N
T.7N
068870

(CA District form)

WELL SCHEDULE
GEOLOGICAL SURVEY, WRD

Lat 34 44 54 Long 120 18 12 Seq. No. 01

B&M S

County: Santa Barbara Well No. 8N/33W-25B4
Area: Los Alamos Drill Log No. 068870
Date June 26, 2003 Other No. ______
Recorded by Chuck Lamb / Dennis Gibbs
Source of data drill log / owner / personal inspection

Location map Los Alamos Scale 1:24000
Altitude of LSD ______ ft. How obtained ______
Topography at well flat / flood plain
Owner Carl/Butch/Laura Abeloe Phone No. (805) 344-2815
Address 3899 Hwy 135, Los Alamos, CA
Permission to measure/sample given by Laura Abeloe
Contact before? (Yes) No

Driller Enloe Well Drilling
Address Santa Maria
Date drilled May 20, 1983 Drill depth 100 ft.
Method drilled Rotary Well finish ______
Perforations 60-100 ft.
Type log data drillers
Use of well withdrawal Use of water domestic
Pump type submersible Serial No. ______
Motor ______ Serial No. ______
Power type electric HP ______ Meter No. ______

Well Depth ______ ft. From MP Meas. Rept. Date ______

Casing diam. 8 inch Casing type PVC

Water level 10.79 ft. (Stdg.) Pmpg. (Meas.) Rept. 6/26/2003
above (below) 1 inch hole, T.O.C., NW which is 1.0 ft. (above) below LSD
Water level abv/blw LSD = 9.79 - 1.00 = 8.79

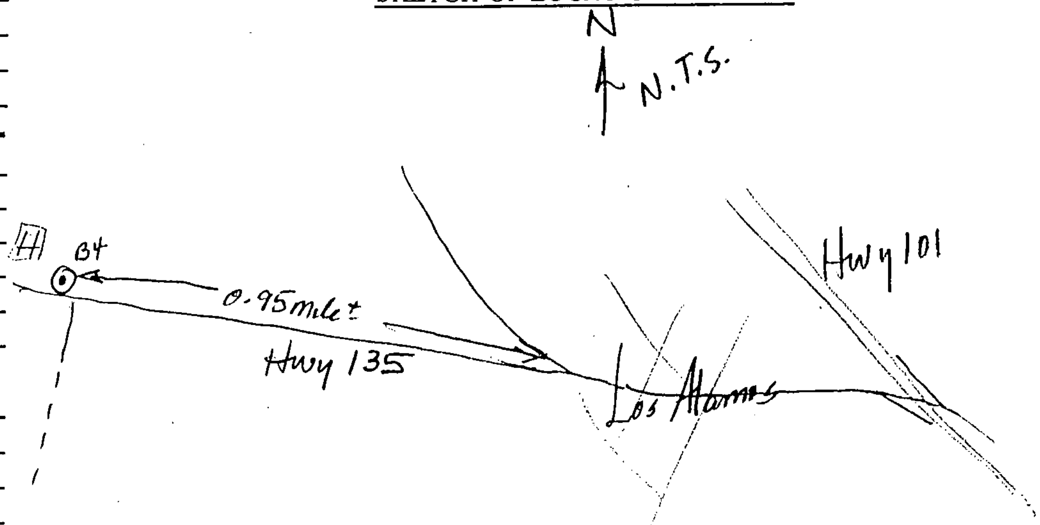
23 - 12.21 = 9.79 steel tape

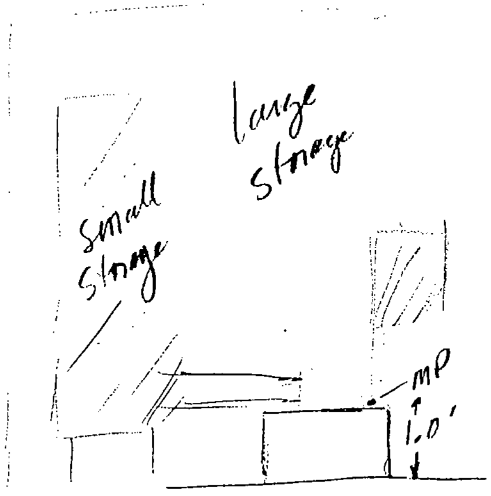
Location: Well is about 200 ft north of Hwy 135 and 10 ft north of large metal storage tank

4/2/03 23.00
− 14.41
8.59

Etrex GPS NAD83
344454.1 ± 16 ft.
120 18 12.3

SKETCH OF LOCATION AND M.P.





068870

☆U.S. GPO:1994—584-769

ORIGINAL
File with DWR
Page 1 of 1
Owner's Well No. 04-01
Date Work Began 7/09/04, Ended 7/23/04
Local Permit Agency Santa Barbara Co.Environmental Health
Permit No. SR0103311 Permit Date 7/07/04

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0907621

DWR USE ONLY — DO NOT FILL IN

08N32W28P004S

STATE WELL NO./STATION NO.

LATITUDE | LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD Mud Rotary FLUID Bentonite

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
	Please See Attached
	Formation Log

TOTAL DEPTH OF BORING 562 (Feet)
TOTAL DEPTH OF COMPLETED WELL 524 (Feet)

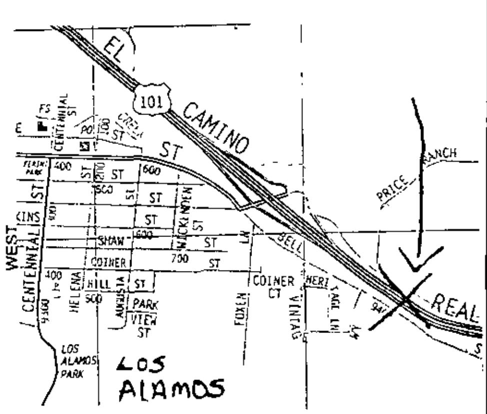
WELL OWNER

WELL LOCATION

Address Bell Street
City Los Alamos
County Santa Barbara
APN Book 133 Page 130 Parcel 009
Township 8N Range 32W Section 28
Lat ___ DEG. MIN. SEC. N Long ___ DEG. MIN. SEC. W

LOCATION SKETCH

NORTH



SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

USES (✓)

WATER SUPPLY
X Domestic ___ Public
X Irrigation ___ Industrial

MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 133 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 133 (Ft.) & DATE MEASURED 7/23/04
ESTIMATED YIELD * 385 (GPM) & TEST TYPE Continuous
TEST LENGTH 12 (Hrs.) TOTAL DRAWDOWN 210 (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	310	17	x				F480PVC	10	.512	
310	514	17		x			F480PVC	10	.512	.040
514	524	17	x				F480PVC	10	.512	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	50	x			6-Sack
50	524			x	Lonestar #3

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
X Geophysical Log(s)
___ Soil/Water Chemical Analyses
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME Floyd V. Wells, Inc.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

1337 W. Betteravia Road, Santa Maria, CA 93455
ADDRESS CITY STATE ZIP

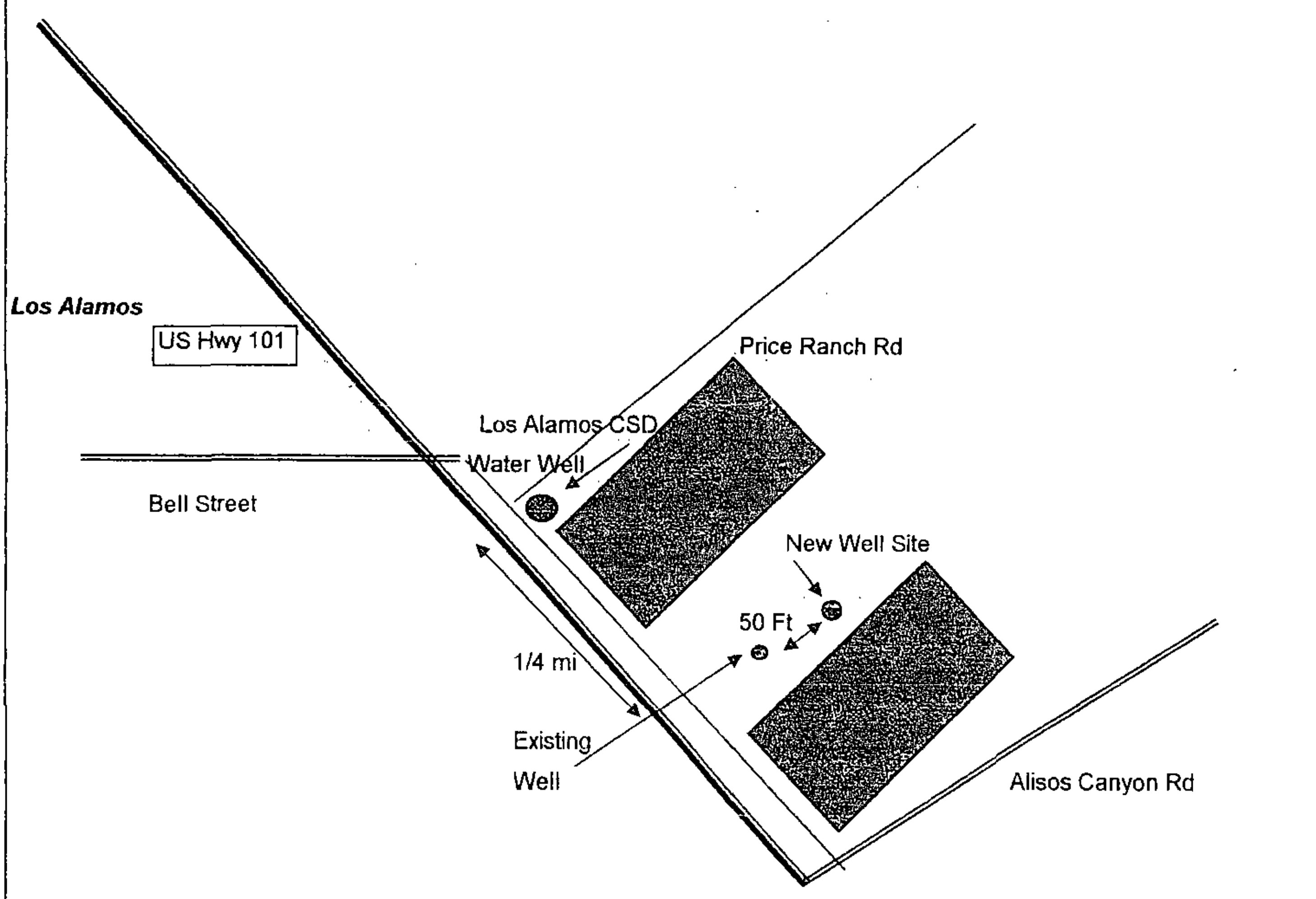
Signed [signature] C-57 LICENSED WATER WELL CONTRACTOR 09/24/04 DATE SIGNED 57-229570 C-57 LICENSE NUMBER

0907621

Formation Log		
Depth	Depth	Formation Description
0	12	Dark brown clay fine sand
12	21	1/8 - 1/4 Gravels, small gravels fine sand some dark brown clay ½ gravels
21	29	1/8 to 3/4 Gravels, small gravel
29	61	1/4 - 1" Gravels course sand, fine sand, brown clay
61	79	1/8 – 1 1/2 Gravels course gravels fine sands, some brown clay
79	98	|Course gravels, 1/8 to 1 3/4 gravel
98	110	Brown clay fine sand 1" to 1 1/2" gravels
110	148	Mostly brown clay some fine sand
148	153	Some brown clay course sands, fine sands, 1/4 gravels
153	171	Mostly brown clay some fine sands, little course gravel
171	187	Light brown clay very little course gravel
187	192	Light green clay with some tan sand very little course gravels grayish clay
192	200	Brown clay
200	217	Redish brown clay some course sand
217	238	Course gravels, 1/4 to 1/2 gravels, no clay, with some slay
264	286	Light brown clay, small gravel, course gravel, fine sand
286	330	Sticky brown clay
330	386	Brown clay, course sand, fine sand some small gravel
386	474	Course gravel, fine sand, some clay
474	542	Mostly brown clay some fine, sand little course gravel
542	552	1/2 gravels brown clay fine sands
552	562	Grayish blue clay, some fine sands

Plot Plan (1/4" = 20')

Indicate below the exact location of the proposed well with respect to the following items: Property lines, sewer lines and sewage disposal systems, animal enclosures, watercourses, flood plain, drainage pattern, existing wells, access roads, easements, and well site elevation. Include dimensions.



ORIGINAL
File with DWR

OCT 31 1974

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

№ 115694

State Well No. 8N/32W-30D1

Other Well No.

(1) OWNER:

Name [redacted]

(2) LOCATION OF WELL:

County Santa Barbara   Owner's number, if any

Township, Range, and Section 1/2 mile N. Hwy 135 & 1/3 mile W.

Distance from cities, roads, railroads, etc. Bell Street, 33' S. of San Antonio Creek.

(3) TYPE OF WORK (check):

New Well XX Deepening ☐ Reconditioning ☐ Destroying ☐

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary Rev. XX
Cable ☐
Other ☐

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE ☒ DOUBLE ☐

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft. (If gravel packed)	To ft. (If gravel packed)
+1	20	30"	14ga	36"		
+1	895	16"	1/4"	26"	0	899

Size of shoe or well ring: Size of gravel: Sandy 5

Describe joint welded

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
265	355			1/8" std.
378	409			1/8" std.
463	523			1/8" std.
667	895			1/8" std.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes ☒ No ☐ To what depth 50 ft.

Were any strata sealed against pollution? Yes ☐ No ☐ If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing conductor and concrete

(9) WATER LEVELS:

Depth at which water was first found, if known ft.

Standing level before perforating, if known ft.

Standing level after perforating and developing ft.

(10) WELL TESTS:

Was pump test made? Yes ☐ No ☐ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Temperature of water Was a chemical analysis made? Yes ☐ No ☐

Was electric log made of well? Yes ☐ No ☐ If yes, attach copy

(11) WELL LOG:

Total depth 899 ft. Depth of completed well 895 ft.

Formation: *Describe by color, character, size of material, and structure*

ft. to ft.	
0 - 20	top soil
20 - 30	hard clay
30 - 83	blue sticky clay
83 - 90	coarse sand & pea gravel & large rocks
90 - 101	coarse sand, gravel & rock
101 - 117	coarse sand w/ gravel
117 - 142	sandy gray clay
142 - 144	gravel & small rock
144 - 179	sandy gray clay
179 - 186	brown sticky clay
186 - 191	coarse sand & gravel (loose)
191 - 198	soft brown clay
198 - 201	coarse sand and gravel
201 - 227	brown clay
227 - 230	coarse sand, gravel & small rock
230 - 250	soft brown clay
250 - 296	sticky gray clay
296 - 300	shale and gravel
300 - 308	coarse sand & gravel 1/4 - 1/2
308 - 318	sandy brown clay
318 - 339	sticky gray clay
339 - 341	gravel & shale (loose)
341 - 343	sticky gray clay
343 - 347	coarse sand, gravel & small rock
347 - 363	sticky gray clay
363 - 366	coarse sand gravel & small rock
366 - 403	sandy brown clay (tight)
403 - 412	coarsesand, gravel w/smallrock
412 - 419	gray clay
419 - 425	sticky gray clay
425 - 428	coarse sand & gravel w/some clay
428 - 469	brown sticky clay'
469 - 476	fine sand & gravel
476 - 492	brown sticky clay
492 - 498	silt, fine sand & gravel
498 - 502	sticky gray clay

" OVER

Work started 7-10 1974, Completed 7-30 1974

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

CONFIDENTIAL NOT FOR PUBLIC RELEASE

NAME Ben Barrow Company, Inc.
(Person, firm, or corporation) *(Typed or printed)*

Address P.O. Box 888
Woodland, California 95695

[SIGNED] (signature) (Well Driller)

License No. 283326 Dated August 2, 1974

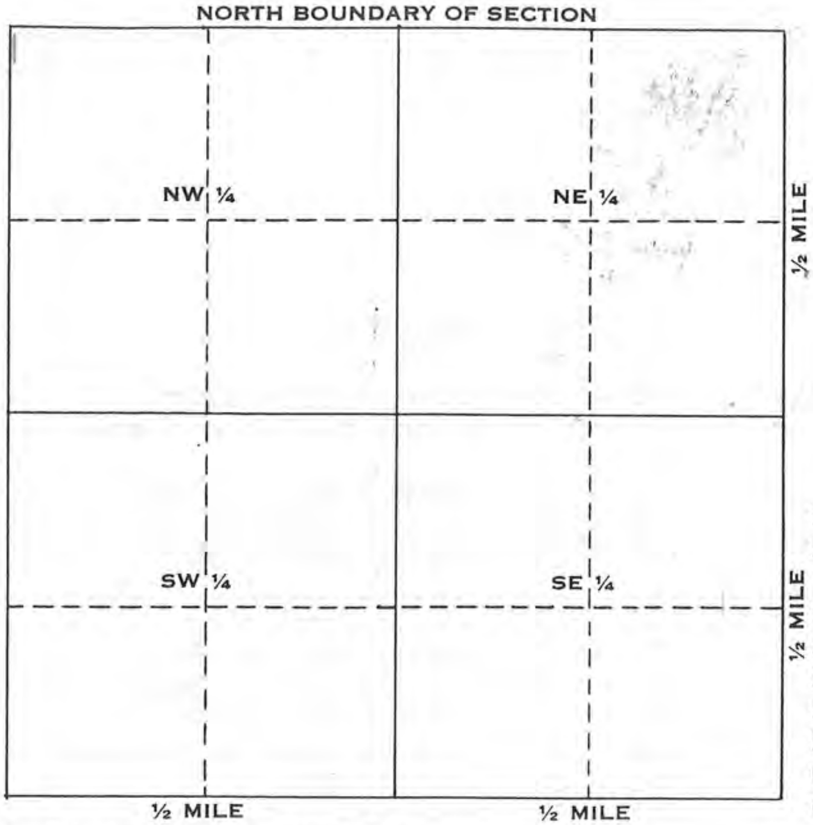
SKETCH LOCATION OF WELL ON REVERSE SIDE

Log continued on back page

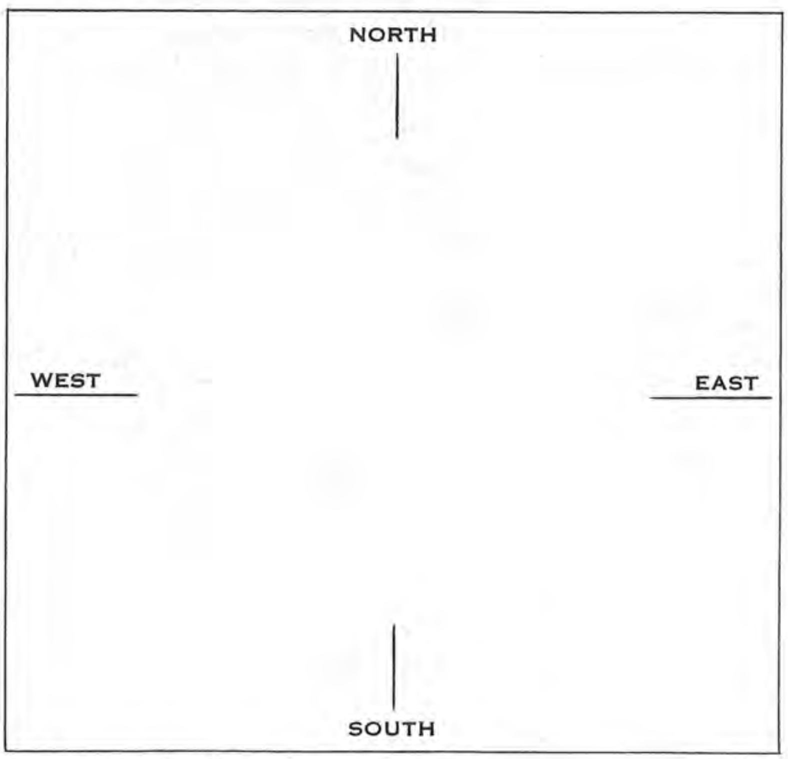
WELL LOCATION SKETCH

76

RECEIVED
AUG 23 1974
SAN JOAQUIN DISTRICT



A. Location of well in sectionized areas.
Sketch roads, railroads, streams, or other features as necessary.



B. Location of well in areas not sectionized.
Sketch roads, railroads, streams, or other features as necessary.
Indicate distances.

Township ______________________ N/S

Range ______________________ E/W

Section No. ______________________

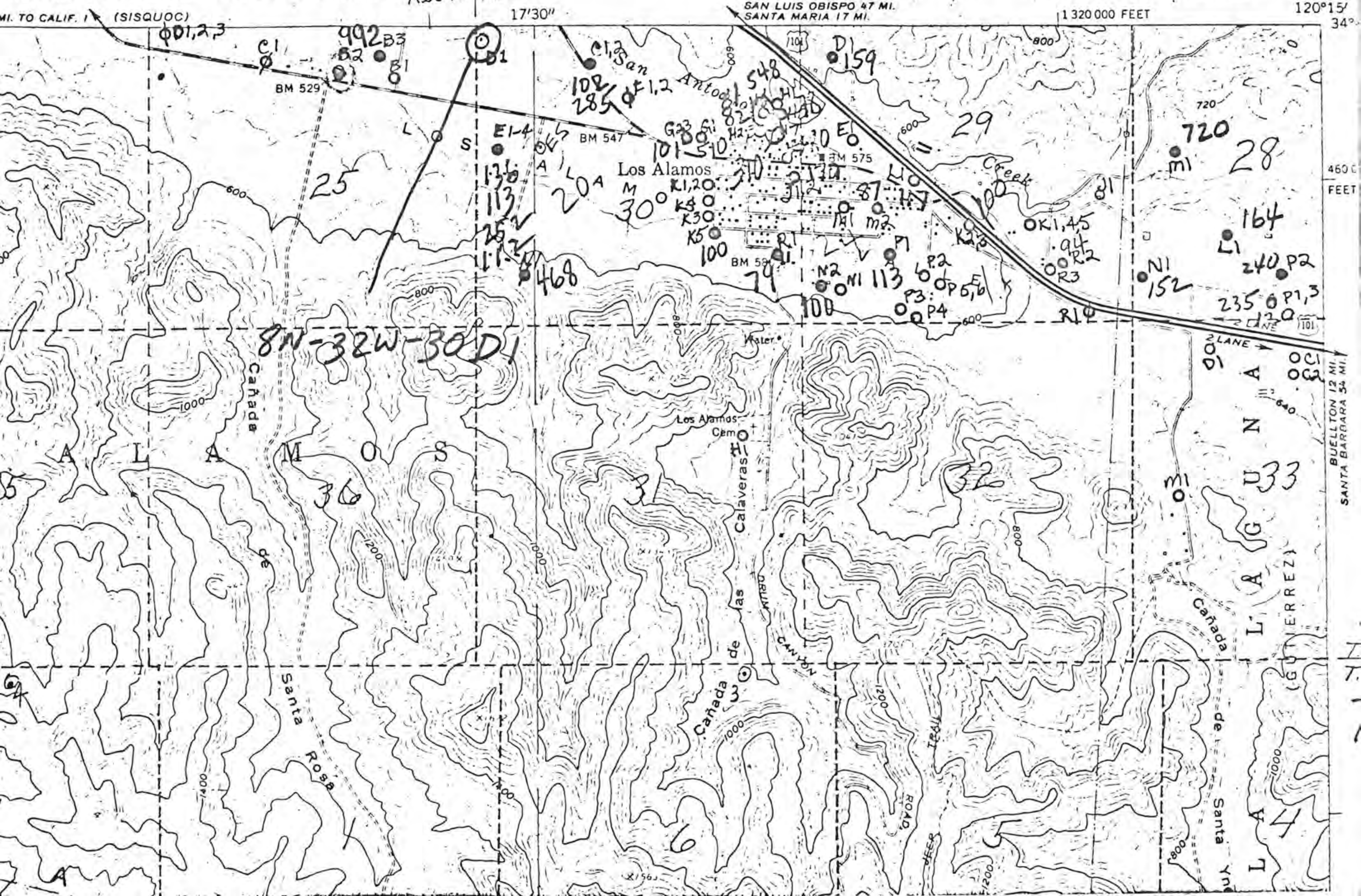
502 - 510	silt, fine sand & gravel
510 - 517	sandy gray clay w/some gravel
517 - 541	sticky gray clay
541 - 567	blue sticky clay
567 - 570	hard brown clay
570 - 572	sand & gravel
572 - 608	blue sticky clay
608 - 609	hard clay
609 - 626	blue clay
626 - 654	hard gray clay
654 - 656	coarse sand & gravel w/ some clay
656 - 662	coarse sand and gravel
662 - 664	gray sticky clay
664 - 676	blue clay
676 - 709	hard sandy brown clay
709 - 721	hard brown clay w/some shale
721 - 728	sticky yellow clay
728 - 732	coarse sand and gravel
732 -733	yellow clay
733 - 751	coarse sand and gravel
751 - 753	yellow sticky clay
753 - 755	coarse sand and gravel
755 - 767	yellow clay
767 - 773	sandy clay & gravel
773 - 791	yellow clay
791 - 793	blue clay
793 - 795	gray clay & shale
795 - 854	yellow clay
854 - 861	coarse sand and gravel
861 - 865	clay and shale
865 - 874	soft yellow clay
874 - 875	sandy clay w/some gravel
875 - 879	coarse sand and gravel
879 - 881	shale and clay
881 - 895	clay and gravel
895 - 899	coarse sand & gravel

Los Alamos quad

STATE OF CALIFORNIA
EDMUND G. BROWN, GOVERNOR
BANKS, DIRECTOR OF WATER RESOURCES

33W 32W

LOS ALAMOS QUADRANGLE
CALIFORNIA—SANTA BARBARA CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 LOMPOC 15' QUADRANGLE



ORIGINAL
File with DWR

SEP 30 1973

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

8N/33W-0

Do Not Fill In

№ 78802

State Well No. 8N/33W

Other Well No.

(1) OWNER:

Name

Addre

(2) LOCATION OF WELL:

County Santa Barbara Owner's number, if any 6

Township, Range, and Section 3/10 mile West of Bell St. on

Distance from cities, roads, railroads, etc. Hwy. 135 1/10 mile south of Hwy. 135

(3) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [X]
Cable [ ]
Other [ ]

(6) CASING INSTALLED:

STEEL: OTHER:

SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall	If gravel packed: Diameter of Bore	From ft.	To ft.
0	150	14"	.375	24"	0	1001
150	680	"	.312			
680	1001	"	.375			

Size of shoe or well ring: Size of gravel:

Describe joint Butt welded

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
150	1001	14 rows of 125 mesh		

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes [ ] No [X] To what depth ft.

Were any strata sealed against pollution? Yes [ ] No [X] If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known — ft.

Standing level before perforating, if known — ft.

Standing level after perforating and developing — ft.

(10) WELL TESTS:

Was pump test made? Yes [X] No [ ] If yes, by whom? F.V. Wells, INc.

Yield: 1250 gal./min. with 400 ft. drawdown after 4 hrs.

Temperature of water Was a chemical analysis made? Yes [ ] No [X]

Was electric log made of well? Yes [X] No [ ] If yes, attach copy

(11) WELL LOG:

Total depth 1001 ft. Depth of completed well 1001 ft.

Formation: *Describe by color, character, size of material, and structure*

ft. to ft.

SEE ATTACHED LOG

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

Work started 3-14-73 19 , Completed 3-24-73

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Floyd V. Wells, Inc.
(Person, firm, or corporation) (*Typed or printed*)

Address P. O. Box 1007, Santa Maria, Calif.

[SIGNED] F.V. Wells
(*Well Driller*)

License No. C57-229570 Dated Sept. 10, 1973

SKETCH LOCATION OF WELL ON REVERSE SIDE

OVER

DWR 188 (REV. 9-68)

25179-950 9-68 50M TRIP OSP

78802

Peerless Pumps
Irrigation Systems
Sales and Service

Licensed
Drilling
Contractors

FLOYD V. WELLS, INC.

116 North Blosser Road • Phone WAlnut 5-8626
SANTA MARIA, CALIFORNIA 93454

Mailing Address:
Post Office Box 1007
Santa Maria, California

Goleta Office:
5798 Dawson Ave.
Phone 967-4124
Santa Maria
Phone ZEnith 2-7726

Log of well drilled for :

Well number : #6

Location : 3/10 mile west of Bell St. on Hwy. 135, 1/10 mile south of Hwy. 135, Los Alamos

Well bore : 24"

Casing : 1001 ft. of 14" wall pipe, .375 wall from 680 ft. to 1001 ft., .312 wall from 150 ft. to 680 ft., .375 wall from 0 to 150 ft.

Perforations : 1001 ft. to 150 ft. of 14 rows, 125 mesh

Well completed : 24 March 1972

SEP 30 1973

Formation

From	0	to	10	feet	Adobe
"	10	"	31	"	Adobe and gravel
"	31	"	45	"	Black clay and gravel, loose
"	45	"	70	"	Dark brown clay and gravel
"	70	"	87	"	Light brown clay and coarse sand and gravel
"	87	"	97	"	Dark brown clay and gravel
"	97	"	112	"	Light brown clay and gravel
"	112	"	155	"	Dark brown clay with small amount of gravel
"	155	"	190	"	Light brown sandy clay with coarse sand and gravel, loose
"	190	"	220	"	Dark brown clay with small amount gravel
"	220	"	260	"	Light brown clay with coarse sand and gravel strips
"	260	"	290	"	Dark brown sandy clay with coarse sand strips
"	290	"	320	"	Light gray clay
"	320	"	330	"	Dark brown clay
"	330	"	345	"	Light brown clay with thin gravel strips
"	345	"	368	"	Dark brown clay
"	368	"	423	"	Brown sandy clay with coarse sand and gravel strips
"	423	"	450	"	Dark brown clay with thin gravel strips
"	450	"	460	"	Green clay
"	460	"	515	"	Brown clay with gravel strips
"	515	"	555	"	Dark brown clay with gravel

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

- continued -

Log of well drilled for

From	555	to	615	feet	Blue clay
"	615	"	625	"	Brown clay
"	625	"	665	"	Dark gray clay
"	665	"	685	"	Brown clay
"	685	"	702	"	Dark gray clay with light brown clay
"	702	"	745	"	Brown clay with coarse sand and gravel
"	745	"	779	"	Brown clay
"	779	"	800	"	Gray clay
"	800	"	830	"	Brown clay
"	830	"	860	"	Sandy brown clay
"	860	"	1001	"	Brown sandy clay with coarse sand

8N,33W-0 78802

Schlumberger

INDUCTION ELECTRICAL LOG

COUNTY	FIELD or LOCATION	WELL	COMPANY

COMPANY

WELL FERRERO #6

FIELD Los Alamos

COUNTY Santa Barbara STATE Calif

LOCATION

Sec. Twp. Rge.

Other Services:

Permanent Datum: G.L. , Elev.

Log Measured From G.L. , Ft. Above Perm. Datum

Drilling Measured From G.L.

Elev.: K.B.

D.F.

G.L.

Date	3-17-72			
Run No.	- 1 -			
Depth—Driller	993			
Depth—Logger	992			
Btm. Log Interval	991			
Top Log Interval	06			
Casing—Driller	- @ -	@	@	@
Casing—Logger	—			
Bit Size	10 5/8 x 9 7/8 @ 700			
Type Fluid in Hole	NATURAL			
Dens. | Visc.	- N.A. -			
pH | Fluid Loss	7 | - ml	ml	ml	
Source of Sample	PIT			
R_m @ Meas. Temp.	7.0 @ 60 °F	@ °F	@ °F	@
R_{mf} @ Meas. Temp.	9.6 @ 60 °F	@ °F	@ °F	@
R_{mc} @ Meas. Temp.	@ °F	@ °F	@ °F	@
Source: R_{mf} R_{mc}	M | C			
R_m @ BHT	5.3 @ 75 °F	@ °F	@ °F	@
Time Since Circ.	1-HR			
Max. Rec. Temp.	18 °F	°F	°F	
Equip. | Location	7516 | 15			
Recorded By	BARBARICK			
Witnessed By	FISH			

08N32W30G

The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR 08N32W30G

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752

Page 1 of 2

Owner's Well Number WELL NO 5

Date Work Began 10-4-06 Date Work Ended 11-18-06

Local Permit Agency LOS ALAMOS COMM. SERV. DIST

Permit Number N.A Permit Date N.A

DWR Use Only – Do Not Fill In

State Well Number/Site Number: N / W

Latitude / Longitude

APN/TRS/Other

Geologic Log

Orientation: [X] Vertical ( ) Horizontal ( ) Angle Specify ____

Drilling Method ____ Drilling Fluid ____

Depth from Surface Feet	to Feet	Description (Describe material, grain size, color, etc)
0	90	BROWN SAND
90	110	GRAVEL AND SAND
110	230	CLAY W, SAND AND GRAVEL
230	360	BROWN SAND CLAY
360	500	HARD BROWN CLAY
500	700	BROWN GRAVELLY CLAY AND SAND
700	800	BROWN CLAY W, SAND
800	900	SANDY CLAY
900	970	BROWN GRAVELLY SAND
970	1010	HARD GREY CLAY

Total Depth of Boring 1010 Feet

Total Depth of Completed Well 962 Feet

Well Owner

Well Location

Address 33 ST JOSEPH ST

City LOS ALAMOS County SANTA BARBRA

Latitude ____ Deg. Min. Sec. N Longitude ____ Deg. Min. Sec. W

Datum ____ Decimal Lat. ____ Decimal Long. ____

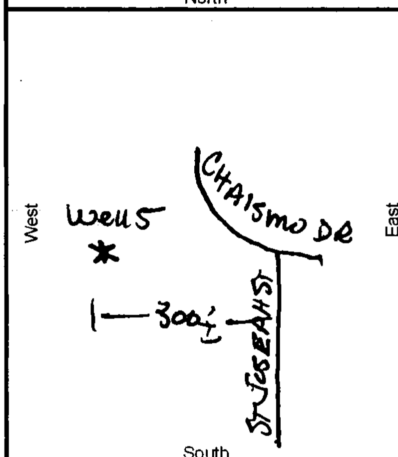
APN Book 101 Page 110 Parcel 035

Township ____ Range ____ Section ____

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North



South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

[X] New Well
( ) Modification/Repair
( ) Deepen
( ) Other ____
( ) Destroy
Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

[X] Water Supply
[ ] Domestic [X] Public
[ ] Irrigation [ ] Industrial
( ) Cathodic Protection
( ) Dewatering
( ) Heat Exchange
( ) Injection
( ) Monitoring
( ) Remediation
( ) Sparging
( ) Test Well
( ) Vapor Extraction
( ) Other ____

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7-06

Estimated Yield * 800 (GPM) Test Type CONSTANT

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
0	60	36	COND	STEEL	5/16	28		
+2	210	24	BLANK	STEEL	1/4	12 3/4		
210	212	"	MECHICAL CONNECTOR			12 3/4		
212	217	"	BLANK	T 304 SS	1/4	12 3/4		
217	352	"	SCREEN	T 304 SS		12 3/4	WW	
352	502	"	BLANK	T 304 SS	1/4	12 3/4		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description
0	60	CEMENT	10.5 SK
60	120	CEMENT	10.5 SK
120	1010	GRAVEL	RMC #3

Attachments

[ ] Geologic Log
[ ] Well Construction Diagram
[ ] Geophysical Log(s)
[ ] Soil/Water Chemical Analyses
[ ] Other ____

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name BEST DRILLING AND PUMP, INC.
Person, Firm or Corporation

2950 OLETA LANE — HIGHLAND — CA 92346
Address — City — State — Zip

Signed [signature] — 12-7-06 — 826672
C-57 Licensed Water Well Contractor — Date Signed — C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

*The free Adobe Reader may be used to view and complete this form. However, software must be purchased to complete, save, and reuse a saved form.

File Original with DWR

State of California

Well Completion Report

Refer to Instruction Pamphlet

No. e046752 CONT.

Page 2 of 2

Owner's Well Number Well 5

Date Work Began ______ Date Work Ended ______

Local Permit Agency ______

Permit Number ______ Permit Date ______

DWR Use Only – Do Not Fill In

State Well Number/Site Number

Latitude N Longitude W

APN/TRS/Other

Geologic Log

Orientation ○ Vertical ○ Horizontal ○ Angle Specify ______

Drilling Method ______ Drilling Fluid ______

Depth from Surface Feet	to Feet	Description Describe material, grain size, color, etc

Total Depth of Boring ______ Feet

Total Depth of Completed Well ______ Feet

Well Owner

Well Location

Address ______

City ______ County ______

Latitude ___ Deg. ___ Min. ___ Sec. N Longitude ___ Deg. ___ Min. ___ Sec. W

Datum ______ Decimal Lat. ______ Decimal Long. ______

APN Book ______ Page ______ Parcel ______

Township ______ Range ______ Section ______

Location Sketch

(Sketch must be drawn by hand after form is printed.)

North / West / East / South

Illustrate or describe distance of well from roads, buildings, fences, rivers, etc. and attach a map. Use additional paper if necessary. Please be accurate and complete.

Activity

- ○ New Well
- ○ Modification/Repair
  - ○ Deepen
  - ○ Other ______
- ○ Destroy
  - Describe procedures and materials under "GEOLOGIC LOG"

Planned Uses

- [x] Water Supply
  - ☐ Domestic ☒ Public
  - ☐ Irrigation ☐ Industrial
- ○ Cathodic Protection
- ○ Dewatering
- ○ Heat Exchange
- ○ Injection
- ○ Monitoring
- ○ Remediation
- ○ Sparging
- ○ Test Well
- ○ Vapor Extraction
- ○ Other ______

Water Level and Yield of Completed Well

Depth to first water 40 (Feet below surface)

Depth to Static Water Level 89 (Feet) Date Measured 11-7

Estimated Yield * 800 (GPM) Test Type Constant

Test Length 72 (Hours) Total Drawdown 115 (Feet)

*May not be representative of a well's long term yield.

Casings

Depth from Surface Feet	to Feet	Borehole Diameter (Inches)	Type	Material	Wall Thickness (Inches)	Outside Diameter (Inches)	Screen Type	Slot Size if Any (Inches)
502	702	24	Screen	T304 SS	-	12 3/4	WW	.040
702	792	24	Blank	T304 SS	1/4	12 3/4		
792	952	24	Screen	T304 SS		12 3/4	WW	1040
952	962	24	Blank	T304 SS	1/4	12 3/4		

Annular Material

Depth from Surface Feet	to Feet	Fill	Description

Attachments

- ☐ Geologic Log
- ☐ Well Construction Diagram
- ☐ Geophysical Log(s)
- ☐ Soil/Water Chemical Analyses
- ☐ Other ______

Attach additional information, if it exists.

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name ______
Person, Firm or Corporation

______ Address ______ City CA State ______ Zip

Signed ______ C-57 Licensed Water Well Contractor ______ Date Signed ______ C-57 License Number

DWR 188 REV. 1/2006

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

State of California

Well Completion Report

Form DWR 188 Complete 12/15/2017
WCR2017-005628

Owner's Well Number: WELL #6 | Date Work Began: 10/23/2017 | Date Work Ended: 11/08/2017

Local Permit Agency: Santa Barbara County Environmental Health Services

Secondary Permit Agency: | Permit Number: 0002481 | Permit Date: 10/23/2017

Well Owner (must remain confidential pursuant to Water Code 13752)

Name: XXXXXXXXXXXXXXXXXXXX

Mailing Address: XXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXX

City: XXXXXXXXXXXXXXXXXXXX State: XX Zip: XXXXX

Planned Use and Activity

Activity: New Well

Planned Use: Water Supply Public

Well Location

Address: 175 BELL ST

City: LOS ALAMOS Zip: 93440 County: Santa Barbara

Latitude: 34 Deg. 44 Min. 40.95 Sec. N Longitude: -120 Deg. 16 Min. 47.23 Sec. W

Dec. Lat.: 34.7447083 Dec. Long.: -120.2797861

Vertical Datum: Horizontal Datum: WGS84

Location Accuracy: Location Determination Method:

APN: 101-152-008

Township: 08 N

Range: 32 W

Section: 30

Baseline Meridian: San Bernardino

Ground Surface Elevation:

Elevation Accuracy:

Elevation Determination Method:

Borehole Information

Orientation: Vertical Specify:

Drilling Method: Direct Rotary Drilling Fluid: Bentonite

Total Depth of Boring: 1005 Feet

Total Depth of Completed Well: 960 Feet

Water Level and Yield of Completed Well

Depth to first water: (Feet below surface)

Depth to Static Water Level: 140 (Feet) Date Measured: 11/08/2017

Estimated Yield*: 600 (GPM) Test Type: Air Lift

Test Length: 12 (Hours) Total Drawdown: (feet)

*May not be representative of a well's long term yield.

Geologic Log - Free Form

Depth from Surface Feet to Feet		Description
0	42	DARK BROWN CLAY
42	54	SAND & GRAVEL
54	71	BROWN SANDY CLAY
71	126	SAND & GRAVEL
126	143	BROWN CLAY
143	152	SAND & GRAVEL
152	157	BROWN CLAY
157	173	SAND & GRAVEL
173	179	BROWN CLAY & GRAVEL LAYERS
179	267	SAND & GRAVEL
267	272	BROWN CLAY
272	281	SAND & GRAVEL
281	293	BROWN CLAY
293	303	SAND & GRAVEL
303	308	BROWN CLAY & HARD LAYERS

308	317	SAND & GRAVEL
317	321	BROWN CLAY
321	348	SAND & GRAVEL
348	364	SAND W/ CLAY LAYERS
364	428	BROWN CLAY
428	437	SAND
437	463	GREY / BROWN CLAY
463	478	GRAVEL LAYERS
478	564	BROWN CLAY
564	570	SAND & GRAVEL
570	637	BROWN CLAY W/ SAND LAYERS
637	648	SAND & THIN GRAVEL ZONES
648	654	BROWN CLAY
654	665	SAND & THIN GRAVEL ZONES
665	677	BROWN CLAY
677	685	SAND & GRAVEL
685	732	BLUE CLAY W/ GRAVEL LAYERS
732	743	SAND & GRAVEL
743	757	BLUE CLAY
757	763	SAND & GRAVEL
763	768	BLUE CLAY
768	782	SAND & GRAVEL
782	836	BLUE CLAY
836	864	SAND
864	902	BLUE CLAY & SAND
902	935	SAND & GRAVEL
935	951	CLAY
951	958	SAND & GRAVEL
958	1005	BROWN CLAY

Casings

Casing #	Depth from Surface Feet to Feet		Casing Type	Material	Casings Specificatons	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if any (inches)	Description
1	0	58	Conductor or Fill Pipe	Low Carbon Steel	Grade: ASTM A53	0.25	24			
2	0	190	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	190	290	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	
2	290	330	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	330	690	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	
2	690	810	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			
2	810	950	Screen	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75	Milled Slots	0.04	
2	950	960	Blank	PVC	OD: 12.750 in. | SDR: 17 | Thickness: 0.750 in.	0.75	12.75			

Annular Material

Depth from Surface Feet to Feet		Fill	Fill Type Details	Filter Pack Size	Description
0	1005	Filter Pack	Other Gravel Pack		LAPIS #3

Other Observations:

Borehole Specifications

Depth from Surface Feet to Feet		Borehole Diameter (inches)
0	58	30
58	1005	22

Certification Statement

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief

Name: FILIPPONI-THOMPSON DRILLING INC
Person, Firm or Corporation

P O BOX 845	ATASCADERO	CA	93423
Address	City	State	Zip

Signed: *electronic signature received* — C-57 Licensed Water Well Contractor
11/30/2017 — Date Signed
432680 — C-57 License Number

DWR Use Only

CSG #	State Well Number	Site Code	Local Well Number

N — Latitude Deg/Min/Sec

W — Longitude Deg/Min/Sec

TRS: 08N32W30H

APN:

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SAC●C PROJECT: GC16ZG00FUVS300 PROJECT CHIEF: David O'Leary

ELEV: 583' LOCATION: 8300 Cat Canyon Rd., Los Alamos, CA 93440; N34°45'20" W120°17'40" LOGGED BY: Anthony Brown ~~Adam Kies~~

DRILLED BY: USGS RDP RIG TYPE: Mud Rotary- TH60 LAG METHOD: Rice (mud)

Date	Depth	Time (min)	Rig noise etc.	Color (Munsell - soil)	Cones / EC (pH: 6.5, EC: 841, 4440)	Graphic	Description and other observations	Bit size, &Rice time	Date
7/19	0–20	1511, 1540, 1730	12'	2.5Y 4/2; 2.5Y 5/3	V Hvy 3908		Gravelly (gran) sand (vf-vc); Sandy (vf-vc) gravel (gran - sm peb)	20" hole opener	7/19
7/20	40	1000, 1016, 1025, 1034	25' chatter; 32'	2.5Y 6/4	V Hvy m 4890		Sand (vf-vc); Sandy (vf-vc) gravel (gran - md peb)	9 7/8" long tooth Tricone	7/20
	60	1417, 1424, 1436		10YR 4/4; 2.5Y 5/4	V Hvy m 4340		Gravelly (gran - sm peb) sand (vf-vc)		
	80	1520, 1532, 1552, 1558	73'	↓	V Hvy m 3780		Gravelly (gran - sm peb) sand (vf-vc); Sandy (vf-vc) gravel (gran - lg peb)		
	100	1614, 1620, 1626	85'; 95'	2.5Y 6/3	Hvy 3670		Sand (vf-m); Sandy (vf-vc) gravel (gran - lg peb)		
	120	1646, 1652, 1658		↓	Hvy 3550		Sandy (vf-vc) gravel (gran - lg peb)		
	140	1713, 1721, 1728		10YR 5/4	Hvy m 3400		Sandy (vf-vc) gravel (gran - md peb)	Rice time 1 1/2 min	
7/20	160	1735, 1750, 1804	144'; 155'	10YR 6/4	Hvy 3070		144 silty clay 155; Sand (vf-m)		7/20
7/21	180	0855, 0901, 0908	176' color		Lt m 2910		Sand (vf-vc) w/ minor gravel (gran - sm peb) & interbedded clay		7/21
	200	0932, 0945, 1006	199' color	10YR 5/4	Lt 2810		Silty sand (vf-c); clay		
	220	1025, 1036, 1045	212' chatter; 218'	2.5Y 6/4 lt yl br; 10YR 6/4; 10YR 5/4	Mod 2800		Sandy (vf-c) silty clay; Sandy (m-vc) gravel (gran - lg peb)	Rice time 1.5 min	
	240	1103, 1111, 1132	232'; 237'		V Hvy 2740		Silty sand (vf-m); Sand (vf-m); Gravelly (gran - md peb) sand (vf-vc) mostly vf-m		
	260	1152, 1222, 1326, 1336	248'; 254'		V Hvy m 2830		Sand (vf-m); Sandy (vf-vc) silty clay		
	280	1354, 1408, 1416	261'; 275'		Hvy 2790		Clay; Sandy (vf-vc) silty clay		
	300	1428, 1435, 1443		↓	Hvy m 2760		Sandy (vf-vc) silty clay		
	320	1522, 1531, 1538	306'	10YR 6/4	Hvy 2620		Sand (vf-vc) w/ minor gravel (gran)	Rice time 2.5 min	
	340	1552, 1558, 1605	333'	10YR 5/4	V Hvy 2590		Sandy (vf-vc) silt		
	360	1630, 1636, 1652			Mod 2570		Sandy (vf-vc) silt		
	380	1715, 1750, 1801	362'; 364' Bailed; 374' easy	10YR 6/4	Lt m 3470		Sand (vf-vc) clayey silt		
	400	1810, 1817, 1824	388'; 395' chatter	10YR 5/4	Lt 2540		Sand (vf-m); Sandy (vf-m) silt		

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SAC[redacted] C | PROJECT: GC16ZG00FUVS300 | PROJECT CHIEF: David O'Leary

ELEV: 583' | LOCATION: 8300 Cat Canyon Rd., Los Alamos, CA 93440; N34°45'20" W120°17'40" | LOGGED BY: Anthony Brown ~~Adam Kjos~~

DRILLED BY: *USGS RDP* | RIG TYPE: *Mud Rotary- TH60* | LAG METHOD: *Rice (mud)*

Date	Depth	Time (min)	Rig noise etc.	Color (Munsell - soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time	Date
	400								
7/22	420	1024 1033 1043	▸416'	10YR 6/4	v HVY / m / 2220		clayey silt Gravelly (gran - md peb) SAND (vf - vc)	9 7/8" long tooth Tricone	7/22
	440	1100 1111 1121		10YR 4/3 10YR 5/4	VHVY / 2140		clayey sandy (vf-c) silt	Rice Time 3½ min	
	460	1138 1146 1156		↓	vHVY / 2180		clayey sandy (vf-c) silt		
	480	1232 1246 1257		↓	vHVY / 2240		clay (Bentonitic)		
	500	1325 1335 1346		10YR 5/3	HVY / m / 2090		clay clayey silty SAND (vf - c)		
	520	1356 1403 1410	▸505'	10YR 6/4	v HVY / 2250		SAND (vf-c)		
	540	1538 1543 1548		↓	vHVY / m / 2560		Gravelly (gran-sm peb) SAND (vf-vc)		
	560	1603 1608 1616	▸557' color	↓ 7.5Y 5/3	v HVY / 2490		Gravelly (gran - sm peb) SAND (vf-vc)		
	580	1632 1638 1647			VHVY / 2410		Gravelly (gran-sm peb) SAND (vf-vc)	Rice Time 5½ min	
	600	1702 1709 1716			VHVY / 2380		Gravelly (gran-sm peb) SAND (vf-vc)		
	620	1730 1736 1748	▸chatter 617'	2.5Y 5/2 2.5Y 4/1	vHVY / 2340		Gravelly (gran - sm peb) SAND (vf-vc)		
7/22	640	1758 1833 1846 @ 635' 0837 - 0846	▸chatter 628'	2.5Y 5/2	mod / 2250		SANDY (vf-c) silt SANDY (vf-m) silt w/ clay (salt n pepper)		7/22
7/23	660	0900 0905 0922	▸652' slow	↓	HVY / 2020		SAND (vf-vc)	7 7/8" long tooth Tricone w/ Jets	7/23
	680	0943 0958 1030	▸669' chatter	2.5Y 4/1	HVY / 1942		clayey silty SAND (vf-vc) S&P	Rice Time 9 min	
	700	1044 1119 1153		2.5Y 5/2	mod / 1916		clayey silty SAND (vf-vc)		
	720	1233 - 1237" Add Packing 1242 1331	▸716'	↓	mod / 2110		silty SAND (vf-vc)		
	740	1345 1406 1431	▸727'	2.5Y 5/3	mod / 2190		SAND (vf-vc)		
	760	1448 1621 1724		↓	mod / 1847		clayey silty SAND (vf-m) sticky mostly SAND (vf-f) but drilling like bakdup	Rice Time 9 min	
7/23	780	1733 1809 1825 0834 - 0835	▸768' chatter ▸773' slow	2.5Y 6/4 2.5Y 6/3	H / 2166		silty sand (vf-vc) clay stopped @ 776' @ 1825		7/23
7/24	800	0855 0918 0929	▸796'	2.5Y 5/3	H / m / 1943		clay clayey SAND (vf-c)		7/24

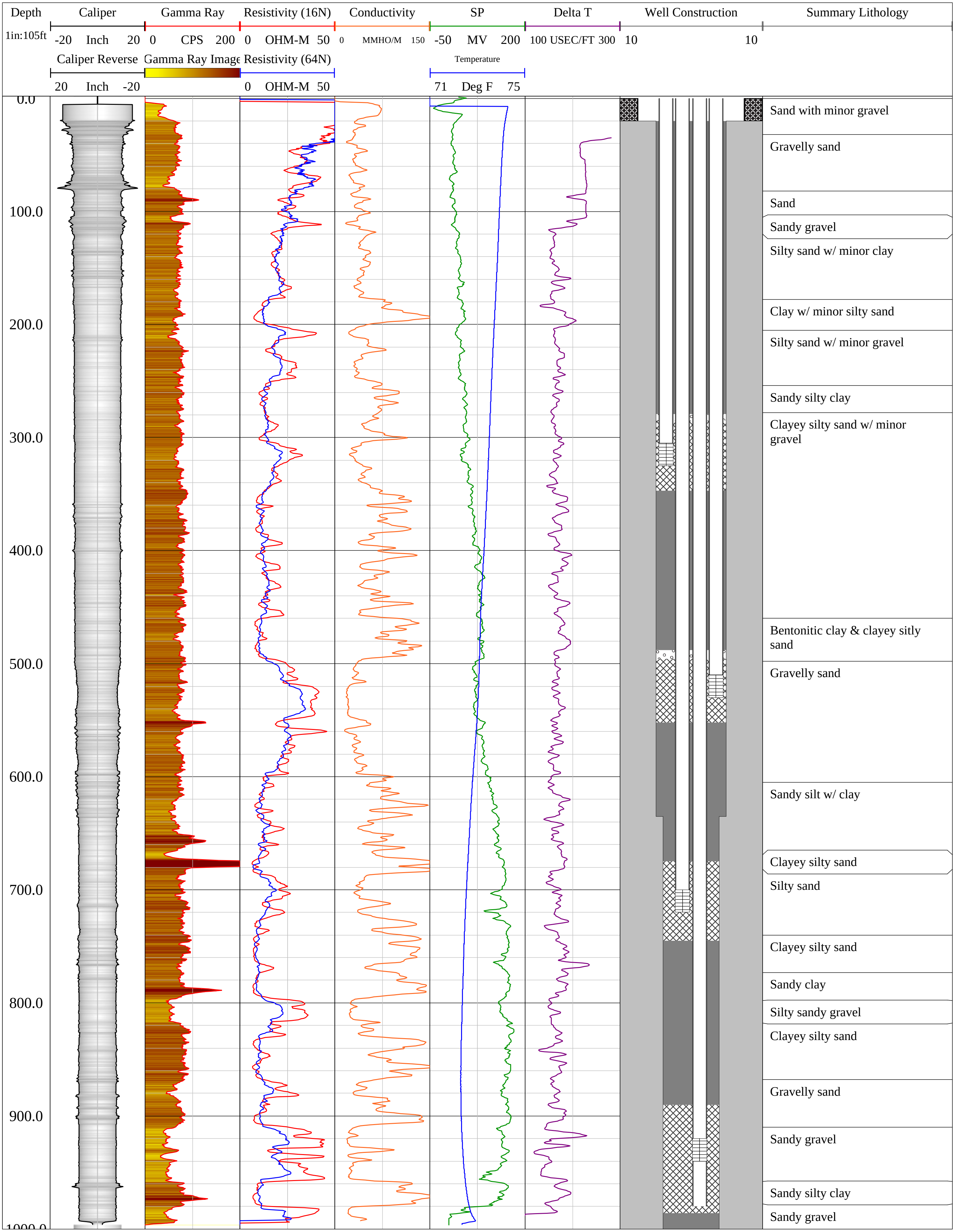
USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SAC[illegible]C PROJECT: GC16ZG00FUVS300 PROJECT CHIEF: David O'Leary

ELEV: 583' LOCATION: 8300 Cat Canyon Rd., Los Alamos, CA 93440, N34°45'20" W120°17'40" LOGGED BY: Anthony Brown, [illegible]

DRILLED BY: *USGS RDP* RIG TYPE: *Mud Rotary- TH60* LAG METHOD: *Rice (mud)*

Date	Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time	Date
	800								
7/24	820	0946 0950 0955	809' chatter 816'	2.5y 5/3	HVY / 1939		clayey sand (vf-c) SAND (vf-vc) w/ some silt SANDY (vf-vc) GRAVEL (gran-md peb)	7 7/8" longtooth tricone	7/24
	840	1014 1019 1120	832' slow		mod / 1974		SANDY (vf-vc) GRAVEL (gran-md peb) clay	Rice Time 10 min	
	860	1144 1209 1307	850' chatter 852' slow	2.5y 6/3	mod / 1924		clay clayey silty SAND (vf-vc)		
	880	1326 1430 1437	868' chatter		HVY / M 1920		Gravelly (gran) SAND (vf-vc)		
	900	1456 1512 1537	886' slower		VHVY / M 1906		Gravelly (gran) SAND (vf-vc)		
	920	1556 1614 1618	910' chatter		VHVY / M 2350		Gravelly (gran) sand (vf-vc)		
	940	1638 1645 1704	937' slow (1')		VHVY / 1995		sandy (vf-vc) gravel (gran-md peb)		
7/24	960	1724 1729 1748	slow 958'		VHVY / 1858		sandy (vf-vc) gravel (gran-md peb)	Rice Time 11 min	7/24
7/25	980	1024 1057 1122	978' chatter		lt / 2020		sandy (vf-vc) silty clay		7/25
	1000	1143 1148 1155			HVY / 2000		SANDY (vf-vc) gravel (gran-md peb)		


Depth
1in:105ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Gamma Ray
0 CPS 200
Gamma Ray Image
Resistivity (16N)
0 OHM-M 50
Resistivity (64N)
0 OHM-M 50
Conductivity
0 MMHO/M 150
SP
-50 MV 200
Temperature
71 Deg F 75
Delta T
100 USEC/FT 300
Well Construction
10 10
Summary Lithology
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
Sand with minor gravel
Gravelly sand
Sand
Sandy gravel
Silty sand w/ minor clay
Clay w/ minor silty sand
Silty sand w/ minor gravel
Sandy silty clay
Clayey silty sand w/ minor gravel
Bentonitic clay & clayey sitly sand
Gravelly sand
Sandy silt w/ clay
Clayey silty sand
Silty sand
Clayey silty sand
Sandy clay
Silty sandy gravel
Clayey silty sand
Gravelly sand
Sandy gravel
Sandy silty clay
Sandy gravel

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SACC #5 | PROJECT: | PROJECT CHIEF: David O'Leary
ELEV: | LOCATION: | LOGGED BY:
DRILLED BY: USGS RDP | RIG TYPE: Auger | LAG METHOD: N/A

Date	Depth	Time (min) Start or End	Rig noise etc.	Color (Munsell – soil)	Cones / mud EC	Graphic	Description and other observations	Bit size, &Rice time
							÷ No Lith symbol i.e. (cgmS) No sorting, Can use field Shorthand.	
1/21/2016	5'	1624 / 16:[illegible]	Hard	10YR 5/4			Sand (S); V.f-Med Sand (Minor Coarse Sand) w/ minor silt ~~Well sorted~~	8.5"
	10'	16:[illegible] / 16:[illegible]					Clayey Silty Sand (csS); V.f-Medium Sand (minor Coarse Sand) w/ Silt and Clay	
	15'	16:[illegible] / 16:54					(cgmS); V.f-V.Coarse Sand w/ Silt, Clay and granule-lrg Peb; V. ~~Poorly Sorted~~ — Color Change	
	20'	1703 / 1705					(gmS); V.f-V.Coarse Sand w/ Silt, Clay and granule-lrg Pebb V. Poorly Sorted	
	25'	1711 / 1714					(gmS); V.f-V.Coarse Sand w/ Silt Clay and granule-V.lrg Pebb	
	30'	1720 / 17[illegible]					Sandy clayey silt; Silt w/ Clay and V.f.-Medium Sand (minor Crs-V.Crs Sand) — Color change	
	35'	17[illegible] / 1732					gravely Sandy Clayey Silt; Silt w/ Clay, V.f-V.Crs Sand and gran-Sm peb (minor clay)	
	40'	1737 / 1739					Slightly gravelly Clayey Silty Sand; V.f.-V.Crs Sand (dom V.f-med Sand) W/ Silt, Clay and gran-Med peb	
	45'	1744 / 1747					Sandy Silt; Silt w/ V.f-Med Sand (minor Crs-V.Crs Sand) w/ minor Clay and trace gran-Sm Pebb	
	50'	1754 / 1756					Sandy Silt; Silt w/ V.f.-Med Sand (minor crs-V.Crs Sand) w/ minor Clay and trace gran-lrg Peb	
2/2/16	55'	1801 / 1803		7.5YR 4/3			Sandy Silt; Silt w/ V.f-Med Sand (minor crs-V.Crs Sand) w/ minor clay and trace-minor gran-Med Peb	
	60'	0727 / 0730		7.5YR 4/3			Sandy silt; Silt w/ V.f-Med Sand (minor crs-V.crs Sand) w/ trace-minor cly and trace granules	
	65'	0737 / 0739	Soft	10YR 5/4			Silty Sand; V.f.-Crs Sand (minor V.crs Sand) w/ Silt and trace gran — More Sandy (loosing clay component)	
	70'	0749 / 0751		10YR 5/4			Silty Sand; V.f.-Crs Sand (minor V.Crs Sand) w/ silt and trace gran	
	75'	0800 / 0804		10YR 5/3			Silty Sand; V.f-V.Crs Sand w/ Silt, trace minor clay and trace gran med peb	
	80'	0812 / 0815		10YR 5/3			Silty Sand; V.f.-V.Crs Sand w/ Silt, trace Clay and trace gran-Sm Peb	
	85'	0831 / 0833	really soft	10YR 5/3			Silty Sand; V.f.-V.Crs Sand w/ Silt, trace Clay and trace gran lrg Peb	
	90'	0847 / 0849		10YR 5/3			Sl gravelly Silty Sand; V.f-V.Crs Sand (dom V.f.-Med Sand) w/ silt and gran-lrg peb	
	95'	0856 / 0857		10YR 5/3			Sl. grvly Slty Snd; V.f-V.Crs Snd (dom V.f.-Med Snd) w/ slt and gran-lrg peb	
	100'	0904 / 0906		10YR 5/3			Slgrvly Slty Snd; V.f-V.Crs Snd w/ slt, minor Cly, and gran-med Peb	

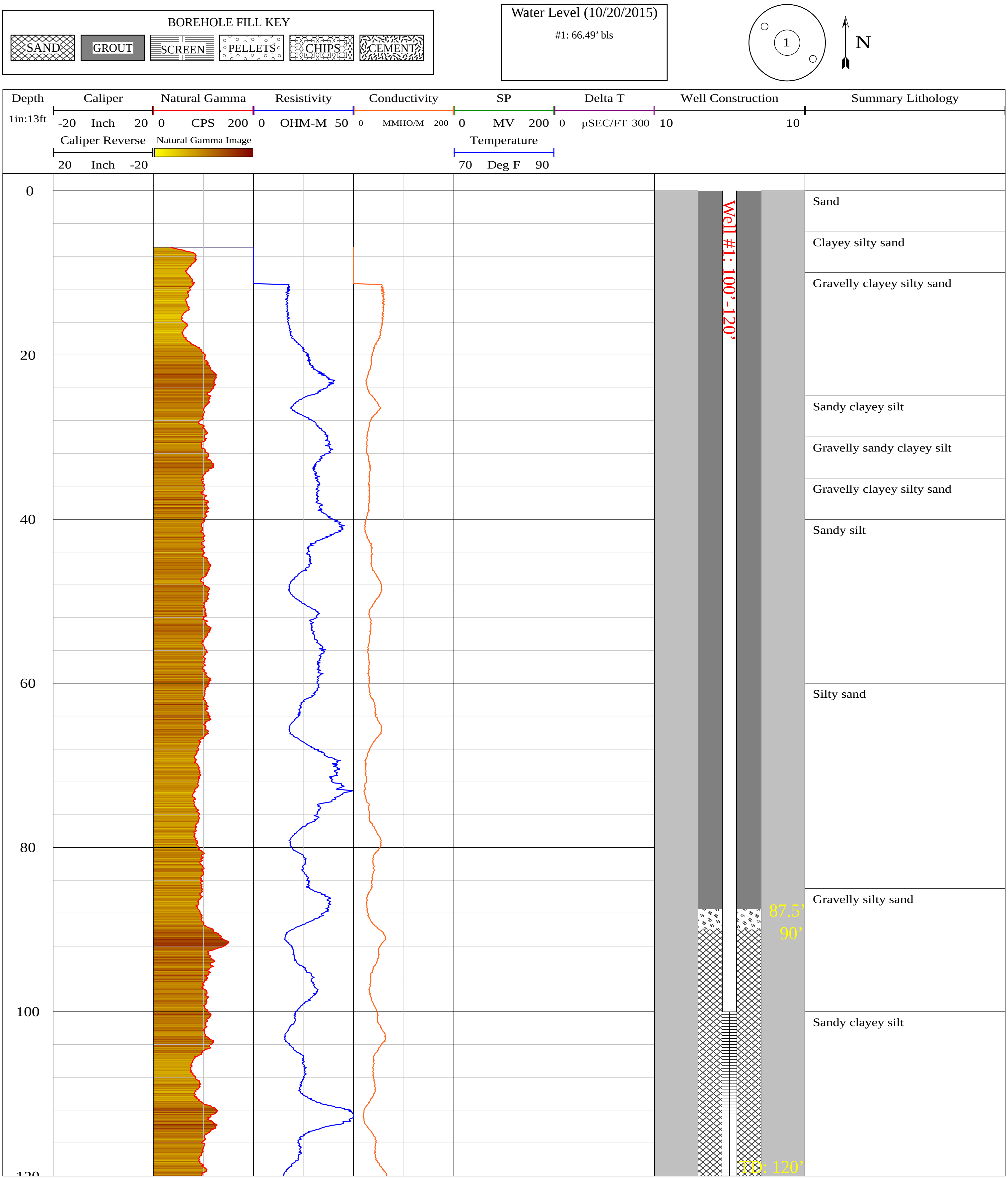
USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: ~~SAW5~~ SACC#5	PROJECT:	PROJECT CHIEF: David O'Leary
ELEV:	LOCATION:	LOGGED BY: David O'Leary, Adam Kjos, Chris Kohel
DRILLED BY: USGS RDP	RIG TYPE: Auger	LAG METHOD: N/A

1/22/2016

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / mud EC	Graphic	Description and other observations	Bit size, &Rice time
105'	0918 0920		10YR 6/3			Sandy Clyy silt; Silt w/clay and v.f.-v.Crs Sand; Wet Sample	8.5"
110'	0931 0933		10YR 4/3			105'-110' poss H_2O E-tape = 107.6' LSD Sndy clyy silt; Silt w/cly and v.f.-v.crs Snd; wet sample	
115'	1126 1127	Chatter	10YR 4/3			Sndy Clyy silt; Silt w/Cly and v.f.-crs Snd (minor v.Crs Sand)	
120'	1137 1139 1150 TD		10YR 4/3			Sndy Clyy silt; silt w/cly and v.f.-crs Snd (minor v.crs Sand) TD	

SITE ID: 344520120174005	STATION NAME: 008N032W19M005S	TOTAL DEPTH: 120’
USGS SITE NAME: SACC #5 San Antonio Creek Cat Canyon Road-5		COMPLETION DATE: 11/22/2016
WELL OWNER: County of Santa Barbara		



DRILLER: USGS Research Drilling Program	DRILL TYPE: Auger	WELL FINISH: 8” Monitoring Well Manhole
CASING TYPE: 2” Schedule 80 PVC, 20’ Sections	SCREEN TYPE: 2” Schedule 80 PVC ⟶1.30" X 0.020" Slot	
BOREHOLE DIA.: 8.5”: 0’-120’	FILTER PACK: CEMEX #3 Monterey Sand	

SEALS: Baroid Quik-Grout 0’-87.5’, Pel-Plug 1/4” TR30 Pellets 87.5’-90’

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SACR 325 PROJECT: GC16ZG00FUVS300 PROJECT CHIEF: David O'Leary

ELEV: 361' LOCATION: [redacted] CA-135, Los Alamos, CA 93455, N34°45'32" W120°23'39" LOGGED BY: Anthony Brown Adam Kjos

DRILLED BY: USGS RDP RIG TYPE: Mud Rotary- TH60 LAG METHOD: Rice (mud)

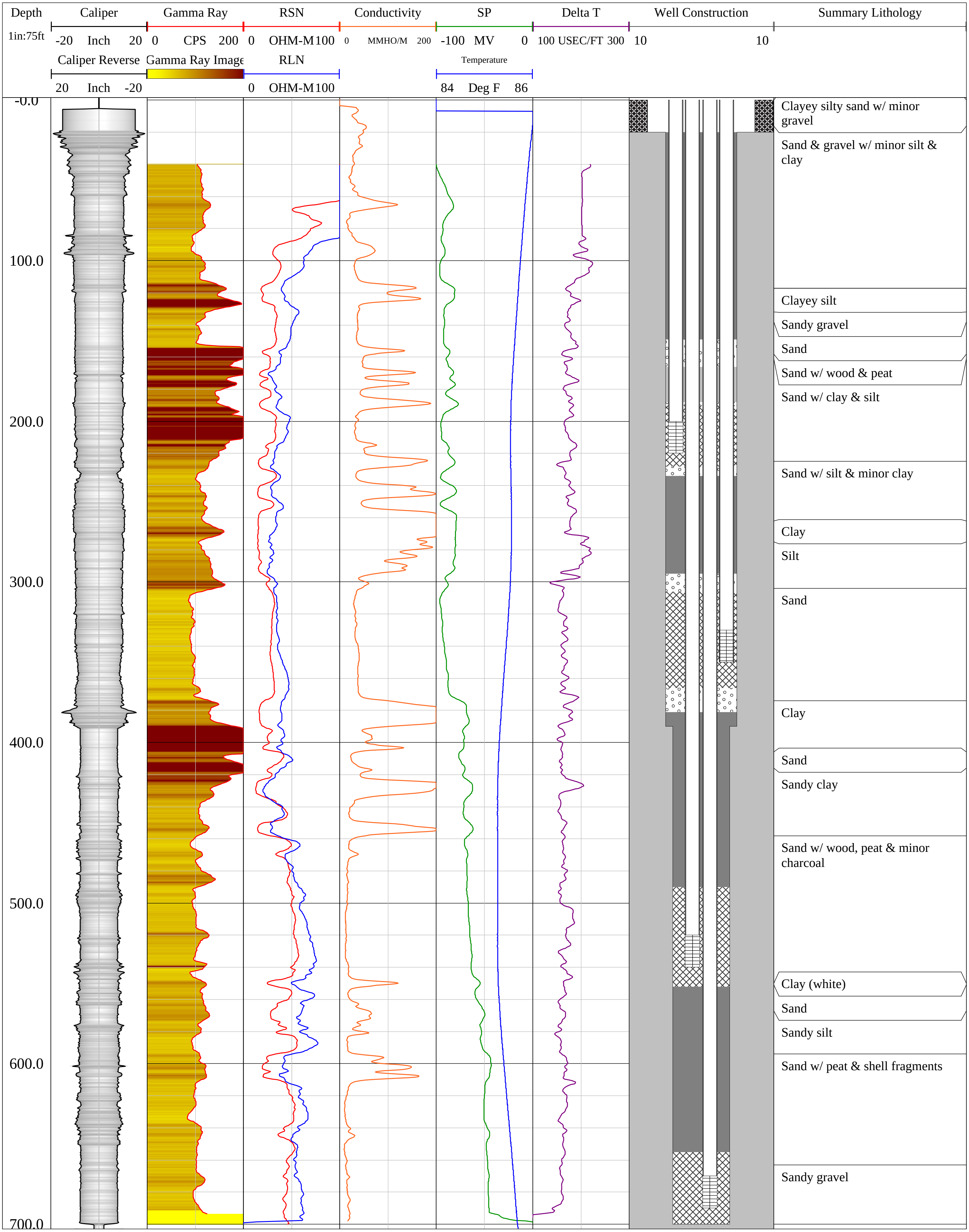
Date	Depth	Time (min)	Rig noise etc.	Color (Munsell - soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
	0				EC 4780			
7/30	20	1514 1543 1614		2.5y 3/2 2.5y 5/3	VHVY / 3950		0-1 - wood 1-2 - RIPRAP - cement/asphalt 2-3 soil - silty clay 3-4 silty clay 4-14 sand (gr-mp) (vf-vc) 14-16 sl(vf-vc) g (gr-mp) 16-17 clayey 17-20 = 14-16	20" HOLE Opener
7/31	40	0944 0949 0959	33'	2.5y 6/3	VHVY M / 3080		SANDY (vf-vc) gravel (gran-md peb) Gravelly (gran-md peb) SAND (vf-vc)	9 7/8" longtooth tricone
	60	1132 1137 1142		2.5y 6/3	VHVY / 3050		slightly Gravelly (gran-sm peb) sand (vf-vc)	
	80	1153 1209 1219	68' slow 71' FAST	2.5y 4/2 2.5y 5/3	HVY / 3010		64'-65' soil Hor 65-68' silty sand (vf-vc) w/ gravel (gran-md peb) 68'-71' clayey silt w/ md peb 71-80' - mainly (vf-m) w/ g-vc + gran	
	100	1229 1232 1236	81'	2.5y 5/3	Mod / 2920		SANDY (vf-vc) gravel (gran-md peb)	
	120	1332 1337 1347	108' 117'	2.5y 6/3 2.5y 4/1	HVY/ H M / 3310		Gravelly (md peb) sand (vf-m) Lost Circ. clayey silt	
	140	1437 1447 1455	128' 138'		VHVY M / 3240		clayey silt sandy (vf-vc) gravel (gran-lg peb) sand (vf-m)	
	160	1504 1510 1519	152' 158'		VHVY M / 3330		SAND (vf-m) SAND (vf-vc) SAND (m-vc) Abundant wood + Peat	Rice Time 2 MIN
	180	1544 1552 1622	161' 168' color 171' 173' Fast 177' slow		VHVY M / 3160		Gray SAND (vf-m) Green SAND (vf-m) clay SAND (vf-m) clay (silty)	
	200	1637 1659 1727	182' 190' 195'		VHVY H M / 2960		SAND (vf-m) silty clay SAND (vf-m)	
7/31	220	1736 1739 1752	216' slow		HVY / 2950		SAND (vf-m) SAND (vf-vc)	
8/1	240	1801 1843 0844 0848	225' slow 230'		H/VHVY M / 2830		silty clay SAND (vf-vc)	Rice Time 3 MIN
	260	0900 0908 0949	241' 252' slow		Mod M / 2850		SAndy (vf-m) silt clay	
	280	1208 1326 1402	274' Fast		H M / 2950		clay	
	300	1419 1439 1447	288' Fast		Mod M / 2640		silt	
	320	1500 1506 1511			VHVY / 2630		SAND (vf-vc) upper - gray, mid - green, bottom - brown	Rice Time 3 MIN
	340	1530 1536 1543			VHVY M / 2640		SAND (vf-m)	
	360	1602 1611 1619			VHVY M / 2690			
8/1	380	1629 1634 1656	374' slow		VHVY M / 2820			
8/2	400	1755 1845 0856 0908	383' slow		H M / 2540		clay	7 7/8 tricone

8/2

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SACR	PROJECT: GC16ZG00FUVS300	PROJECT CHIEF: David O'Leary
ELEV: 361'	LOCATION: 1098 CA-135, Los Alamos, CA 93455, N34°45'32" W120°23'39"	LOGGED BY: *Anthony Brown Adam Kjos*
DRILLED BY: *USGS RDP*	RIG TYPE: *Mud Rotary- TH60*	LAG METHOD: *Rice (mud)*

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
400							7 7/8" longtooth tricone
420	0919 0928 0934	407'		Hvy M / 2600		clay SAND(vf-m) w/ SAND (c-vc) w/mafics	Rice Time 4 1/2 min 8/2
440	1003 1038 1101	425' slow 434' Fast		lt / 2420		SANDy (vf-m) clay	
460	1114 1119 1141	443' Fast 454' slow 457' Fast		mod / 2440		SAND (vf-m) w/ small wood chips	
480	1155 1158 1202			vHvy / 2470		SAND(vf-m) w/ small woodchips	
500	1215 1218 1220			vHvy M / 2390		SAND (vf-m) w/ v sm wood chips	
520	1258 1301 1303			VHvy / 2470		SAND (vf-m) w/ v sm wood chips	Rice Time 5 min
540	1319 1321 1323	539'		vHvy / 2270		SAND (vf-m) w/ v sm wood chips some charcoal SAND (vf-m) w/ Peat and wood chips	
560	1340 1343 1346	550'		Hvy / 2170		SAND (vf-m)	
580	1400 1407 1409	567' slow-Fast		vHvy M / 2260		SANDY (vf-m) silt	
600	1422 1423 1438	594' slow/Fast		lt / 2310		Peat SAND (vf-vc) w/ shell fragments	
620	1451 1516 1518	601' slow 604' Fast 607' slow/Fast		mod / 2290			Rice Time 6 min
640	1531 1532 1533			Hvy / 2300		SAND (vf-m) w/ Peat + Shells @ 635'-640'	
660	1555 1558 1601			Mod / 2370		SAND (vf-m) w/ Peat + Shells	
680	1613 1616 1620	663' chatter		v Hvy m / 2360		SANDy (vf-vc) gravel (gran-sm peb) rounded	
TO 700	1633 1637 1643			vHvy / 2370		sandy (vf-vc) gravel (gran-sm peb) ↓	



Depth
1in:75ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Gamma Ray
0 CPS 200
Gamma Ray Image
RSN
0 OHM-M100
RLN
0 OHM-M100
Conductivity
0 MMHO/M 200
SP
-100 MV 0
Temperature
84 Deg F 86
Delta T
100 USEC/FT 300
Well Construction
10 10
Summary Lithology
-0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
Clayey silty sand w/ minor gravel
Sand & gravel w/ minor silt & clay
Clayey silt
Sandy gravel
Sand
Sand w/ wood & peat
Sand w/ clay & silt
Sand w/ silt & minor clay
Clay
Silt
Sand
Clay
Sand
Sandy clay
Sand w/ wood, peat & minor charcoal
Clay (white)
Sand
Sandy silt
Sand w/ peat & shell fragments
Sandy gravel

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SAGR | PROJECT: GC16ZG00FUVS200 | PROJECT CHIEF: David O'Leary

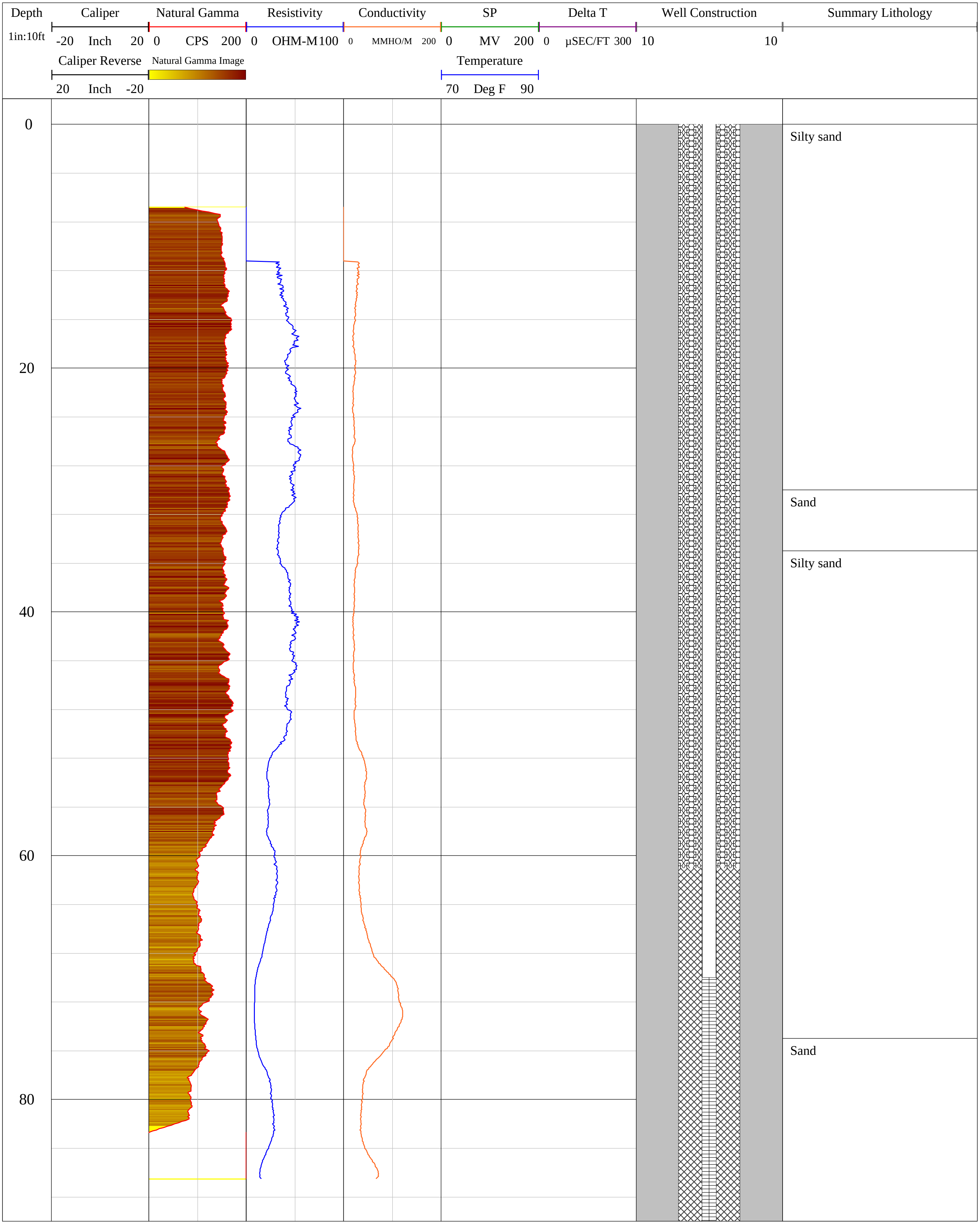
ELEV: ~322' | LOCATION: Graciosa Road, Santa Maria, CA; N34°46'24" W120°25'39" | LOGGED BY: *Adam Kjos*

DRILLED BY: *USGS RDP* | RIG TYPE: *Auger- CME750* | LAG METHOD: *N/A*

10/17/2015

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
	0948					~2' silty sand (vf-m)	8.5"
5	0950					moist Sand (f-c) w/ trace grav (g-sp.)	
	1001						
10	1003						
	1010						
15	1012					slightly darker	
	1018						
20	1020						
	1026						
25	1028						
	1035						
30	1037						
	1044						
35	1046						
	1055						
40	1057						
	1109						
45	1111						
	1122						
50	1124						
	1134	~52 Torque up					
55	1136						
	1207						
60	1209						
	1214						
65	1216						
	1221						
70	1223						
	1228						
75	1230						
	1236						
80	1238						
	1607						
85	1609						
	1614						
90	1616						
TD							

Nearby Well
62.34' @ MP (~2' als=0)
@ 0930 10/17



Depth
1in:10ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Natural Gamma
0 CPS 200
Natural Gamma Image
Resistivity
0 OHM-M 100
Conductivity
0 MMHO/M 200
SP
0 MV 200
Temperature
70 Deg F 90
Delta T
0 μSEC/FT 300
Well Construction
10 10
Summary Lithology
0
20
40
60
80
Silty sand
Sand
Silty sand
Sand

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SAHC | PROJECT: GC16ZG00FUVS200 | PROJECT CHIEF: David O'Leary

ELEV: ~444' | LOCATION: Vandenberg Road, Santa Maria, CA; N34°48'36" W120°26'57" | LOGGED BY: Adam Kjos

DRILLED BY: USGS RDP | RIG TYPE: Auger- CME ~~750~~ 85 | LAG METHOD: N/A

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
10/14/2015	1538						
5	1542					Sandy (vf-m) silty clay; - moist, minor - organic rich	
	1613					Harder	
10	1616					- moist	
	1622						
15	1624						
	1636						
20	~~1632~~						
	1637						
25	1639					24' minor color change, slightly more sand	
	1643					Sandy (vf-m) silty clay	
30	1645						
	1649	softer				~~Potential perched zone?~~	
35	1651						
	1656						
40	1658						
	1702						
45	1704						
	1708						
50	1710						
	1713						
55	1715						
	1719						
60	1721						
	1725						
65	1727					64' sandier?	
	1732					silty sandy (vf-m) clay w/	
70	1734					intermittent softer sandy hor.	
	1738						
75	1740						
10/15/2015	0809						
80	0811	Poor Returns					
	0817						
85	0819						
	0823						
90	0825						
TD							

WL 67' blsd (Near-by well) @ 1430 10/14/15

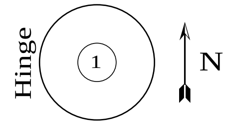
SITE ID: 344836120270001	STATION NAME: 009N034W34N002S	TOTAL DEPTH: 90’
USGS SITE NAME: SAHC San Antonio Creek Harris Canyon		COMPLETION DATE: 10/15/2015
WELL OWNER: County of Santa Barbara		

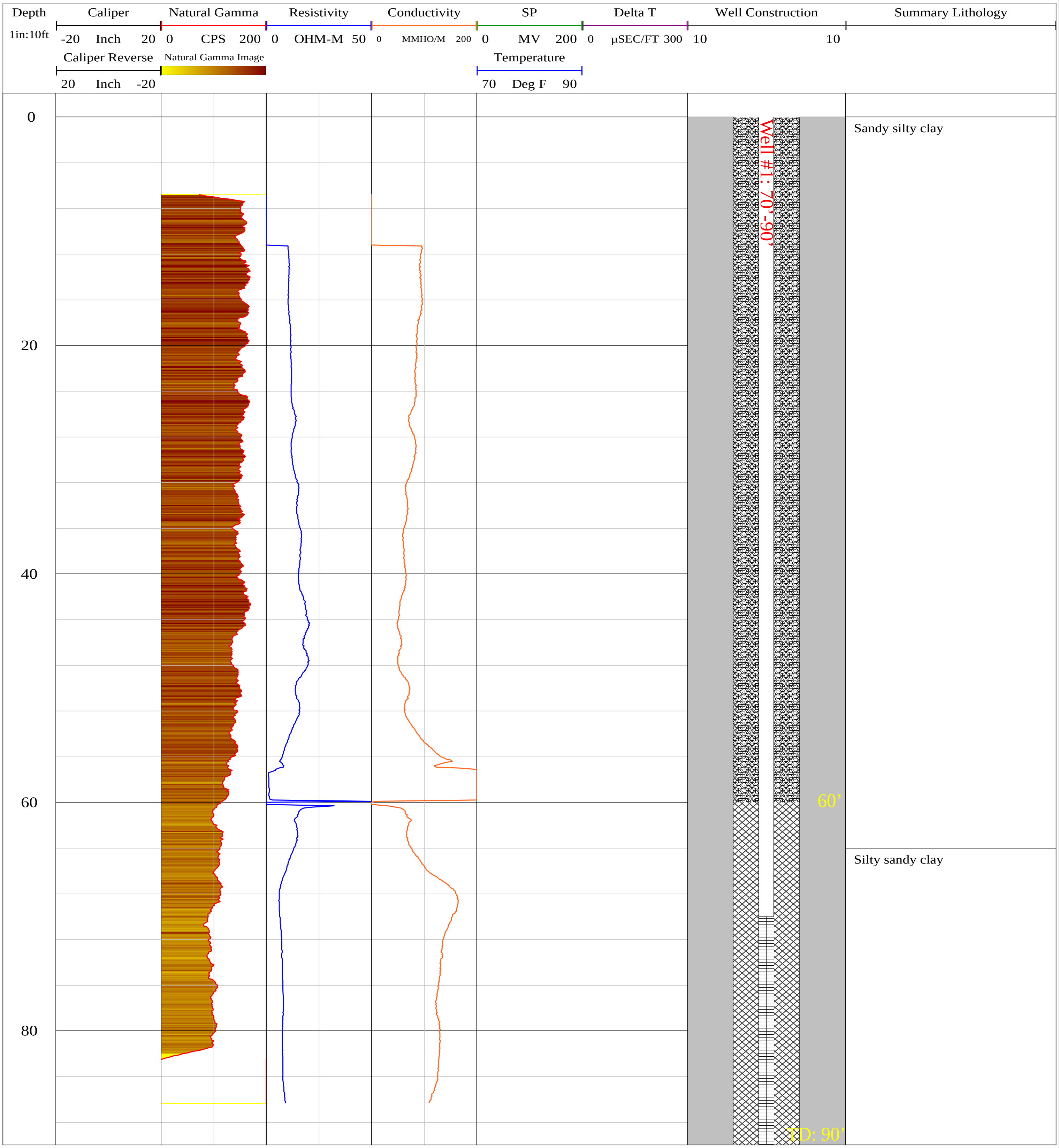
BOREHOLE FILL KEY

SAND | GROUT | SCREEN | PELLETS | CHIPS | CEMENT

Water Level (01/04/2018)

#1: 69.82’ bls





DRILLER: USGS Research Drilling Program	DRILL TYPE: Auger / WELL FINISH: 10” Steel Monument
CASING TYPE: 2” Schedule 80 PVC, 20’ Sections	SCREEN TYPE: 2” Schedule 80 PVC ⟶1.30" X 0.020" Slot
BOREHOLE DIA.: 8.5”: 0’-90’	FILTER PACK: CEMEX #3 Monterey Sand

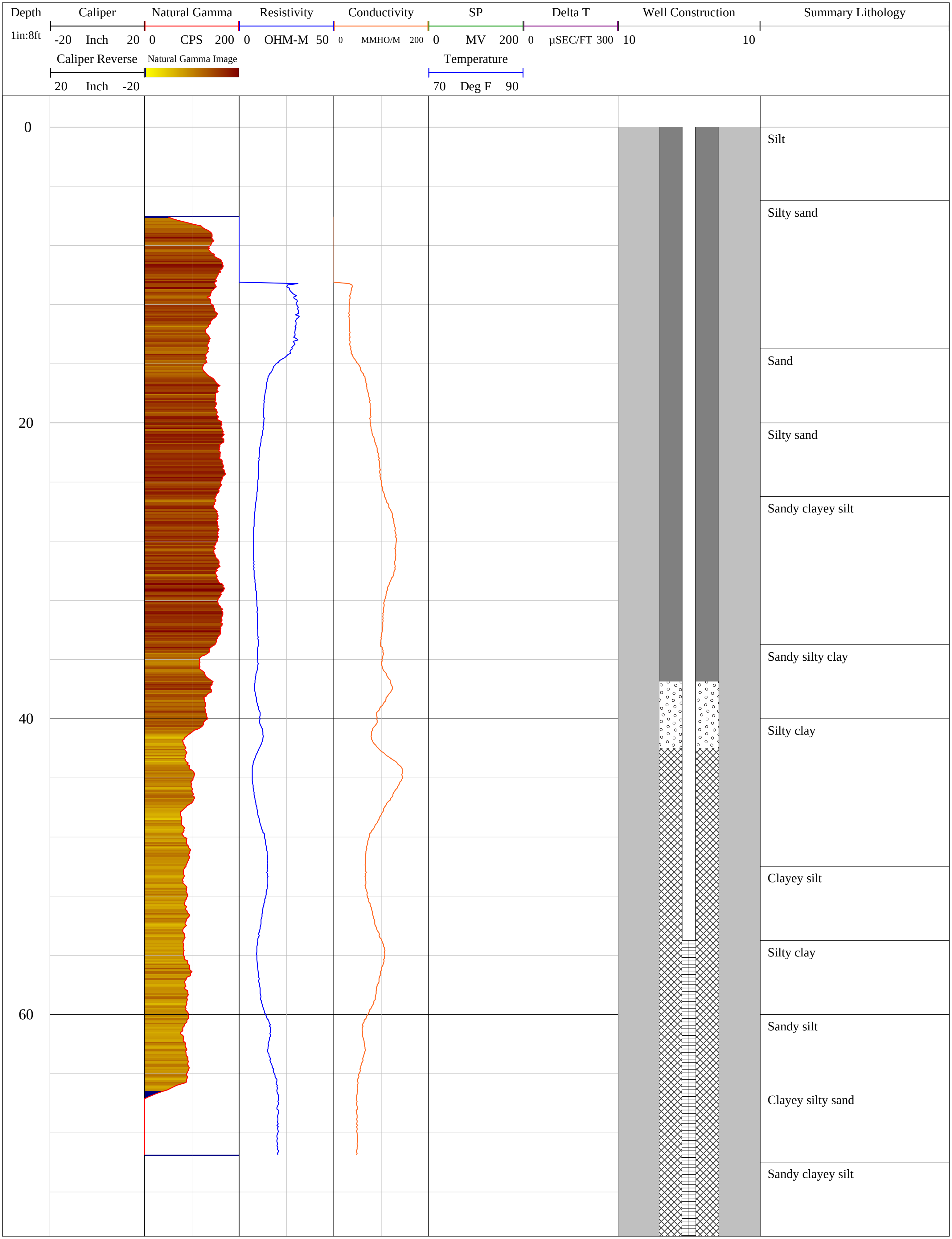
SEALS: Baroid EZ-SEAL (granular) 50’-60’, Baroid HOLEPLUG (3/8” grade) 0’-50’

Table ___. Lithologic AUGER log for multiple well monitoring site SAHG

Depth (ft)	Description
5	Silt (z); silt with trace fine to coarse sand and clay; well sorted; black (2.5Y 2.5/1)
10	Silty sand (zS); fine to coarse sand with silt and trace clay and granules to very large pebbles; moderately sorted; sub-angular to sub-rounded; very dark gray (2.5Y 3/1)
15	Silty sand (zS); fine to medium sand with silt and trace clay and coarse sand and granules; moderately to well sorted; sub-angular to sub-rounded; very dark grayish brown (10YR 3/2)
20	Sand (S); medium sand with trace coarse sand and granules; well sorted; sub-angular to sub-rounded; grayish brown (2.5Y 5/2)
25	Silty sand (zS); fine to medium sand and silt with trace coarse sand, clay and granules; moderately sorted; sub-angular to sub-rounded; dark grayish brown (2.5Y 4/2)
30	Sandy clayey silt (sM); silt and clay with fine to medium sand; moderately sorted; very dark gray (2.5Y 3/1)
35	Sandy clayey silt (sM); silt and clay with very fine to medium sand; moderately to poorly sorted; very dark grayish brown (2.5Y 3/2)
40	Sandy silty clay (sM); clay and silt with very fine to medium sand; moderately to poorly sorted; very dark grayish brown (2.5Y 3/2)
45	Silty clay (M); clay and silt with trace fine to medium sand; moderately sorted; very dark grayish brown (2.5Y 3/2)
50	Silty clay (M); clay and silt with trace fine to medium sand and granules; moderately sorted; very dark grayish brown (2.5Y 3/2)
55	Clayey silt (M); silt and clay with trace fine to medium sand; moderately to well sorted; very dark grayish brown (2.5Y 3/2)
60	Silty clay (M); clay and silt with trace very fine to fine sand and granules; well sorted; very dark grayish brown (2.5Y 3/2)
65	Sandy silt (sZ); silt with fine to medium sand and trace clay; moderately to well sorted; dark grayish brown (2.5Y 4/2)
70	Clayey silty sand (mS); fine to medium sand with silt and minor clay; moderately to well sorted; sub-angular to sub-rounded; dark grayish brown (2.5Y 4/2)

Table ___. Lithologic AUGER log for multiple well monitoring site SAHG

Depth (ft)	Description
75	Sandy clayey silt (sM); silt with clay and fine to medium sand; moderately sorted; olive brown (2.5Y 4/3)



Depth
1in:8ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Natural Gamma
0 CPS 200
Natural Gamma Image
Resistivity
0 OHM-M 50
Conductivity
0 MMHO/M 200
SP
0 MV 200
Temperature
70 Deg F 90
Delta T
0 μSEC/FT 300
Well Construction
10
10
Summary Lithology
0
20
40
60
Silt
Silty sand
Sand
Silty sand
Sandy clayey silt
Sandy silty clay
Silty clay
Clayey silt
Silty clay
Sandy silt
Clayey silty sand
Sandy clayey silt

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SALA	PROJECT:	PROJECT CHIEF: David O'Leary
ELEV: 607'	LOCATION: N34°44'37" W120°16'17"	LOGGED BY: David O'Leary, Adam Kjos, Chris Kohel
DRILLED BY: USGS RDP	RIG TYPE: Auger	LAG METHOD: N/A

11/26/2016

Depth	Time (min)	Rig noise etc.	Color (Munsell soil)	Cones / mud EC	Graphic	Description and other observations	Bit size, &Rice time
5'	10:03 10:04		10YR 3/3			gravelly Sandy silt, silt w/ v.f.-v.crs Sand (dom v.f.-med Sand) w/ gran-v.lrg Peb.	8.5"
10'	10:13 10:18		10YR 4/2			Silty Sand gravel Gran-lrg Peb w/ v.f.-v.crs Sand and silt	
15'	1026 1030		10YR 4/3			Sandy silty Clay w/ silt v.f.-v.crs Sand and trace gran-sml Peb; v.firm clay	
20'	1038 1043		10YR 4/3			Sandy silty Clay; Clay w/ silt, v.f.-v.crs Sand and trace gran-sml Peb; v.firm clay	
25'	1047 1050		10YR 5/3			Sandy silt; silt w/ v.f.-v.crs Sand (dom v.f.-med Sand), minor clay and tr. gran-sml Peb	
30'	1053 1056	Soft	10YR 5/4			gravelly Sand clay silt; silt w/ clay, v.f.-v.crs Sand and gran-lrg Peb	
35'	1059 1102		10YR 5/3			Slightly grvl clayey silt; silt w/ clay, v.f.-v.crs Sand and gran-... cohesive Clay	
40'	1111 1113		10YR 5/3			Sandy silty Clay; Clay w/ silt, v.f.-v.crs Sand and trace gran-lrg Peb; cohesive clay	
45'	1116 1118		10YR 5/3			Slightly grvl sandy silty clay; clay w/ silt, v.f.-v.crs Sand and gran-lrg Peb; cohesive clay	
50'	1121 1122		10YR 5/3			Slightly grvl sandy silty clay; clay w/ silt, v.f.-v.crs Sand and gran-lrg Peb; cohesive clay	
55'	1127 1131		10YR 5/3			slightly grvl sandy silty clay; clay w/ silt, v.f.-v.crs Sand and gran-med Peb; cohesive Clay Color change	
60'	1135 1139		10YR 4/3			Slightly grvly Sandy silty clay; clay w/ silt, v.f.-v.crs Sand and gran-sml Peb; cohesive clay	
65'	1140 1142	Falls	10YR 4/3			Slightly grvl Sandy silty clay; clay w/ silt, v.f.-v.crs Sand and gran-sml Peb; cohesive clay	
70'	1147 1148		10YR 4/3			Silty Clay; Clay w/ silt and minor v.f.-v.crs Sand and trace gran-med Peb; cohesive clay	
75'	1153 1155		10YR 4/3			Silty Clay; Clay w/ silt and minor v.f.-medium Sand; cohesive clay	
80'	12:37 1239		10YR 5/3			Silty Clay; Clay w/ silt and minor v.f.-medium Sand; cohesive clay	
88'	1242 1244		10YR 5/3			Silty Clay; Clay w/ silt and minor v.f.-medium Sand; cohesive clay	
91'	1247 1250		10YR 5/3			Silty Clay; Clay w/ silt and minor v.f.-medium Sand; cohesive clay TD = 91'	

USGS MONITORING WELL DRILLING AND LITHOLOGIC LOG

COMMON WELL NAME: SALS	PROJECT: GC.17.ZG00.FUVS2.00	PROJECT CHIEF: David O'Leary
ELEV:	LOCATION: San Antonio Creek CA	LOGGED BY: C. Kohel A. Kjos D. O'Leary
DRILLED BY: USGS RDP	RIG TYPE: Auger	LAG METHOD: N/A (augers)

11/20/2016

Depth	Time (min)	Rig noise etc.	Color (Munsell – soil)	Cones / EC	Graphic	Description and other observations	Bit size, &Rice time
	11:00						
5'	11:20	None	7.5YR 2.5/1			(SM); Clay w/silt, v.f - f Sand and trace granule - sm. peb Organic rich black clay; Cohesive Clay	8.5"
10'	11:30	None	7.5YR 3/1			(SM); Clay w/silt, v.f f Sand, and trace granule - small peb Organic rich v. dark gray clay; Cohesive clay	
15'	11:37	None	7.5YR 3/1			(SM); Clay w/silt and v. fine - Coarse Sand; Organic rich Clay; Cohesive clay	
20'	11:47	None	10YR 3/2			(zC); Clay w/silt and trace - minor v.f - medium Sand; V. Cohesive clay	
25'	11:57	None	10YR 4/2			(zC); Clay w/silt, trace - minor v.f. - v. Coarse Sand and trace granules; V. Cohesive Clay	
30'	12:05	None	7.5YR 4/1			(SM); Clay w/silt, v.f - v. Coarse Sand and trace granule - small peb; V. Cohesive clay	
35'	12:12	None	10YR 3/2			(SM); Clay w/silt, v.f v. Coarse Sand and trace granules, V. Cohesive clay	
40'	12:18	None	2.5Y 3/1			(zC); Clay w/silt, minor v. fine - v. Coarse Sand and trace granules; Adhesive clay	
45'	12:24	None	5Y 3/1			(zC); Clay w/silt and minor v.f - Coarse Sand; Adhesive clay	
50'	12:30	None	5Y 3/1			(zC); Clay w/silt and minor v. fine - Medium Sand; Adhesive clay	
55'	12:35	None	5Y 3/1			(zC); Clay w/silt and minor v.f. - Medium Sand; Adhesive Clay	
60'	12:40	None	5Y 3/1			(zC); Clay w/silt and Minor v.f - Medium Sand; Adhesive clay	

Brown clay ↑ gray clay ↓

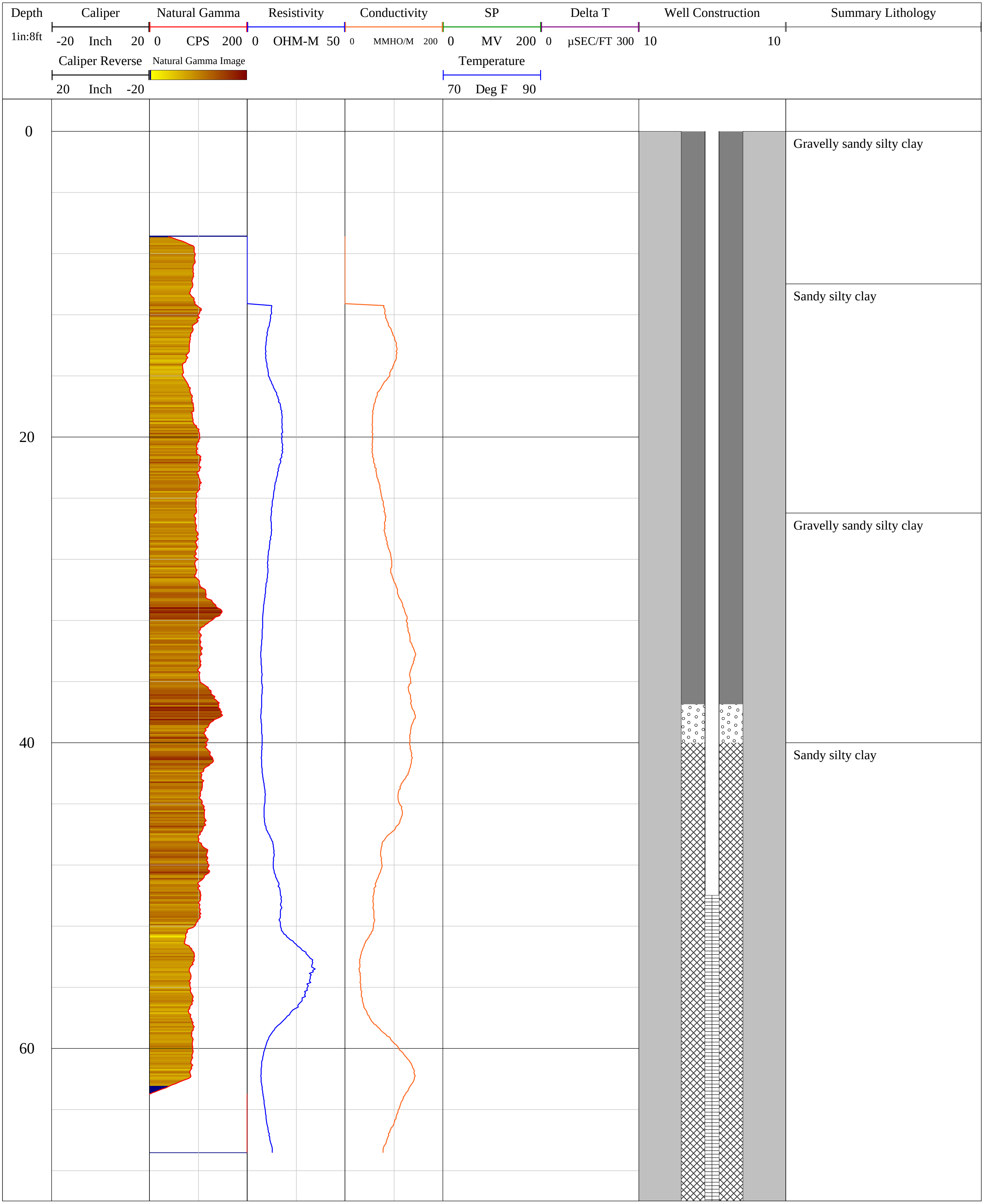
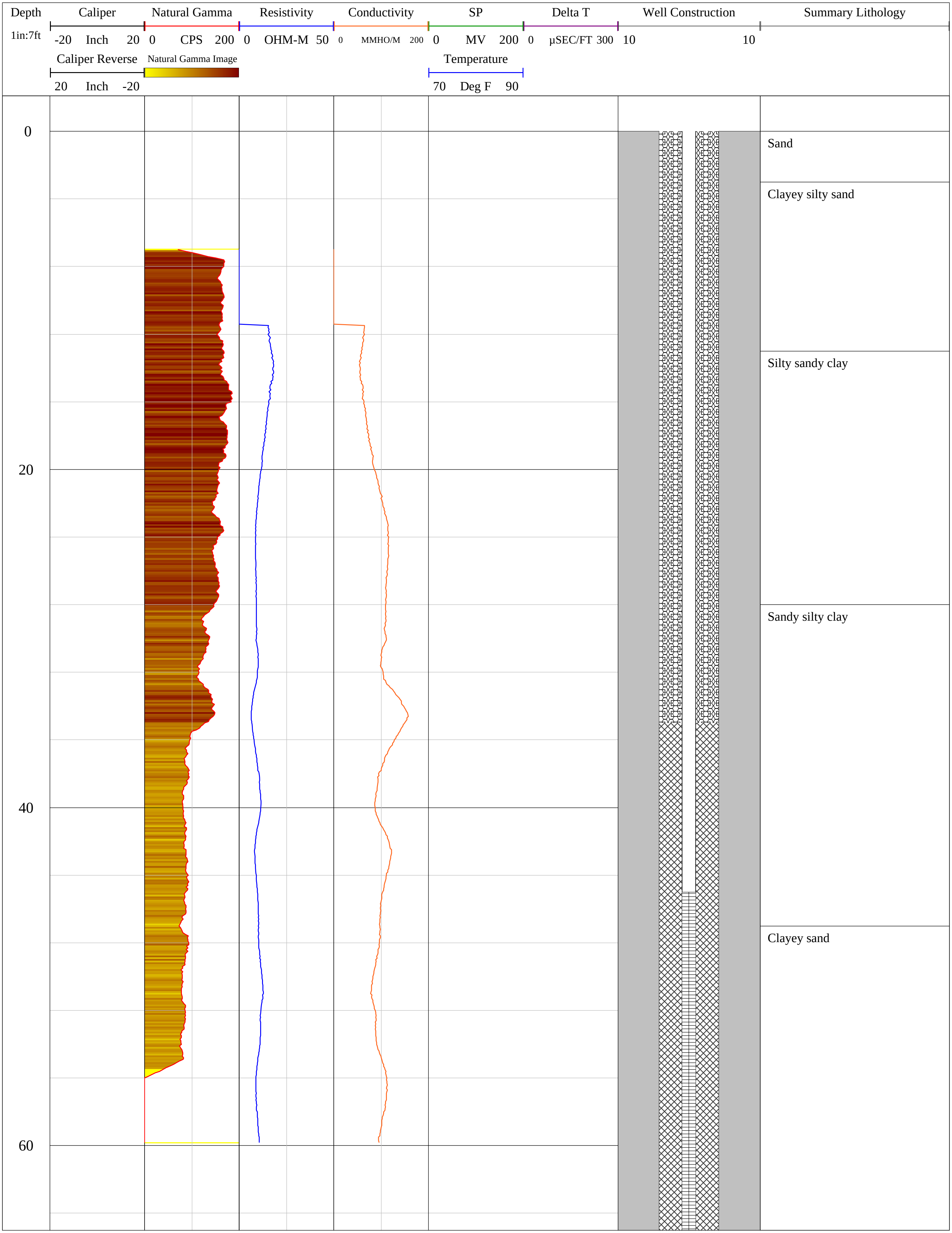

Depth
1in:8ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Natural Gamma
0 CPS 200
Natural Gamma Image
Resistivity
0 OHM-M 50
Conductivity
0 MMHO/M 200
SP
0 MV 200
Temperature
70 Deg F 90
Delta T
0 µSEC/FT 300
Well Construction
10 10
Summary Lithology
0
20
40
60
Gravelly sandy silty clay
Sandy silty clay
Gravelly sandy silty clay
Sandy silty clay

Table ___. Lithologic AUGER log for multiple well monitoring site SASA

Depth (ft)	Description
5	Sandy clayey silt (sM); clay and silt with very fine to medium sand and trace gravel; moderately sorted; very dark gray (2.5Y 3/1)
10	Sandy silty clay (sM); clay and silt with minor very fine to fine sand and trace coarse sand and gravel; moderately sorted; black (2.5Y 2.5/1)
15	Sandy silty clay (sM); clay and silt with minor very fine to fine sand; moderately sorted; black (2.5Y 2.5/1)
20	Sandy silty clay (sM); clay and silt with minor very fine to fine sand; moderately sorted; black (2.5Y 2.5/1)
25	Sandy silty clay (sM); clay and silt with minor very fine sand and trace gravel; well sorted; black (2.5Y 2.5/1)
30	Clayey silt (M); silt and clay with trace very fine sand; well sorted; very dark grayish brown (2.5Y 3/2)
35	Clayey silt (M); silt and clay with trace very fine to coarse sand; well sorted; very dark grayish brown (2.5Y 3/2)
40	Clayey silt (M); silt and clay with trace very fine to medium sand; well sorted; black (2.5Y 2.5/1)
45	Sandy clayey silt (sM); silt and clay with minor very fine to fine sand; moderately sorted; dark grayish brown (2.5Y 4/2)
50	Sandy silt (sZ); silt with very fine sand; well sorted; olive brown (2.5Y 4/3)
55	Sandy silt (sZ); silt with minor very find sand; well sorted; dark olive brown (2.5Y 3/3); slightly calcareous
60	Silt (Z); silt with trace very fine sand; well sorted; olive brown (2.5Y 4/3); slightly to moderately calcareous
65	Sandy silt (sZ); silt with very fine to fine sand and trace coarse sand; moderately to well sorted; light olive brown (2.5Y 5/3); slight to moderately calcareous; poor returns
65 bit	Sandy silt (sZ); silt with very fine to fine sand and trace coarse sand and gravel; moderately to well sorted; dark grayish brown (2.5Y 4/2); slightly to moderately calcareous


Depth
1in:7ft
Caliper
-20 Inch 20
Caliper Reverse
20 Inch -20
Natural Gamma
0 CPS 200
Natural Gamma Image
Resistivity
0 OHM-M 50
Conductivity
0 MMHO/M 200
SP
0 MV 200
Temperature
70 Deg F 90
Delta T
0 µSEC/FT 300
Well Construction
10
10
Summary Lithology
0
20
40
60
Sand
Clayey silty sand
Silty sandy clay
Sandy silty clay
Clayey sand

APPENDIX G-3

Domestic Water Quality and Monitoring Regulations; Proposed General Waste Discharge Requirements for Discharges from Irrigated Lands

§64310. Reduction of Fees for Public Water Systems Serving Disadvantaged Community.

(a) A public water system must pay the full amount of the annual fee unless it requests and receives from the State Board a determination that its annual fees are reduced because it is a community water system that serves a disadvantaged community in which case the fee to be paid is the amount for a disadvantaged community as shown in Table 64305-A.

(b) To qualify for the reduction provided for in subsection (a), a public water system must certify, and provide documentation to the State Board upon request, that it serves a disadvantaged community.

§64315. Payment of Fees

(a) Each fee required by this chapter shall be paid to the State Board within forty five (45) calendar days of the date of the invoice, except that this date may be extended by the State Board for good cause, which shall be determined at the State Board's sole discretion.

CHAPTER 15. DOMESTIC WATER QUALITY AND MONITORING REGULATIONS

Article 1. Definitions

§64400. Acute Risk.

"Acute risk" means the potential for a contaminant or disinfectant residual to cause acute health effects, i.e., death, damage or illness, as a result of a single period of exposure of a duration measured in seconds, minutes, hours, or days.

§64400.05. Combined Distribution System.

"Combined distribution system" means the interconnected distribution system consisting of the distribution systems of wholesale systems and of the consecutive systems that receive finished water.

§64400.10. Community Water System.

"Community water system" means a public water system which serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents.

§64400.20. Compliance Cycle.

"Compliance cycle" means the nine-year calendar year cycle during which public water systems shall monitor. Each compliance cycle consists of three three-year compliance periods. The first calendar year cycle began January 1, 1993 and ends December 31, 2001; the second begins January 1, 2002 and ends December 31, 2010; the third begins January 1, 2011 and ends December 31, 2019.

§64400.25. Compliance Period.
"Compliance period" means a three-year calendar year period within a compliance cycle. Within the first compliance cycle, the first compliance period runs from January 1, 1993 to December 31, 1995; the second from January 1, 1996 to December 31, 1998; the third from January 1, 1999 to December 31, 2001.

§64400.28. Confluent Growth.
"Confluent growth" means a continuous bacterial growth covering the entire filtration area of a membrane filter, or a portion thereof, in which bacterial colonies are not discrete.

§64400.29. Consecutive System.
"Consecutive system" means a public water system that receives some or all of its finished water from one or more wholesale systems. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.

§64400.30. Customer.
"Customer" means a service connection to which water is delivered by a community water system or a person that receives water from a nontransient-noncommunity water system for more than six months of the year.

§64400.32. Detected.
"Detected" means at or above the detection limit for purposes of reporting (DLR).

§64400.34. Detection Limit for Purposes of Reporting (DLR).
"Detection limit for purposes of reporting (DLR)" means the designated minimum level at or above which any analytical finding of a contaminant in drinking water resulting from monitoring required under this chapter shall be reported to the State Board.

§64400.36. Dual Sample Set.
"Dual sample set" means a set of two samples collected at the same time and same location, with one sample analyzed for TTHM and the other sample analyzed for HAA5.

§64400.38. Enhanced Coagulation.
"Enhanced coagulation" means the addition of sufficient coagulant for improved removal of disinfection byproduct precursors by conventional filtration treatment.

§64400.40. Enhanced Softening.
"Enhanced softening" means the improved removal of disinfection byproduct precursors by precipitative softening.

§64400.41. Finished Water.
"Finished water" means the water that is introduced into the distribution system of a public water system and is intended for distribution and consumption without further treatment, except as treatment necessary to maintain water quality in the distribution system (e.g., booster disinfection, addition of corrosion control chemicals).

§64400.42. Fluoridation.
"Fluoridation" means the addition of fluoride to drinking water to achieve an optimal level, pursuant to Section 64433.2, that protects and maintains dental health.

§64400.45. GAC10.
"GAC10" means granular activated carbon filter beds with an empty-bed contact time of 10 minutes based on average daily flow and a carbon reactivation frequency of once every 180 days, except that the reactivation frequency for GAC10 used as a best available technology for compliance with the TTHM and HAA5 MCLs monitored pursuant to section 64534.2(d) shall be once every 120 days.

§64400.46. GAC20.
"GAC20" means granular activated carbon filter beds with an empty-bed contact time of 20 minutes based on average daily flow and a carbon reactivation frequency of once every 240 days.

§64400.47. Haloacetic Acids (Five) or HAA5.
"Haloacetic acids (five)" or "HAA5" means the sum of the concentrations in milligrams per liter (mg/L) of the haloacetic acid compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid), rounded to two significant figures after addition.

§64400.50. Initial Compliance Period.
"Initial compliance period" means the first full three-year compliance period which began January 1, 1993, for existing systems. For new systems, the "initial compliance period" means the period in which the State Board grants the permit.

§64400.60. Initial Finding.
"Initial finding" means the first laboratory result from a water source showing the presence of an organic chemical listed in §64444, Table 64444-A.

§64400.65. IOC.
"IOC" means inorganic chemical.

§64400.66. Locational Running Annual Average or LRAA.
"Locational running annual average" or "LRAA" means the average of sample analytical results for samples taken at a particular monitoring location during the previous four calendar quarters.

§64400.67. Maximum Residual Disinfectant Level or MRDL.
"Maximum residual disinfectant level" or "MRDL" means a level of a disinfectant added for water treatment that may not be exceeded at the consumer's tap.

§64400.70. MCL.
"MCL" means maximum contaminant level.

§64400.80. Nontransient-noncommunity Water System.
"Nontransient-noncommunity water system" means a public water system that is not a community water system and that regularly serves at least the same 25 persons over 6 months per year.

§64400.90. Operational Evaluation Levels or OEL.
"Operational evaluation level" or "OEL" means the sum of the two previous quarters' TTHM results plus twice the current quarter's TTHM result, divided by 4 to determine an average; or the sum of the two previous quarters' HAA5 results plus twice the current quarter's HAA5 result, divided by 4 to determine an average.

§64401. Repeat Compliance Period.
"Repeat compliance period" means any subsequent compliance period after the initial compliance period.

§64401.10. Repeat Sample.
"Repeat sample" means a required sample collected following a total coliform-positive sample.

§64401.20. Replacement Sample.
"Replacement sample" means a sample collected to replace an invalidated sample.

§64401.30. Routine Sample.
"Routine sample" means a bacteriological sample the water supplier is required to collect on a regular basis, or one which the supplier is required to collect for a system not in compliance with Sections 64650 through 64666 when treated water turbidity exceeds 1 nephelometric turbidity unit (NTU), pursuant to §64423(b).

§64401.40. Sanitary Survey.
"Sanitary survey" means an on-site review of a public water system for the purpose of evaluating the adequacy of the water source, facilities, equipment, operation and maintenance for producing and distributing safe drinking water.

§64401.50. Significant Rise in Bacterial Count.
"Significant rise in bacterial count" means an increase in coliform bacteria, as determined in §64426, when associated with a suspected waterborne illness or disruption of physical works or operating procedures.

§64401.55. SOC.
"SOC" means synthetic organic chemical.

§64401.60. Standby Source.
"Standby source" means a source which is used only for emergency purposes pursuant to §64414.

§64401.65. SUVA.
"SUVA" means Specific Ultraviolet Absorption at 254 nanometers (nm), an indicator of the humic content of a water. It is calculated by dividing a sample's ultraviolet absorption at a wavelength of 254 nm (UV_{254}) (in m^{-1}) by its concentration of dissolved organic carbon (DOC) (in mg/L).

§64401.70. System with a Single Service Connection.
"System with a single service connection" means a system which supplies drinking water to consumers via a single service line.

§64401.71. Tier 1 Public Notice.
"Tier 1 public notice" means a public notice issued in response to the events listed in subsection 64463.1(a) and in the manner specified in subsections 64463.1(b) and (c).

§64401.72. Tier 2 Public Notice.
"Tier 2 public notice" means a public notice issued in response to the events listed in section 64463.4(a) and in the manner specified in subsections 64463.4(b) and (c).

§64401.73. Tier 3 Public Notice.
"Tier 3 public notice" means a public notice issued in response to the events listed in section 64463.7(a) and in the manner specified in subsections 64463.7(b), and (c) or (d).

§64401.75. Too Numerous to Count.
"Too numerous to count" means that the total number of bacterial colonies exceeds 200 on a 47-mm diameter membrane filter used for coliform detection.

§64401.80. Total Coliform-positive.
"Total coliform-positive" means a sample result in which the presence of total coliforms has been demonstrated.

§64401.82. Total Organic Carbon or TOC.
"Total organic carbon" or "TOC" means total organic carbon reported in units of milligrams per liter (mg/L), as measured using heat, oxygen, ultraviolet irradiation, chemical oxidants, or combinations of these oxidants that convert organic carbon to carbon dioxide, rounded to two significant figures.

§64401.85. Transient-noncommunity Water System.
"Transient-noncommunity water system" means a public water system that is not a community water system or a nontransient-noncommunity water system.

§64401.90. Treatment.
"Treatment" means physical, biological, or chemical processes, including blending, designed to affect water quality parameters to render the water acceptable for domestic use.

§64401.92. Total Trihalomethanes or TTHM.
"Total Trihalomethanes" or "TTHM" means the sum of the concentrations in milligrams per liter (mg/L) of the trihalomethane compounds (bromodichloromethane, bromoform, chloroform, and dibromochloromethane), rounded to two significant figures after addition.

§64401.95. VOC.
"VOC" means volatile organic chemical.

§64402. Vulnerable System.
"Vulnerable system" means a water system which has any water source which in the judgment of the State Board, has a risk of containing an organic contaminant, based on an assessment as set forth in §64445(d)(1).

§64402.10. Water Source.
"Water source" means an individual groundwater source or an individual surface water intake. Sources which have not been designated as standby sources shall be deemed to be water sources.

§64402.20. Water Supplier.
"Water supplier", "person operating a public water system" or "supplier of water" means any person who owns or operates a public water system. These terms will be used interchangeably in this chapter.

(a) "Wholesale water supplier," or "wholesaler" means any person who treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption.

(b) "Retail water supplier," or "retailer" means

(1) Any person who owns or operates any distribution facilities and any related collection, treatment, or storage facilities under the control of the operator of the public water system which are used primarily in connection with the public water system; or

(2) Any person who owns or operates any collection or pretreatment storage facilities not under the control of the operator of the public water system which are used primarily in connection with the public water system.

§64402.30. Wholesale System.

"Wholesale system" means a public water system that treats source water as necessary to produce finished water and then delivers some or all of that finished water to another public water system. Delivery may be through a direct connection or through the distribution system of one or more consecutive systems.

Article 2. General Requirements

§64412. Determination of Persons Served.

(a) The number of persons served by a community water system shall be determined by the water system using one of the following methods:

(1) Utilizing the most recent United States census data, or more recent special census data certified by the California Department of Finance, for the service area served by the water system;

(2) Multiplying the number of service connections served by the water system by 3.3 to determine the total population served;

(3) Determining the total number of dwelling units or efficiency dwelling units as defined in the Uniform Building Code (Title 24, California Code of Regulations), the number of mobile home park spaces and the number of individual business, commercial, industrial and institutional billing units served by the water system and multiplying this total by 2.8 to arrive at the total population served by the system.

(b) Each community water system shall report to the State Board annually the number of persons and the number of service connections served by the system using the procedures set forth in subsection (a).

§64413.1. Classification of Water Treatment Facilities.

(a) Each water treatment facility shall be classified pursuant to Table 64413.1-A based on the calculation of total points for the facility using the factors specified in subsection (b).

Table 64413.1-A.
Water Treatment Facility Class Designations

Total Points	*Class*
Less than 20	T1
20 through 39	T2
40 through 59	T3
60 through 79	T4
80 or more	T5

(b) The calculation of total points for each water treatment facility shall be the sum of the points derived in each of paragraphs (1) through (13). If a treatment facility treats more than one source, the source with the highest average concentration of each contaminant shall be used to determine the point value in paragraphs (2) through (5).

(1) For water source, the points are determined pursuant to Table 64413.1-B.

Table 64413.1-B.
Points for Source Water Used by the Facility

Type of source water used by the facility	*Points*
Groundwater and/or purchased treated water meeting primary and secondary drinking water standards, as defined in § 116275 of the Health and Safety Code	2
Water that includes any surface water or groundwater under the direct influence of surface water	5

(2) For influent microbiological water quality, points shall be determined by using the median of all total coliform analyses completed in the previous 24 months pursuant to Table 64413.1-C:

Table 64413.1-C.
Influent Water Microbiological Quality Points

Median Coliform Density Most Probable Number Index (MPN)	*Points*
less than 1 per 100 mL	0
1 through 100 per 100 mL	2
greater than 100 through 1,000 per 100 mL	4
greater than 1,000 through 10,000 per 100 mL	6
greater than 10,000 per 100 mL	8

(3) For facilities treating surface water or groundwater under the direct influence of surface water, points for influent water turbidity shall be determined pursuant to Table 64413.1-D on the basis of the previous 24 months of data, except that if turbidity data is missing for one or more of the months, the points given for turbidity shall be 5. The maximum influent turbidity sustained for at least one hour according to an on-line turbidimeter shall be used unless such data is not available, in which case, the maximum influent turbidity identified by grab sample shall be used. For facilities that have not been in operation for 24 months, the available data shall be used. For facilities whose permit specifies measures to ensure that influent turbidity will not exceed a specified level, the points corresponding to that level shall be assigned.

Table 64413.1-D.
Influent Water Turbidity Points

Maximum Influent Turbidity Level Nephelometric Turbidity Units (NTU)	*Points*
Less than 15	0
15 through 100	2
Greater than 100	5

(4) The points for influent water perchlorate, nitrate, or nitrite levels shall be determined by an average of the three most recent sample results, pursuant to Table 64413.1-E.

Table 64413.1-E.
Influent Water Perchlorate, Nitrate, and Nitrite Points

Perchlorate, Nitrate, and Nitrite Data Average	*Points*
Less than or equal to the maximum contaminant level (MCL), as specified in Table 64431-A	0
For each contaminant greater than its MCL	5

(5) The points for other influent water contaminants with primary MCLs shall be a sum of the points for each of the inorganic contaminants (Table 64431-A), organic contaminants (Table 64444-A) and radionuclides (Tables 64442 and 64443). The points for each contaminant shall be based on an average of the three most recent sample results, pursuant to Table 64413.1-F. If monitoring for a contaminant has been waived pursuant to sections 64432(m) or (n), 64432.2(c), or 64445(d), the points shall be zero for that contaminant.

Table 64413.1-F.
Influent Water Chemical and Radiological Contaminant Points

Contaminant Data Average	*Points*
Less than or equal to the MCL	0
Greater than the MCL	2
5 Times the MCL or greater	5

(6) The total points for surface water filtration treatment shall be the sum of the points of those treatment processes utilized by the facility for compliance with section 64652, pursuant to Table 64413.1-G.

Table 64413.1-G.
Points for Surface Water Filtration Treatment

Treatment	*Points*
Conventional, direct, or inline	15
Diatomaceous earth	12
Slow sand, membrane, cartridge, or bag filter	8
Backwash recycled as part of process	5

(7) The points for each treatment process utilized by the facility and not included in paragraph (6) that is used to reduce the concentration of one or more contaminants for which a primary MCL exists, pursuant to Table 64431-A, Table 64444-A, and Tables 64442 and 64443, shall be 10. Blending shall only be counted as a treatment process if one of the blended sources exceeds a primary MCL.

(8) The points for each treatment process not included in paragraphs (6), or (7) that is used to reduce the concentration of one or more contaminants for which a secondary MCL exists, pursuant to Tables 64449-A and 64449-B, shall be 3. Blending shall only be counted as a treatment process if one of the blended sources exceeds a secondary MCL.

(9) The points for each treatment process not included in paragraphs (6), (7), or (8) that is used for corrosion control or fluoridation shall be 3.

(10) The total points for disinfection treatment shall be the sum of the points for those treatment processes utilized by the facility for compliance with section 64654(a), pursuant to Table 64413.1-H.

Table 64413.1-H.
Points for Disinfection Treatment

Treatment Process	*Points*
Ozone	10
Chlorine and/or chloramine	10
Chlorine dioxide	10
Ultraviolet (UV)	7

(11) The points for disinfection/oxidation treatment not included in paragraphs (6), (7), (8), or (10) shall be a sum of the points for all the treatment processes used at the facility pursuant to Table 64413.1-I.

Table 64413.1-I.
Points for Disinfection/Oxidation Treatment without Inactivation Credit

Treatment Process	*Points*
Ozone	5
Chlorine and/or chloramine	5
Chlorine dioxide	5
Ultraviolet (UV)	3
Other oxidants	5

(12) The points for any other treatment process that alters the physical or chemical characteristics of the drinking water and that was not included in paragraphs (6), (7), (8), (9), (10), or (11) shall be 3.

(13) The points for facility flow shall be 2 per million gallons per day or fraction thereof of maximum permitted treatment facility capacity, up to a maximum of 50 points; except that for facilities utilizing only blending, the points shall be based on the flow from the contaminated source and the dilution flow required to meet the MCL(s) specified in Tables 64431-A, 64444-A, 64449-A, 64449-B, and Tables 64442 and 64443.

§64413.3. Classification of Distribution Systems.

(a) The distribution system for each community and nontransient- noncommunity water system shall be classified pursuant to Table 64413.3-A unless modified pursuant to subsection(b). For a wholesaler, the population served shall include the customers served by its retailers.

Table 64413.3-A.
Distribution System Classifications

Population Served	*Class*
1,000 or less	D1
1,001 through 10,000	D2
10,001 through 50,000	D3
50,001 through 5 million	D4
Greater than 5 million	D5

(b) The class determined pursuant to (a) shall be upgraded by one level if the population served is 5 million or less and the sum of all the points from paragraphs (1) through (6) exceeds 20.

(1) The points for pressure zones shall be zero for up to three zones, 4 for four to ten zones, or 6 for more than ten zones.

(2) The points for disinfectants used shall be zero if no disinfectant is applied in the distribution system and no more than one type of disinfectant residual is entering the distribution system. The points shall be 5 if a single disinfectant or ammonia is applied in the distribution system. The points shall be 8 if there are multiple disinfectants in the system.

(3) The points based on the largest single pump in the system for which the distribution operator is responsible shall be 4 for up to fifty horsepower, or 6 for fifty or more horsepower.

(4) The points for distribution storage reservoirs in the system shall be 4 for one to five reservoirs, or 6 for greater than five.

(5) The points for one or more existing uncovered distribution reservoirs shall be 10.

(6) The points to be added if any of the distribution system customers are also served by a non-potable water distribution system shall be 6. This does not apply to wholesalers if the only customers receiving non-potable water are served by its retailers.

§64413.5. Treatment Facility Staff Certification Requirements.

(a) Each water supplier shall designate at least one chief operator that meets the requirements specified in §63765 for each water treatment facility utilized by the water system.

(b) Each water supplier shall designate at least one shift operator that meets the requirements specified in §63765 for each water treatment facility utilized by the water system for each operating shift.

(c) Except as provided in (d), a chief operator or shift operator shall be on-site at all times that the facility is operating.

(d) If the water supplier's operations plan, submitted and approved pursuant to §64661, demonstrates an equal degree of operational oversight and reliability with either unmanned operation or operation under reduced operator certification requirements, the chief operator or shift operator is not required to be on-site, but shall be able to be contacted within one hour.

(e) If there is no change in the treatment facility and the employed shift and/or chief operators, the water supplier shall be in compliance until January 1, 2003 with the shift and operator certification requirements that were in effect on December 31, 2000. If the water system employs a new shift and/or chief operator, that operator shall meet the certification requirements pursuant to §63765(a).

§64413.7. Distribution System Staff Certification Requirements.

(a) Each water supplier shall designate at least one chief operator that meets the requirements specified in §63770 for each distribution system utilized by the water system.

(b) Each water supplier shall designate at least one shift operator that meets the requirements specified in §63770 for each distribution system utilized by the water system for each operating shift.

(c) The chief operator or shift operator shall be on-site or able to be contacted within one hour.

§64414. Standby Sources.

(a) A source which has been designated "standby" shall be monitored a minimum of once every compliance cycle for all inorganic, organic, and radiological MCLs, unless a waiver has been granted by the State Board pursuant to Section 64432(m) or (n) for inorganics, Section 64432.2(c) for asbestos, or Section 64445(d) for organics.

(b) A standby source which has previous monitoring results indicating nitrate or nitrite levels equal to or greater than 50 percent of the MCL shall collect and analyze a sample for nitrate and nitrite annually. In addition, upon activation of such a source, a sample shall be collected, analyzed for these chemicals and the analytical results reported to the State Board within 24 hours of activation.

(c) A standby source shall be used only for short-term emergencies of five consecutive days or less, and for less than a total of fifteen calendar days a year.

(d) Within 3 days after the short-term emergency use of a standby source, the water supplier shall notify the State Board. The notification shall include information on the reason for and duration of the use.

(e) The status of a designated standby source shall not be changed to that of a regular source of drinking water supply, unless the source meets all existing drinking water standards and approval is obtained from the State Board in advance.

(f) A standby source for which perchlorate has been previously detected shall have a sample collected and analyzed for perchlorate annually. Additionally, upon activation of such a source, a sample shall be collected and analyzed for perchlorate, and the analytical result shall be reported to the State Board within 48 hours of activation.

§64415. Laboratory and Personnel.

(a) Except as provided in subsection (b), required analyses shall be performed by laboratories certified by the State Board to perform such analyses pursuant to Article 3, commencing with section 100825, of Chapter 4 of Part 1 of Division 101, Health and Safety Code. Unless directed otherwise by the State Board, analyses shall be made in accordance with U.S. EPA approved methods as prescribed at 40 Code of Federal Regulations parts 141.21 through 141.42, 141.66, and 141.89.

(b) Sample collection, and field tests including color, odor, turbidity, pH, temperature, and disinfectant residual shall be performed by personnel trained to perform such sample collections and/or tests by:

(1) The State Board;

(2) A laboratory certified pursuant to subsection (a); or

(3) An operator, certified by the State Board pursuant to section 106875(a) or (b) of the Health and Safety Code and trained by an entity in paragraph (1) or (2) to perform such sample collections and/or tests.

§64416. Sampling Plan for all Monitoring Except Bacteriological.

(a) Each public water system serving contiguous areas totaling more than 10,000 service connections shall submit a plan to the State Board for monitoring the quality of water.

(1) This plan shall be supported by analytical, hydrological and geological data, and may be developed in cooperation with other agencies or water suppliers.

(2) Constituents to be addressed in the plan shall include inorganic chemicals, organic chemicals, trihalomethanes, radioactivity, general minerals and general physical parameters.

(3) Sampling of certain wells on a rotating basis may be included in the plan if the water supplier is able to demonstrate with analytical, hydrological and geological data that those wells are producing similar quality water from the same aquifer.

(4) The water supplier shall submit an updated plan to the State Board at least once every ten years or at any time the plan no longer ensures representative monitoring of the system.

Article 2.5. Point-of-Use Treatment

§64417. Definitions.

"Point-of-use treatment device" or "POU" means a treatment device applied to a single tap for the purpose of reducing contaminant levels in drinking water at that tap.

§64418. General Provisions.

(a) Except for a proposed new community water system that does not have a domestic water supply permit, a public water system that meets the requirements of Health and Safety Code section 116380(a) may be permitted to use POUs in lieu of centralized treatment for the purpose of complying with one or more maximum contaminant levels or action levels in this Title, other than for microbial contaminants, volatile organic chemicals, organic chemicals that pose an inhalation risk, or radon, and as allowed under the state and federal Safe Drinking Water Acts, if:

(1) the public water system meets the requirements of this Article and any applicable statutory requirements;

(2) the public water system has:

(A) applied for funding from any federal, state, or local agency to correct the system's violations, and

(B) demonstrated to the State Board that centralized treatment for achieving compliance is not immediately economically feasible, as defined in section 64418.1;

(3) the public water system has applied for a permit or permit amendment to use POUs. The duration of the permit or permit amendment issued will be in accordance with Health and Safety Code section 116552;

(4) for a community water system, following a public hearing, the State Board determines pursuant to section 64418.6 that there is no substantial community opposition;

(5) the public water system has a State Board-approved:

(A) POU Treatment Strategy, as defined in section 64418.3,

(B) POU Operations and Maintenance Program, as defined in section 64418.4, and

(C) POU Monitoring Program, as defined in section 64418.5; and

(6) the public water system ensures that each building and each dwelling unit connected to the public water system has a POU installed pursuant to this Article.

(b) With State Board approval and without having to meet the requirement of paragraph (a)(6), a public water system may utilize POUs in lieu of centralized treatment for the purpose of reducing contaminant levels, other than microbial contaminants, volatile organic chemicals, or radon, to levels at or below one or more of the maximum contaminant levels or action levels in this Title, in the water it supplies to some or all of the persons it serves, but the public water system will not be deemed in compliance without meeting the requirement of paragraph (a)(6). A public water system's application for a permit to utilize POUs pursuant to this subsection may include a request that one or more of the requirements of this article be amended or eliminated to address the public water system's specific utilization, and such request may be granted or denied by the State Board.

(c) Funding for centralized treatment is available when funding for centralized treatment, from any source, is received by, or otherwise placed under control of, the public water system.

(d) As used in this article, the estimated cost for both centralized treatment and POU treatment shall be the complete life cycle cost for a similar period of time.

§64418.1. Immediate Economic Feasibility of Centralized Treatment.

(a) To specifically meet the requirements of subparagraph 64418(a)(2)(B), a community water system, when comparing the costs of centralized treatment to the use of POU treatment, shall submit to the State Board information demonstrating that the:

(1) estimated annual cost of centralized treatment, per household, is more than one percent (1%) of the median household income (MHI) of the customers served by the community water system; and

(2) (A) if the community's annual MHI is equal to or less than the statewide annual MHI, the estimated annual cost of centralized treatment, per household, plus the median annual water bill from the most recent 12 months per household is more than 1.5 percent (1.5%) of the annual MHI of the customers served by the community water system, or

(B) if the community's annual MHI is greater than the statewide annual MHI, the estimated annual cost of centralized treatment, per household, plus the median annual water bill from the most recent 12 months per household is more than two percent (2%) of the annual MHI of the customers served by the community water system.

(b) A noncommunity water system shall submit to the State Board documents that demonstrate that centralized treatment is not immediately economically feasible.

§64418.2. POU Requirements.

(a) Each POU must:

(1) be independently certified in accordance with an American National Standard Institute (ANSI) standard that is applicable to the specific type of proposed POU and that adequately addresses a California drinking water standard; or

(2) be approved by the State Board upon determination that the proposed POU unit design, construction, treatment performance, and field or pilot test results can reliably produce water in compliance with California drinking water standards under local expected influent water quality and flow conditions;

(3) be owned, controlled, operated, and maintained by the public water system and/or a person(s) under contract with the public water system, to ensure proper operation, maintenance, monitoring, and compliance with this Article and applicable drinking water standards;

(4) be equipped with a mechanical warning (e.g. alarm, light, etc.) that alerts users when a unit needs maintenance or is no longer operating in a manner that assures the unit is producing effluent meeting state and federal drinking water standards, unless the device is equipped with an automatic shut-off mechanism that prevents the flow of water under such circumstances; and

(5) be equipped with a totalizing flow meter if:

(A) the POU's treatment efficiency or capacity is volume limited; or

(B) if requested by the State Board following a determination that information about the quantity of water treated by the POU is necessary to assess POU efficiency.

(b) Except as provided in subsection (c), pilot testing shall be performed by the public water system, and/or a person(s) under contract with the public water system, on each proposed type of POU to establish its use limitations and operations and maintenance criteria, as well as verification that it will produce effluent that meets drinking water standards under local expected influent water quality and flow conditions. Pilot testing shall include the following steps:

(1) Prior to performing pilot testing, a pilot testing protocol shall be submitted to the State Board for review. The pilot testing protocol must be adequate to demonstrate that water treated by the POU will meet drinking water standards;

(2) Pilot testing for a POU shall be conducted in the manner and for the time period specified by the most current pilot testing protocol for that POU approved under section 64418.2(b)(1), and shall be conducted for no less than two months; and

(3) After completion of the pilot testing, the public water system shall submit a report to the State Board describing the results and findings of the pilot testing.

(c) The State Board may exempt a public water system from the pilot testing requirements in section 64418.2(b), or permit a reduced level of pilot testing required pursuant to subsection (b), if:

(1) the public water system demonstrates to the State Board that the POUs proposed for use have been tested, by the public water system or another person, under equivalent water quality and flow conditions; and

(2) the limitations, criteria, and effluent verification in subsection (b) can be ascertained and have been reported to the State Board.

§64418.3. POU Treatment Strategy.

(a) Prior to installing POUs, and as part of its permit application to use POU in lieu of centralized treatment, a public water system shall submit to the State Board a POU Treatment Strategy sufficient to reliably reduce levels of the contaminants listed in section 64418(a) and comply with drinking water standards. The POU Treatment Strategy shall include the following:

(1) A description of the compliance issues for which POUs are being proposed to address and how the use of POUs will achieve compliance;

(2) A description of how the public water system will determine the type, number, and location of POUs to ensure a sufficient number of devices are installed for human consumption at each building and each dwelling unit connected to the public water system;

(3) The public water system's authority to require customers to accept POUs in lieu of centralized treatment and to take an action, such as discontinuing service, if a customer fails to accept POUs;

(4) The basis for the POU selection(s);

(5) The qualifications and identification of the person(s) responsible for POU installation, operation, maintenance, and water quality sampling and analyses;

(6) A Customer Education Program that includes information about the POU, how the devices work, required maintenance and monitoring, and the need for the person(s) responsible for the POU, as defined in paragraph (a)(5) of this section, to have access to the device to perform required maintenance and monitoring. The Customer Education Program shall be designed to reach all customers and shall be implemented prior to and following installation of POUs;

(7) The authority, ordinances, and/or access agreements adequate to allow the public water system's representatives access to customers' premises for POU installation, maintenance, and water quality monitoring, as well as the surveys necessary to meet paragraph (a)(2);

(8) Identification of applicable local regulatory requirements;

(9) A Consumer Notification Protocol designed to timely inform consumers, in the appropriate language(s), in the event that an installed POU fails to produce water that meets drinking water standards. The Consumer Notification Protocol shall include:

(A) an example of a notice that includes the requirements of Article 18 of this Title, and

(B) a plan for providing an alternative water supply that meets drinking water standards, consistent with section 64551.100 of this Title, in a quantity sufficient for daily household ingestion needs, to customers served by each installed POU not meeting drinking water standards. An alternative water supply shall be provided according to the following timeline;

1. as soon as possible, but no later than 24 hours following the receipt of results of confirmation samples indicating an MCL exceedance for nitrate, nitrite, nitrate plus nitrite, or perchlorate, or

2. as soon as possible, but no later than 7 days following the receipt of results of confirmation samples indicating an MCL exceedance for contaminants other than nitrate, nitrite, nitrate plus nitrite, or perchlorate;

(10) A Customer Notification Protocol for routine notifications that includes examples of notices, to be provided no less frequently than quarterly, in the appropriate language(s) to inform each customer and consumer:

(A) that only the taps for which POUs are installed provide water meeting drinking water standards, and

(B) regarding the mechanical warning or shut-off mechanism required pursuant to paragraph 64418.2(a)(5), including a telephone number that connects the customer or consumer to water system personnel or recording system that shall be accessible by water system personnel 24 hours a day, seven days a week, for the purpose of providing the customer or consumer a reliable means of notifying personnel when the mechanical warning or shut-off mechanism is activated;

(11) The proposed schedules for:

(A) the distribution of public hearing information pursuant to section 64418.6,

(B) the public hearing required pursuant to section 64418.6,

(C) the distribution to customers of POU acceptance surveys pursuant to section 64418.6,

(D) POU installation, and

(E) the construction of centralized treatment; and

(12) An estimate of the percent of all customers within the public water system's service area who are expected to voluntarily allow installation of POU devices, as well as a description of how the public water system will address customers who do not.

(b) A public water system shall comply with the most current State Board-approved version of its POU Treatment Strategy at all times.

§64418.4. POU Operations and Maintenance (O&M) Program.

(a) Prior to installing POUs, and as part of its permit application to use POU in lieu of centralized treatment, a public water system shall submit to the State Board a POU Operations and Maintenance Program (O&M Program) sufficient to reliably reduce levels of the contaminants listed in section 64418(a) and comply with drinking water standards. The O&M Program shall include the following:

(1) An installation protocol that, at a minimum, describes locations and assurances that POUs will be accessible for operation and maintenance;

(2) The type and frequency of maintenance, at intervals specified by the manufacturer and determined by pilot testing, whichever is shorter, that ensures POUs produce effluent that meets drinking water standards;

(3) The number and type of auxiliary POUs and parts necessary to ensure continuous effective treatment;

(4) Replacement schedules for critical components and POUs necessary to ensure continuous effective treatment;

(5) The qualifications and identification of the person(s) responsible for POU installation, operation, and maintenance; and

(6) POU waste-handling and disposal procedures sufficient to ensure that wastes generated by the POU and the POU itself are properly and safely disposed of in accordance with federal, state and local requirements.

(b) To ensure a POU is properly operating and has not been bypassed, POUs shall be inspected by the public water system no less often than every twelve months and when a POU's effluent is monitored pursuant to section 64418.5.

(c) Based on the on-going operation and maintenance of installed POUs, a public water system shall revise its POU O&M Program as necessary to ensure continuous effective treatment and that POUs produce effluent that meets drinking water standards. Revised POU O&M Programs shall be submitted to the State Board for review and may not be implemented without State Board approval, confirming that the revised POU O&M Program meets the requirements of this section.

(d) A public water system shall maintain a copy of, and at all times implement the most current State Board-approved version of its POU O&M Program.

§64418.5. POU Monitoring Program.

(a) Prior to installing POUs, and as part of its permit application to use POU in lieu of centralized treatment, a public water system shall submit to the State Board a POU Monitoring Program sufficient to ensure that water treated by the proposed POU consistently meet drinking water standards. The POU Monitoring Program shall include the following:

(1) source water monitoring – quarterly, with samples collected during the same month (first, second, or third) of each calendar quarter;

(2) POU effluent – initially, with samples collected as soon as possible but no later than 72 hours after a device is installed; and

(3) POU effluent – on-going following the monitoring in paragraph (a)(2), annually, with one twelfth of all units sampled monthly on a rotating basis. After completion of one year of monitoring, a public water system may alternatively monitor one quarter of all units each calendar quarter provided that monitoring results do not exceed 75 percent (75%) of a contaminant's MCL, and the water system submits a revised monitoring plan to the State Board. Water systems shall resume monthly monitoring if results exceed 75 percent (75%) of a contaminant's MCL.

(b) For a contaminant other than nitrate, nitrite, nitrate plus nitrite, or perchlorate, after no less than one year of monitoring conducted pursuant to subsection (a), a public water system may reduce the number of POU units monitored to no less than one third of all installed units per year such that all installed units are monitored no less frequently than once every three years, if all the results of the on-going monitoring conducted pursuant to paragraph (a)(3) do not exceed 75 percent (75%) of a contaminant's MCL, and the public water system submits a revised monitoring plan to the State Board.

(c) In accordance with subsections 64432.8(b) and 64445.2(b) of this Title, the State Board may require additional monitoring for the contaminant of concern or other contaminants, including microbial contaminants, if monitoring results indicate a potential health risk associated with the contaminant, POU technology, or a public water system's compliance with this Article.

(d) The public water system shall revise its POU Monitoring Program as necessary to ensure continuous effective treatment based on the on-going operation and maintenance of installed POUs or additional monitoring required pursuant to subsection (c). Revised POU Monitoring Programs shall be submitted to the State Board for review and may not be implemented without State Board approval confirming that the revised POU Monitoring Program meets the requirements of this section.

(e) The public water system shall maintain a copy of and implement the most current State Board-approved version of its POU Monitoring Program prepared pursuant to this section.

(f) If a POU effluent sample result exceeds an MCL for a contaminant other than nitrate, nitrite, nitrate plus nitrite, or perchlorate, the public water system shall:

(1) implement the public notification and alternative water procedures identified in its most recent State Board-approved POU Treatment Strategy; and

(2) collect a confirmation sample within seven days of notification of the exceedance. If the confirmation sample, or the average of the original and confirmation sample, exceeds the MCL, notify the State Board within 48 hours of the result, complete corrective actions as soon as possible but within one month of receipt of the result, and increase the monitoring frequency, as requested by the State Board to assess the effectiveness of the corrective actions.

(g) If a POU effluent sample result exceeds an MCL for nitrate, nitrite, nitrate plus nitrite, or perchlorate:

(1) implement the public notification and alternative water procedures identified in its most recent State Board-approved POU Treatment Strategy; and

(2) collect a confirmation sample within 72 hours of notification of the exceedance. If the confirmation sample, or the average of the original and confirmation sample, exceeds the MCL, notify the State Board within 24 hours of the result, continue to provide alternative water until the corrective actions have been confirmed to be effective, complete corrective actions as soon as possible but within one month of receipt of the result, and increase the monitoring frequency, as requested by the State Board to assess the effectiveness of the corrective actions.

§64418.6. Public Hearing and Acceptance.

(a) A community water system shall conduct a customer survey and participate in, and provide information for, a public hearing held by the State Board. At least 30 days prior to placing information into a public repository per paragraph (a)(2), the public water system shall submit a Public Acceptance Protocol to the State Board for review. The

Public Acceptance Protocol must satisfy the following requirements in order to receive State Board approval:

(1) Prior to conducting a customer survey, a community water system shall participate in and provide information for a public hearing that, at a minimum, disseminates the following to those in its service area:

(A) a description of the public water system's POU Treatment Strategy,

(B) a description of the adverse health effects, as specified in the appendices to section 64465, associated with the contaminant(s) of concern,

(C) a copy of those portions of the POU Operation and Maintenance Program and Monitoring Program that necessitates customer involvement,

(D) the estimate of any anticipated increase in water bills that may result from utilization of POUs, and

(E) the supporting documentation, assumptions, and calculations used to determine any anticipated increase in water bills proposed to be presented at the public hearing.

(2) At least 30 days prior to the public hearing, the community water system shall place the information to be presented at the public hearing into a publicly accessible repository and notify the State Board and those in its service area of the date, time, and location of the public hearing, as well as the location and hours of operation of the repository. If the public water system serves multi-unit residential dwellings including, but not limited to, apartments and residential institutions, whether sub-metered or not, the public water system shall provide notice to each resident of such residential dwellings.

(3) Following the public hearing, the community water system shall deliver a survey to each of its customers. The survey shall be delivered in a manner designed to reach each customer and in the language appropriate for communication with the customers. The survey shall consist of the following two choices:

(A) "I vote FOR the use of Point-of-Use treatment devices.", and

(B) "I vote AGAINST the use of Point-of-Use treatment devices."

(b) The community water system shall at all times comply with the most recent Public Acceptance Protocol approved by the State Board pursuant to this section.

(c) Use of POU treatment devices in lieu of centralized treatment shall be considered to have no substantial community opposition if:

(1) the sum of the number of non-voting customers and the number of customers voting against POUs, is less than half of the total customers; and

(2) no more than 25 percent of the total number of customers voted against POUs.

§64418.7. Recordkeeping and Reporting.

(a) A public water system shall maintain the following records for at least ten years and provide the records to the State Board, as specified in subsection (b) or upon request:

(1) results of all water quality monitoring conducted pursuant to this Article;

(2) the location and type of each installed POU;

(3) the date and type of maintenance and repairs performed; and
(4) verbal and written customer complaints received and the resulting corrective actions and/or responses.

(b) A public water system shall report to the State Board, at the frequency noted, the following:
(1) monthly – treated water quality monitoring results;
(2) quarterly – source water monitoring results and any investigations and/or corrective action(s) taken to ensure POUs meet the requirements of this Article including, but not limited to, POU maintenance, customer complaints, inspection results, and manufacturer notices pertaining to proper operation of devices.

(c) The reports required pursuant to subsection (b) shall be submitted to the State Board within ten days following the end of the applicable reporting period.

§64418.8. Compliance.
(a) A public water system using POUs in lieu of centralized treatment shall be in violation of an MCL if:
(1) for all POUs combined, during a 12-month interval, more than five percent (5%) of the results of the effluent monitoring conducted pursuant to section 64418.5 exceed an MCL;
(2) for a POU, the effluent fails to meet the MCL, which is determined in accordance with the applicable compliance determination requirements in this Title. Depending on the contaminant and concentration detected, compliance determination may be based on the result of a single sample, an initial sample averaged with one or two confirmation sample(s), or an average of four quarterly or six monthly samples; or
(3) a building or dwelling unit served by the water system does not have a POU installed pursuant to this Article.

Article 2.7. Point-of-Entry Treatment
§64419. Definitions.
"Point-of-entry treatment device" or "POE" means a treatment device applied to the drinking water entering a house or building for the purpose of reducing contaminant levels in the drinking water distributed throughout the house or building. Notwithstanding the foregoing, where all the water supplied by a public water system for human consumption is treated by the public water system via a single device or facility, regardless of location of the device or facility, the public water system shall be considered to have centralized treatment.

§64420. General Provisions.
(a) Except for a proposed new community water system that does not have a domestic water supply permit, a public water systems that meets the requirements of Health and Safety Code section 116380(a) may be permitted to use POEs in lieu of centralized

treatment for the purpose of complying with one or more maximum contaminant levels, action levels, or treatment techniques in this Title and as allowed under the state and federal State Drinking Water Acts, if:

(1) the public water system meets the requirements of this Article and any applicable statutory requirements;

(2) the public water system has:

(A) applied for funding from any federal, state, or local agency to correct the system's violations, and

(B) demonstrated to the State Board that centralized treatment for achieving compliance is not immediately economically feasible, as defined in section 64420.1;

(3) the public water system has applied for a permit or permit amendment to use POEs. The duration of the permit or permit amendment issued will be in accordance with Health and Safety Code section 116552;

(4) for a community water system, following a public hearing, the State Board determines pursuant to section 64420.6 that there is no substantial community opposition;

(5) the public water system has a State Board-approved:

(A) POE Treatment Strategy, as defined in section 64420.3,

(B) POE Operations and Maintenance Program, as defined in section 64420.4, and

(C) POE Monitoring Program, as defined in section 64420.5; and

(6) the public water system ensures that each building connected to the public water system has a POE installed pursuant to this Article.

(b) With State Board approval and without having to meet the requirement of paragraph (a)(6), a public water system may utilize POEs in lieu of centralized treatment for the purpose of reducing contaminant levels to levels at or below one or more of the maximum contaminant levels, action levels, or treatment techniques in this Title, in the water it supplies to some or all of the persons it serves, but the public water system will not be deemed in compliance without meeting the requirement of paragraph (a)(6). A public water system's application for a permit to utilize POEs pursuant to this subsection may include a request that one or more of the requirements of this article be amended or eliminated to address the public water system's specific utilization, and such request may be granted or denied by the State Board.

(c) Funding for centralized treatment is available when funding for centralized treatment, from any source, is received by, or otherwise placed under control of, the public water system.

(d) As used in this article, the estimated cost for both centralized treatment and POE treatment shall be the complete life cycle cost for a similar period of time.

§64420.1. Immediate Economic Feasibility of Centralized Treatment.

(a) To specifically meet the requirements of subparagraph 64420 (a)(2)(B), a community water system, when comparing the costs of centralized treatment to the use of POE treatment, shall submit to the State Board information demonstrating that the:

(1) estimated annual cost of centralized treatment, per household, is more than one percent (1%) of the median household income (MHI) of the customers served by the community water system; and

(2) (A) if the community's annual MHI is equal to or less than the statewide annual MHI, the estimated annual cost of centralized treatment, per household, plus the median annual water bill from the most recent 12 months per household is more than 1.5 percent (1.5%) of the annual MHI of the customers served by the community water system, or

(B) if the community's annual MHI is greater than the statewide annual MHI, the estimated annual cost of centralized treatment, per household, plus the median annual water bill from the most recent 12 months per household is more than two percent (2%) of the annual MHI of the customers served by the community water system.

(b) A noncommunity water system shall submit to the State Board documents that demonstrate that centralized treatment is not immediately economically feasible.

§64420.2. POE Requirements.

(a) Each POE must:

(1) be independently certified in accordance with an American National Standard Institute (ANSI) standard that is applicable to the specific type of proposed POE and that adequately addresses a California drinking water standard; or

(2) be approved by the State Board upon determination that the proposed POE unit design, construction, treatment performance, and available field or pilot test results can reliably produce water in compliance with California drinking water standards under local expected influent water quality and flow conditions;

(3) be owned, controlled, operated, and maintained by the public water system and/or a person(s) under contract with the public water system, to ensure proper operation, maintenance, monitoring, and compliance with this Article and applicable drinking water standards;

(4) be equipped with a mechanical warning (e.g. alarm, light, etc.) that alerts users when a unit needs maintenance or is no longer operating in a manner that assures the unit is producing effluent meeting state and federal drinking water standards, unless the device is equipped with an automatic shut-off mechanism that prevents the flow of water under such circumstances; and

(5) be equipped with a totalizing flow meter.

(b) Except as provided in subsection (c), pilot testing shall be performed by the public water system, and/or a person(s) under contract with the public water system, on each proposed type of POE to establish its use limitations and operations and maintenance criteria, as well as verification that it will produce effluent that meets drinking water standards under local expected influent water quality and flow conditions. Pilot testing shall include the following steps:

(1) Prior to performing pilot testing, a pilot testing protocol shall be submitted to the State Board for review. The pilot testing protocol must be adequate to demonstrate that water treated by the POE will meet drinking water standards;

(2) Pilot testing for a POE shall be conducted in the manner and for the time period specified by the most current pilot testing protocol for that POE approved under section 64420.2(b)(1), and shall be conducted for no less than two months; and

(3) After completion of the pilot testing, the public water system shall submit a report to the State Board describing the results and findings of the pilot testing.

(c)The State Board may exempt a public water system from the pilot testing requirements in section 64420.2(b), or permit a reduced level of pilot testing required pursuant to subsection (b), if:

(1) the public water system demonstrates to the State Board that the POEs proposed for use have been tested, by the public water system or another person, under equivalent water quality and flow conditions; and

(2) the limitations, criteria, and effluent verification in subsection (b) can be ascertained and have been reported to the State Board.

§64420.3. POE Treatment Strategy.

(a) Prior to installing POEs, and as part of its permit application to use POE in lieu of centralized treatment, a public water system shall submit to the State Board a POE Treatment Strategy sufficient to reliably reduce levels of contaminants and comply with drinking water standards. The POE Treatment Strategy shall include each of the following:

(1) A description of the compliance issues for which POEs are being proposed to address and how the use of POEs will achieve compliance;

(2) A description of how the public water system will determine the type, number, and location of POEs to ensure POEs serve, in their entirety, each building connected to the public water system;

(3) The public water system's authority to require customers to accept POEs in lieu of centralized treatment and to take an action, such as discontinuing service, if a customer fails to accept POEs, or disconnects or modifies a POE installed pursuant to this Article;

(4) The basis for the POE selection(s);

(5) The qualifications and identification of the person(s) responsible for POE installation, operation, maintenance, and water quality sampling and analyses;

(6) A Customer Education Program that includes information about the POE, how the devices work, required maintenance and monitoring, and the need for the person(s) responsible for the POE, as defined in paragraph (a)(5) of this section, to have access to the device to perform required maintenance and monitoring. The Customer Education

Program shall be designed to reach all customers and shall be implemented prior to and following installation of POEs;

(7) The authority, ordinances, and/or access agreements adequate to allow the public water system's representatives access to customers' premises for POE installation, maintenance, and water quality monitoring, as well as the surveys necessary to meet paragraph (a)(2);

(8) Identification of applicable local regulatory requirements;

(9) A Consumer Notification Protocol designed to timely inform consumers, in the appropriate language(s), in the event that an installed POE fails to produce water that meets drinking water standards. The Consumer Notification Protocol shall include:

(A) an example of a notice that includes the requirements of Article 18 of this Title, and

(B) a plan for providing an alternative water supply that meets drinking water standards, consistent with section 64551.100 of this Title, in a quantity sufficient for daily household ingestion needs, to customers served by each installed POE not meeting drinking water standards. An alternative water supply shall be provided according to the following timeline;

1. as soon as possible, but no later than 24 hours following the receipt of results of confirmation samples indicating an MCL exceedance for nitrate, nitrite, nitrate plus nitrite, or perchlorate, or

2. as soon as possible, but no later than 7 days following the receipt of results of confirmation samples indicating an MCL exceedance for contaminants other than nitrate, nitrite, nitrate plus nitrite, or perchlorate;

(10) A Customer Notification Protocol for routine notifications that includes examples of notices, to be provided no less frequently than quarterly, in the appropriate language(s) to inform each customer:

(A) which water supplies are not treated by the POEs, and

(B) regarding the mechanical warning or shut-off mechanism required pursuant to paragraph 64420.2(a)(5), including a telephone number that connects the customer to water system personnel or recording system that shall be accessible by water system personnel 24 hours a day, seven days a week, for the purpose of providing the customer a reliable means of notifying personnel when the mechanical warning or shut-off mechanism is activated;

(11) The proposed schedules for:

(A) the distribution of public hearing information pursuant to section 64420.6,

(B) the public hearing required pursuant to section 64420.6,

(C) the distribution to customers of POE acceptance surveys pursuant to section 64420.6,

(D) POE installation, and

(E) the construction of centralized treatment;

(12) An estimate of the percent of all customers within the public water system's service area who are expected to voluntarily allow installation of POE devices, as well as a description of how the public water system will address customers who do not; and

(13) The means for ensuring that the rights and responsibilities of the customer, with respect to an installed POE, convey with title upon the sale or transfer of property to which the POE is attached.

(b) A public water system shall comply with the most current State Board-approved version of its POE Treatment Strategy at all times.

§64420.4. POE Operations and Maintenance (O&M) Program.

(a) Prior to installing POEs, and as part of its permit application to use POE in lieu of centralized treatment, a public water system shall submit to the State Board a POE Operations and Maintenance (O&M) Program sufficient to reliably reduce levels of contaminants and comply with drinking water standards. The POE O&M Program shall include the following:

(1) An installation protocol that, at a minimum, describes locations and assurances that POEs will be accessible for operation and maintenance;

(2) The type and frequency of maintenance, at intervals specified by the manufacturer and determined by pilot testing, whichever is shorter, that ensures POEs produce effluent that meets drinking water standards;

(3) The number and type of auxiliary POEs and parts necessary to ensure continuous effective treatment;

(4) Replacement schedules for critical components and POEs necessary to ensure continuous effective treatment;

(5) The qualifications and identification of the person(s) responsible for POE installation, operation, and maintenance; and

(6) POE waste-handling and disposal procedures sufficient to ensure that wastes generated by the POE and the POE itself are properly and safely disposed of in accordance with federal, state and local requirements.

(b) To ensure a POE is properly operating and has not been bypassed, POEs shall be inspected by the public water system no less often than every twelve months and when a POE's effluent is monitored pursuant to section 64420.5.

(c) Based on the on-going operation and maintenance of installed POEs, a public water system shall revise its POE O&M Program as necessary to ensure continuous effective treatment and that POEs produce effluent that meets drinking water standards. Revised POE O&M Programs shall be submitted to the State Board for review and may not be implemented without State Board approval confirming that the revised POE O&M Program meets the requirements of this section.

(d) A public water system shall maintain a copy of and implement the most current State Board-approved version of its POE O&M Program.

§64420.5. POE Monitoring Program.

(a) Prior to installing POEs, and as part of its permit application to use POE in lieu of centralized treatment, a public water system shall submit to the State Board a POE Monitoring Program sufficient to ensure that water treated by the proposed POE consistently meet drinking water standards. The POE Monitoring Program shall include the following:

(1) source water monitoring – quarterly, with samples collected during the same month (first, second, or third) of each calendar quarter;

(2) POE effluent – initially, with samples collected as soon as possible but no later than 72 hours after a device is installed; and

(3) POE effluent, on-going following the monitoring in paragraph (a)(2), annually, with one twelfth of all units sampled monthly on a rotating basis. After completion of one year of monitoring, a public water system may alternatively monitor one quarter of all units each calendar quarter provided that monitoring results do not exceed 75 percent (75%) of a contaminant's MCL, and the water system submits a revised monitoring plan to the State Board. Water systems shall resume monthly monitoring if results exceed 75 percent (75%) of a contaminant's MCL.

(b) For a contaminant other than nitrate, nitrite, nitrate plus nitrite, or perchlorate, after no less than one year of monitoring conducted pursuant to subsection (a), a public water system may reduce the number of POE units monitored to no fewer than one third of all installed units per year such that all installed devices are sampled no less frequently than once every three years, if all the results of the on-going monitoring conducted pursuant to paragraph (a)(3) do not exceed 75 percent (75%) of a contaminant's MCL, and the public water system submits a revised monitoring plan to the State Board.

(c) The State Board may require additional monitoring for the contaminant of concern or other contaminants, including microbial contaminants, if monitoring results indicate a potential health risk associated with the contaminant, POE technology, or a public water system's compliance with this Article.

(d) The public water system shall revise its POE Monitoring Program as necessary to ensure continuous effective treatment based on the on-going operation and maintenance of installed POEs or additional monitoring required pursuant to subsection (c). Revised POE Monitoring Programs shall be submitted to the State Board for review and may not be implemented without State Board approval confirming that the revised POE Monitoring Program meets the requirements of this section.

(e) The public water system shall maintain a copy of and implement the most current State Board-approved version of its POE Monitoring Program prepared pursuant to this section.

(f) If a POE effluent sample result exceeds an MCL for a contaminant other than nitrate, nitrite, nitrate plus nitrite, or perchlorate, the public water system shall:

(1) implement the public notification and alternative water procedures identified in its most current State Board-approved POE Treatment Strategy; and

(2) collect a confirmation sample within seven days of notification of the exceedance. If the confirmation sample, or the average of the original and confirmation sample, exceeds the MCL, notify the State Board within 48 hours of the result, complete corrective actions as soon as possible but within one month of receipt of the result, and increase the monitoring frequency, as requested by the State Board to assess the effectiveness of the corrective actions.

(g) If a POE effluent sample result exceeds an MCL for nitrate, nitrite, nitrate plus nitrite, or perchlorate;

(1) implement the public notification and alternative water procedures identified in its most current State Board-approved POE Treatment Strategy; and

(2) collect a confirmation sample within 72 hours of notification of the exceedance. If the confirmation sample, or the average of the original and confirmation sample, exceeds the MCL, notify the State Board within 24 hours of the result, continue to provide alternative water until the corrective actions have been confirmed to be effective, complete corrective actions as soon as possible but within one month of receipt of the result, and increase the monitoring frequency as requested by the State Board to assess the effectiveness of the corrective actions.

§64420.6. Public Hearing and Acceptance.

(a) A community water system shall conduct a customer survey and participate in, and provide information for, a public hearing held by the State Board. At least 30 days prior to placing information into a public repository per subsection (a)(2), the public water system shall submit a Public Acceptance Protocol, to the State Board for review. The Public Acceptance Protocol must satisfy the following requirements in order to receive State Board approval:

(1) Prior to conducting a customer survey, a community water system shall participate in and provide information for a public hearing that, at a minimum, disseminates the following to those in its service area:

(A) a description of the public water system's POE Treatment Strategy,

(B) the adverse health effects, as specified in the appendices to section 64465, associated with the contaminant(s) of concern,

(C) POE Operation and Maintenance Program and Monitoring Program information that necessitates customer involvement,

(D) the estimate of any anticipated increase in water bills that may result from utilization of POEs, and

(E) the supporting documentation, assumptions, and calculations used to determine any anticipated increase in water bills proposed to be presented at the public hearing.

(2) At least 30 days prior to the public hearing, the community water system shall place the information to be presented at the public hearing into a publicly accessible repository and notify the State Board and those in its service area of the date, time, and location of the public hearing, as well as the location and hours of operation of the repository. If the public water system serves multi-unit residential dwellings including, but not limited to, apartments and residential institutions, whether sub-metered or not, the public water system shall provide notice to each resident of such residential dwellings.

(3) Following the public hearing, the community water system shall deliver a survey to each of its customers. The survey shall be delivered in a manner designed to reach each customer and in the language appropriate for communication with the customers. The survey shall consist of the following two choices:

(A) "I vote FOR the use of Point-of-Entry treatment devices.", and

(B) "I vote AGAINST the use of Point-of-Entry treatment devices."

(b) The community water system shall at all times comply with the most recent Public Acceptance Protocol approved by the State Board pursuant to this section.

(c) Use of POE treatment devices in lieu of centralized treatment shall be considered to have no substantial community opposition if:

(1) the sum of the number of non-voting customers and the number of customers voting against POEs, is less than half of the total customers; and

(2) no more than 25 percent of the total number of customers voted against POEs.

§64420.7. Recordkeeping and Reporting.

(a) A public water system shall maintain the following records for at least ten years and provide the records to the State Board, as specified in subsection (b) or upon request:

(1) results of all water quality monitoring conducted pursuant to this Article;

(2) the location and type of each installed POE;

(3) the date and type of maintenance and repairs performed; and

(4) verbal and written customer complaints received and the resulting corrective actions and/or responses.

(b) A public water system shall report to the State Board, at the frequency noted, the following:

(1) monthly – treated water quality monitoring results;

(2) quarterly – source water monitoring results and any investigations and/or corrective action(s) taken to ensure POEs meet the requirements of this Article including, but not limited to, POE maintenance, customer complaints, inspection results, and manufacturer notices pertaining to proper operation of devices.

(c) The reports required pursuant to subsection (b) shall be submitted to the State Board within ten days following the applicable reporting period.

§64420.8. Compliance.

(a) A public water system using POEs in lieu of centralized treatment shall be in violation of an MCL if:

(1) for all POEs combined, during a 12-month interval, more than five percent (5%) of the results of the effluent monitoring conducted pursuant to section 64420.5 exceed an MCL;

(2) for a POE, the effluent fails to meet the MCL, which is determined in accordance with the applicable compliance determination requirements in this Title. Depending on the contaminant and concentration detected, compliance determination may be based on the result of a single sample, an initial sample averaged with one or two confirmation sample(s), or an average of four quarterly or six monthly samples; or

(3) a building or dwelling unit served by the water system does not have a POE installed pursuant to this Article.

Article 3. Primary Standards--Bacteriological Quality

§64421. General Requirements.

(a) Each water supplier shall:

(1) Develop a routine sample siting plan as required in section 64422;

(2) Collect routine, repeat and replacement samples as required in Sections 64423, 64424, and 64425;

(3) Have all samples analyzed by laboratories approved to perform those analyses by the State Board and report results as required in section 64423.1;

(4) Notify the State Board when there is an increase in coliform bacteria in bacteriological samples as required in section 64426; and

(5) Comply with the Maximum Contaminant Level as required in section 64426.1.

(b) Water suppliers shall perform additional bacteriological monitoring as follows:

(1) After construction or repair of wells;

(2) After main installation or repair;

(3) After construction, repair, or maintenance of storage facilities; and

(4) After any system pressure loss to less than five psi. Samples collected shall represent the water quality in the affected portions of the system.

§64422. Routine Sample Siting Plan.

(a) By September 1, 1992, each water supplier shall develop and submit to the State Board a siting plan for the routine collection of samples for total coliform analysis, subject to the following:

(1) The sample sites chosen shall be representative of water throughout the distribution system including all pressure zones, and areas supplied by each water source and distribution reservoir.

(2) The water supplier may rotate sampling among the sample sites if the total number of sites needed to comply with (a)(1) above exceeds the number of samples

required according to Table 64423-A. The rotation plan shall be described in the sample siting plan.

(b) If personnel other than certified operators will be performing field tests and/or collecting samples, the sample siting plan shall include a declaration that such personnel have been trained, pursuant to Section 64415 (b).

(c) The supplier shall submit an updated plan to the State Board at least once every ten years and at any time the plan no longer ensures representative monitoring of the system.

§64423. Routine Sampling.

(a) Each water supplier shall collect routine bacteriological water samples as follows:

(1) The minimum number of samples for community water systems shall be based on the known population served or the total number of service connections, whichever results in the greater number of samples, as shown in Table 64423-A. A community water system using groundwater which serves 25-1000 persons may request from the State Board a reduction in monitoring frequency. The minimum reduced frequency shall not be less than one sample per quarter.

(2) The minimum number of samples for nontransient-noncommunity water systems shall be based on the known population served as shown in Table 64423-A during those months when the system is operating. A nontransient-noncommunity water system using groundwater which serves 25-1000 persons may request from the State Board a reduction in monitoring frequency if it has not violated the requirements in this article during the past twelve months. The minimum reduced frequency shall not be less than one sample per quarter.

(3) The minimum number of samples for transient-noncommunity water systems using groundwater and serving 1000 or fewer persons a month shall be one in each calendar quarter during which the system provides water to the public.

(4) The minimum number of samples for transient-noncommunity water systems using groundwater and serving more than 1000 persons during any month shall be based on the known population served as shown in Table 64423-A, except that the water supplier may request from the State Board a reduction in monitoring for any month the system serves 1000 persons or fewer. The minimum reduced frequency shall not be less than one sample in each calendar quarter during which the system provides water to the public.

(5) The minimum number of samples for transient-noncommunity water systems using approved surface water shall be based on the population served as shown in Table 64423-A. A system using groundwater under the direct influence of surface water shall begin monitoring at this frequency by the end of the sixth month after the State Board has designated the source to be approved surface water.

(6) A public water system shall collect samples at regular time intervals throughout the month, except that a system using groundwater which serves 4,900

persons or fewer may collect all required samples on a single day if they are taken from different sites.

(b) In addition to the minimum sampling requirements, all water suppliers using approved surface water which do not practice treatment in compliance with Sections 64650 through 64666, shall collect a minimum of one sample before or at the first service connection each day during which the turbidity level of the water delivered to the system exceeds 1 NTU. The sample shall be collected within 24 hours of the exceedance and shall be analyzed for total coliforms. If the water supplier is unable to collect and/or analyze the sample within the 24-hour time period because of extenuating circumstances beyond its control, the supplier shall notify the State Board within the 24-hour time period and may request an extension. Sample results shall be included in determining compliance with the MCL for total coliforms in Section 64426.1.

(c) If any routine, repeat, or replacement sample is total coliform-positive, then the water supplier shall collect repeat samples in accordance with Section 64424 and comply with the reporting requirements specified in Sections 64426 and 64426.1.

Table 64423-A
Minimum Number of Routine Total Coliform Samples

Monthly Population Served	*Service Connections*	*Minimum Number of Samples*
25 to 1000	15 to 400	1 per month
1,001 to 2,500	401 to 890	2 per month
2,501 to 3,300	891 to 1,180	3 per month
3,301 to 4,100	1,181 to 1,460	4 per month
4,101 to 4,900	1,461 to 1,750	5 per month
4,901 to 5,800	1,751 to 2,100	6 per month
5,801 to 6,700	2,101 to 2,400	7 per month
6,701 to 7,600	2,401 to 2,700	2 per week
7,601 to 12,900	2,701 to 4,600	3 per week
12,901 to 17,200	4,601 to 6,100	4 per week
17,201 to 21,500	6,101 to 7,700	5 per week
21,501 to 25,000	7,701 to 8,900	6 per week
25,001 to 33,000	8,901 to 11,800	8 per week
33,001 to 41,000	11,801 to 14,600	10 per week
41,001 to 50,000	14,601 to 17,900	12 per week
50,001 to 59,000	17,901 to 21,100	15 per week
59,001 to 70,000	21,101 to 25,000	18 per week
70,001 to 83,000	25,001 to 29,600	20 per week
83,001 to 96,000	29,601 to 34,300	23 per week
96,001 to 130,000	34,301 to 46,400	25 per week
130,001 to 220,000	46,401 to 78,600	30 per week
220,001 to 320,000	78,601 to 114,300	38 per week
320,001 to 450,000	114,301 to 160,700	50 per week
450,001 to 600,000	160,701 to 214,300	55 per week
600,001 to 780,000	214,301 to 278,600	60 per week
780,001 to 970,000	278,601 to 346,400	70 per week
970,001 to 1,230,000	346,401 to 439,300	75 per week
1,230,001 to 1,520,000	439,301 to 542,900	85 per week
1,520,001 to 1,850,000	542,901 to 660,700	90 per week
1,850,001 to 2,270,000	660,701 to 810,700	98 per week
2,270,001 to 3,020,000	810,701 to 1,078,600	105 per week
3,020,001 to 3,960,000	1,078,601 to 1,414,300	110 per week
3,960,001 or more	1,414,301 or more	120 per week

§64423.1. Sample Analysis and Reporting of Results.

(a) The water supplier shall designate (label) each sample as routine, repeat, replacement, or "other" pursuant to Section 64421(b), and have each sample analyzed for total coliforms. The supplier also shall require the laboratory to analyze the same sample for fecal coliforms or Escherichia coli (*E. coli*) whenever the presence of total coliforms is indicated. As a minimum, the analytical results shall be reported in terms of the presence or absence of total or fecal coliforms, or *E. coli* in the sample, whichever is appropriate.

(b) The water supplier shall require the laboratory to notify the supplier within 24 hours, whenever the presence of total coliforms, fecal coliforms or *E. coli* is demonstrated in a sample or a sample is invalidated due to interference problems, pursuant to Section 64425(b), and shall ensure that a contact person is available to receive these analytical results 24-hours a day. The water supplier shall also require the laboratory to immediately notify the State Board of any positive bacteriological results if the laboratory cannot make direct contact with the designated contact person within 24 hours.

(c) Analytical results of all required samples collected for a system in a calendar month shall be reported to the State Board not later than the tenth day of the following month, as follows:

(1) The water supplier shall submit a monthly summary of the bacteriological monitoring results to the State Board.

(2) For systems serving fewer than 10,000 service connections or 33,000 persons, the water supplier shall require the laboratory to submit copies of all required bacteriological monitoring results directly to the State Board.

(3) For systems serving more than 10,000 service connections, or 33,000 persons, the water supplier shall require the laboratory to submit copies of bacteriological monitoring results for all positive routine samples and all repeat samples directly to the State Board.

(d) Laboratory reports shall be retained by the water supplier for a period of at least five years and shall be made available to the State Board upon request.

§64424. Repeat Sampling.

(a) If a routine sample is total coliform-positive, the water supplier shall collect a repeat sample set as described in paragraph (1) within 24 hours of being notified of the positive result. The repeat samples shall all be collected within the same 24 hour time period. A single service connection system may request that the State Board allow the collection of the repeat sample set over a four-day period.

(1) For a water supplier that normally collects more than one routine sample a month, a repeat sample set shall be at least three samples for each total coliform-positive sample. For a water supplier that normally collects one or fewer samples per month, a repeat sample set shall be at least four samples for each total coliform-positive sample.

(2) If the water supplier is unable to collect the samples within the 24-hour time period specified in subsection (a) or deliver the samples to the laboratory within 24 hours after collection because of circumstances beyond its control, the water supplier shall notify the State Board within 24 hours. The State Board will then determine how much time the supplier will have to collect the repeat samples.

(b) When collecting the repeat sample set, the water supplier shall collect at least one repeat sample from the sampling tap where the original total coliform-positive sample was taken. Other repeat samples shall be collected within five service connections upstream or downstream of the original site. At least one sample shall be from upstream and one from downstream unless there is no upstream and/or downstream service connection.

(c) If one or more samples in the repeat sample set is total coliform-positive, the water supplier shall collect and have analyzed an additional set of repeat samples as specified in subsections (a) and (b). The supplier shall repeat this process until either no coliforms are detected in one complete repeat sample set or the supplier determines that the MCL for total coliforms specified in Section 64426.1 has been exceeded and notifies the State Board.

(d) If a public water system for which fewer than five routine samples/month are collected has one or more total coliform-positive samples, the water supplier shall collect at least five routine samples the following month. If the supplier stops supplying water during the month after the total coliform-positive(s), at least five samples shall be collected during the first month the system resumes operation. A water supplier may request the State Board waive the requirement to collect at least five routine samples the following month, but a waiver will not be granted solely on the basis that all repeat samples are total coliform-negative. To request a waiver, one of the following conditions shall be met:

(1) The State Board conducts a site visit before the end of the next month the system provides water to the public to determine whether additional monitoring and/or corrective action is necessary to protect public health.

(2) The State Board determines why the sample was total coliform-positive and establishes that the system has corrected the problem or will correct the problem before the end of the next month the system serves water to the public. If a waiver is granted, a system shall collect at least one routine sample before the end of the next month it serves water to the public and use it to determine compliance with Section 64426.1.

§64425. Sample Invalidation.

(a) A water supplier may request the State Board to invalidate a sample for which a total coliform-positive result has been reported if the supplier demonstrates:

(1) All repeat sample(s) collected at the same tap as the original total coliform-positive sample also are total coliform- positive and all repeat samples collected within five service connections of the original tap are not total coliform-positive; or

(2) The laboratory did not follow the prescribed analytical methods pursuant to Section 64415(a), based on a review of laboratory documentation by the State Board. The supplier shall submit to the State Board a written request for invalidation along with the laboratory documentation, the supplier's sample collection records and any observations noted during sample collection and delivery. The water supplier shall require the laboratory to provide the supplier with documentation which shall include, but not be limited to:

(A) A letter from the director of the laboratory having generated the data, confirming the invalidation request by reason of laboratory accident or error;

(B) Complete sample identification, laboratory sample log number (if used), date and time of collection, date and time of receipt by the laboratory, date and time of analysis for the sample(s) in question;

(C) Complete description of the accident or error alleged to have invalidated the result(s);

(D) Copies of all analytical, operating, and quality assurance records pertaining to the incident in question; and

(E) Any observations noted by laboratory personnel when receiving and analyzing the sample(s) in question.

(b) Whenever any total coliform sample result indicative of the absence of total coliforms has been declared invalid by the laboratory due to interference problems as specified at 40 Code Federal Regulations, Section 141.21(c)(2), the supplier shall collect a replacement sample from the same location as the original sample within 24 hours of being notified of the interference problem, and have it analyzed for the presence of total coliforms. The supplier shall continue to re-sample at the original site within 24 hours and have the samples analyzed until a valid result is obtained.

§64426. Significant Rise in Bacterial Count.

(a) Any of the following criteria shall indicate a possible significant rise in bacterial count:

(1) A system collecting at least 40 samples per month has a total coliform-positive routine sample followed by two total coliform-positive repeat samples in the repeat sample set;

(2) A system has a sample which is positive for fecal coliform or *E. coli*; or

(3) A system fails the total coliform Maximum Contaminant Level (MCL) as defined in Section 64426.1.

(b) When the coliform levels specified in subsection (a) are reached or exceeded, the water supplier shall:

(1) Contact the State Board by the end of the day on which the system is notified of the test result or the system determines that it has exceeded the MCL, unless the notification or determination occurs after the State Board office is closed, in which case the supplier shall notify the State Board within 24 hours; and

(2) Submit to the State Board information on the current status of physical works and operating procedures which may have caused the elevated bacteriological findings, or any information on community illness suspected of being waterborne. This shall include, but not be limited to:

(A) Current operating procedures that are or could potentially be related to the increase in bacterial count;

(B) Any interruptions in the treatment process;

(C) System pressure loss to less than 5 psi;

(D) Vandalism and/or unauthorized access to facilities;

(E) Physical evidence indicating bacteriological contamination of facilities;

(F) Analytical results of any additional samples collected, including source samples;

(G) Community illness suspected of being waterborne; and

(H) Records of the investigation and any action taken.

(c) Upon receiving notification from the State Board of a significant rise in bacterial count, the water supplier shall implement the emergency notification plan required by Section 116460, Health and Safety Code.

§64426.1. Total Coliform Maximum Contaminant Level (MCL).

(a) Results of all samples collected in a calendar month pursuant to Sections 64423, 64424, and 64425 that are not invalidated by the State Board or the laboratory shall be included in determining compliance with the total coliform MCL. Special purpose samples such as those listed in section 64421(b) and samples collected by the water supplier during special investigations shall not be used to determine compliance with the total coliform MCL.

(b) A public water system is in violation of the total coliform MCL when any of the following occurs:

(1) For a public water system which collects at least 40 samples per month, more than 5.0 percent of the samples collected during any month are total coliform-positive; or

(2) For a public water system which collects fewer than 40 samples per month, more than one sample collected during any month is total coliform-positive; or

(3) Any repeat sample is fecal coliform-positive or E. coli-positive; or

(4) Any repeat sample following a fecal coliform-positive or E. coli-positive routine sample is total coliform-positive.

(c) If a public water system is not in compliance with paragraphs (b)(1) through (4), during any month in which it supplies water to the public, the water supplier shall notify the State Board by the end of the business day on which this is determined, unless the determination occurs after the State Board office is closed, in which case the supplier shall notify the State Board within 24 hours of the determination. The water supplier shall also notify the consumers served by the water system. A Tier 2 Public Notice shall be given for violations of paragraph (b)(1) or (2), pursuant to section 64463.4. A Tier 1 Public Notice shall be given for violations of paragraph (b)(3) or (4), pursuant to section 64463.1.

§64426.5. Variance from Total Coliform Maximum Contaminant Level.
A water system may apply to the State Board for a variance from the total coliform MCL in section 64426.1(b)(1) or (2). To be eligible for a variance, the water system shall demonstrate that it meets the following criteria:

(a) During the thirty days prior to application for a variance, water entering the distribution system has:

(1) Been free from fecal coliform or E. coli occurrence based on at least daily sampling;

(2) Contained less than one total coliform per hundred milliliters of water in at least ninety-five percent of all samples based on at least daily sampling;

(3) Complied with the turbidity requirements of section 64653, if approved surface water; and

(4) Maintained a continuous disinfection residual of at least 0.2 mg/L at the entry point(s) to the distribution system;

(b) The system has had no waterborne microbial disease outbreak, pursuant to section 64651.91, while operated in its present configuration;

(c) The system maintains contact at least twice a week with the State Board and local health departments to assess illness possibly attributable to microbial occurrence in the public drinking water system;

(d) The system has analyzed, on a monthly basis, at least the number of samples required pursuant to the approved sample siting plan and has not had an E. coli-positive compliance sample within the last six months, unless the system demonstrates to the State Board that the occurrence is not due to contamination entering the distribution system;

(e) The system has undergone a sanitary survey conducted by the State Board within the past twelve months;

(f) The system maintains a cross-connection control program in accordance with sections 7583 through 7605, title 17 of the California Code of Regulations;

(g) The system agrees to submit a biofilm control plan to the State Board within twelve months of the granting of the first request for a variance;

(h) The system monitors general distribution system bacterial quality by conducting heterotrophic bacteria plate counts on at least a weekly basis at a minimum of ten percent of the number of total coliform sites specified in the approved sample siting plan (preferably using the methods in section 9215(a), 18th edition of Standard Methods for the Examination of Water and Wastewater, 1992, American Public Health Association, et. al); and

(i) The system conducts daily monitoring at distribution system total coliform monitoring sites approved by the State Board and maintains a detectable disinfectant residual at a minimum of ninety-five percent of those points and a heterotrophic plate count of less than 500 colonies per mL at sites without a disinfectant residual.

(j) No water system shall be eligible for a variance or exemption from the MCL for total coliforms unless it demonstrates that the violation of the total coliform MCL is due to a persistent growth of total coliforms in the distribution system pursuant to section 64426.5, rather than to fecal or pathogenic contamination, a treatment lapse or deficiency, or a problem in the operation or maintenance of the distribution system.

§64427. Sanitary Survey.

Systems which collect less than five routine samples per month shall be subject to an initial sanitary survey by the Department by June 29, 1994 for community water systems and June 29, 1999 for nontransient-noncommunity and transient-noncommunity water systems. Sanitary surveys shall be repeated every five years.

Article 3.5. Ground Water Rule

§64430. Requirements.

A public water system that uses ground water shall comply with the following provisions of 40 Code of Federal Regulations as they appear in the Ground Water Rule published in 71 Federal Register 65574 (November 8, 2006) and amended in 71 Federal Register 67427 (November 21, 2006) and 74 Federal Register 30953 (June 29, 2009), which are hereby incorporated by reference: Sections 141.21(d)(3), 141.28(a), 141.153(h)(6),

Appendix A to Subpart O (Consumer Confidence Reports), 141.202(a)(8), 141.203(a)(4), Appendices A and B to Subpart Q (Public Notification), and 141.400 through 141.405, except that in:

(a) sections 141.402(a)(1)(ii), (a)(2), (a)(2)(ii), (a)(4), (a)(4)(ii)(A), (a)(5)(i), and (a)(5)(ii), the phrase "§141.21(a)" is replaced by "22 California Code of Regulations sections 64422 and 64423",

(b) sections 141.402(a)(1)(ii) and 141.405(b)(4), the phrase "§141.21(c)" is replaced by "22 California Code of Regulations section 64425", and

(c) section 141.402(a)(2)(iii), the phrase "§141.21(b)" is replaced by "22 California Code of Regulations section 64424".

[Note: The text reflecting the above section is provided in Addendum A of this book.]

Article 4. Primary Standards--Inorganic Chemicals

§64431. Maximum Contaminant Levels--Inorganic Chemicals.

Public water systems shall comply with the primary MCLs in table 64431-A as specified in this article.

Table 64431-A
Maximum Contaminant Levels
Inorganic Chemicals

Chemical	*Maximum Contaminant Level, mg/L*
Aluminum	1.
Antimony	0.006
Arsenic	0.010
Asbestos	7 MFL*
Barium	1.
Beryllium	0.004
Cadmium	0.005
Chromium	0.05
Cyanide	0.15
Fluoride	2.0
Mercury	0.002
Nickel	0.1
Nitrate (as nitrogen)	10.
Nitrate+Nitrite (sum as nitrogen)	10.
Nitrite (as nitrogen)	1.
Perchlorate	0.006
Selenium	0.05
Thallium	0.002

* MFL=million fibers per liter; MCL for fibers exceeding 10 μm in length.

§64432. Monitoring and Compliance--Inorganic Chemicals.

(a) All public water systems shall monitor to determine compliance with the nitrate and nitrite MCLs in table 64431-A, pursuant to subsections (d) through (f) and Section 64432.1. All community and nontransient-noncommunity water systems shall monitor to determine compliance with the perchlorate MCL, pursuant to subsections (d), (e), and (l), and section 64432.3. All community and nontransient-noncommunity water systems shall also monitor to determine compliance with the other MCLs in table 64431-A, pursuant to subsections (b) through (n) and, for asbestos, section 64432.2. Monitoring shall be conducted in the year designated by the State Board of each compliance period beginning with the compliance period starting January 1, 1993.

(b) Unless directed otherwise by the State Board, each community and nontransient-noncommunity water system shall initiate monitoring for an inorganic chemical within six months following the effective date of the regulation establishing the MCL for the chemical and the addition of the chemical to table 64431-A. If otherwise performed in accordance with this section, groundwater monitoring for an inorganic chemical performed no more than two years prior to the effective date of the regulation establishing the MCL may be used to satisfy the requirement for initiating monitoring within six months following such effective date.

(c) Unless more frequent monitoring is required pursuant to this Chapter, the frequency of monitoring for the inorganic chemicals listed in table 64431-A, except for asbestos, nitrate/nitrite, and perchlorate, shall be as follows:

(1) Each compliance period, all community and nontransient-noncommunity systems using groundwater shall monitor once during the year designated by the State Board. The State Board will designate the year based on historical monitoring frequency and laboratory capacity. All community and nontransient-noncommunity systems using approved surface water shall monitor annually. All systems monitoring at distribution entry points which have combined surface and groundwater sources shall monitor annually.

(2) Quarterly samples shall be collected and analyzed for any chemical if analyses of such samples indicate a continuous or persistent trend toward higher levels of that chemical, based on an evaluation of previous data.

(d) For the purposes of sections 64432, 64432.1, 64432.2, and 64432.3, detection shall be defined by the detection limits for purposes of reporting (DLRs) in table 64432-A.

Table 64432-A
Detection Limits for Purposes of Reporting (DLRs) for Regulated Inorganic Chemicals

Chemical	*Detection Limit for Purposes of Reporting (DLR) (mg/L)*
Aluminum	0.05
Antimony	0.006
Arsenic	0.002
Asbestos	0.2 MFL>10um*
Barium	0.1
Beryllium	0.001
Cadmium	0.001
Chromium	0.01
Cyanide	0.1
Fluoride	0.1
Mercury	0.001
Nickel	0.01
Nitrate (as nitrogen)	0.4
Nitrite (as nitrogen)	0.4
Perchlorate	0.004
Selenium	0.005
Thallium	0.001

* MFL=million fibers per liter; DLR for fibers exceeding 10 um in length.

(e) Samples shall be collected from each water source or a supplier may collect a minimum of one sample at every entry point to the distribution system which is representative of each source after treatment. The system shall collect each sample at the same sampling site, unless a change is approved by the State Board.

(f) A water system may request approval from the State Board to composite samples from up to five sampling sites, provided that the number of sites to be composited is less than the ratio of the MCL to the DLR. Approval will be based on a review of three years of historical data, well construction and aquifer information for groundwater, and intake location, similarity of sources, and watershed characteristics for surface water. Compositing shall be done in the laboratory.

(1) Systems serving more than 3,300 persons shall composite only from sampling sites within a single system. Systems serving 3,300 persons or less may composite among different systems up to the 5-sample limit.

(2) If any inorganic chemical is detected in the composite sample at a level equal to or greater than one fifth of the MCL, a follow-up sample shall be analyzed within 14 days from each sampling site included in the composite for the contaminants

which exceeded the one-fifth-MCL level. If available, duplicates of the original sample taken from each sampling site used in the composite may be used instead of resampling; the analytical results shall be reported within 14 days. The water supplier may collect up to two additional samples each from one or more of the sources to confirm the result(s).

(3) Compliance for each site shall be determined on the basis of the individual follow-up samples, or on the average of the follow-up and confirmation sample(s) if the supplier collects confirmation sample(s) for each detection.

(g) If the level of any inorganic chemical, except for nitrate, nitrite, nitrate plus nitrite, or perchlorate, exceeds the MCL, the water supplier shall do one of the following:

(1) Inform the State Board within 48 hours and monitor quarterly beginning in the next quarter after the exceedance occurred; or

(2) Inform the State Board within seven days from the receipt of the analysis and, as confirmation, collect one additional sample within 14 days from receipt of the analysis. If the average of the two samples collected exceeds the MCL, this information shall be reported to the State Board within 48 hours and the water supplier shall monitor quarterly beginning in the next quarter after the exceedance occurred.

(h) If the concentration of an inorganic chemical exceeds ten times the MCL, within 48 hours of receipt of the result the water supplier shall notify the State Board and resample as confirmation. The water supplier shall notify the State Board of the result(s) of the confirmation sample(s) within 24 hours of receipt of the confirmation result(s).

(1) If the average concentration of the original and confirmation sample(s) is less than or equal to ten times the MCL, the water supplier shall monitor quarterly beginning in the quarter following the quarter in which the exceedance occurred.

(2) If the average concentration of the original and confirmation sample(s) exceeds ten times the MCL, the water supplier shall, if directed by the State Board;

(A) Immediately discontinue use of the contaminated water source; and

(B) Not return the source to service without written approval from the State Board.

(i) Compliance with the MCLs shall be determined by a running annual average; if any one sample would cause the annual average to exceed the MCL, the system is immediately in violation. If a system takes more than one sample in a quarter, the average of all the results for that quarter shall be used when calculating the running annual average. If a system fails to complete four consecutive quarters of monitoring, the running annual average shall be based on an average of the available data.

(j) If a system using groundwater has collected a minimum of two quarterly samples or a system using approved surface water has collected a minimum of four quarterly samples and the sample results have been below the MCL, the system may apply to the State Board for a reduction in monitoring frequency.

(k) Water quality data collected prior to January 1, 1990, and/or data collected in a manner inconsistent with this section shall not be used in the determination of compliance with the monitoring requirements for inorganic chemicals.

(l) Water quality data collected in compliance with the monitoring requirements of this section by a wholesaler providing water to a public water system shall be acceptable for use by that system for compliance with the monitoring requirements of this section.

(m) A water system may apply to the State Board for a waiver from the monitoring frequencies specified in subsection (c)(1), if the system has conducted at least three rounds of monitoring (three periods for groundwater sources or three years for approved surface water sources) and all previous analytical results are less than the MCL. The water system shall specify the basis for its request. If granted a waiver, a system shall collect a minimum of one sample per source while the waiver is in effect and the term of the waiver shall not exceed one compliance cycle (i.e., nine years).

(n) A water system may be eligible for a waiver from the monitoring frequencies for cyanide specified in subsection (c)(1) without any prior monitoring if it is able to document that it is not vulnerable to cyanide contamination pursuant to the requirements in §64445(d)(1) or (d)(2).

(o) Transient-noncommunity water systems shall monitor for the inorganic chemicals in table 64431-A as follows:

(1) All sources shall be monitored at least once for fluoride; and

(2) Surface water sources for parks and other facilities with an average daily population use of more than 1,000 people and/or which are determined to be subject to potential contamination based on a sanitary survey shall be monitored at the same frequency as community water systems.

§64432.1. Monitoring and Compliance--Nitrate and Nitrite.

(a) To determine compliance with the MCL for nitrate in Table 64431-A, all public water systems using groundwater and transient-noncommunity systems using approved surface water shall monitor annually, and all community and nontransient-noncommunity systems using approved surface water shall monitor quarterly.

(1) The water supplier shall require the laboratory to notify the supplier within 24 hours whenever the level of nitrate in a single sample exceeds the MCL, and shall ensure that a contact person is available to receive such analytical results 24-hours a day. The water supplier shall also require the laboratory to immediately notify the State Board of any acute nitrate MCL exceedance if the laboratory cannot make direct contact with the designated contact person within 24 hours. Within 24 hours of notification, the water supplier shall:

(A) Collect another sample, and

(B) Analyze the new sample; if the average of the two nitrate sample results exceeds the MCL, report the result to the State Board within 24 hours. If the average does not exceed the MCL, inform the State Board of the results within seven days from the receipt of the original analysis.

(C) If a system is unable to resample within 24 hours, it shall notify the consumers by issuing a Tier 1 Public Notice pursuant to section 64463.1 and shall collect and analyze a confirmation sample within two weeks of notification of the results of the first sample.

(2) For public water systems using groundwater, the repeat monitoring frequency shall be quarterly for at least one year following any one sample in which the concentration is greater than or equal to 50 percent of the MCL. After four consecutive quarterly samples are less than the MCL, a system may request that the State Board reduce monitoring frequency to annual sampling.

(3) For public water systems using approved surface water, the repeat monitoring frequency shall be quarterly following any one sample in which the concentration is greater than or equal to 50 percent of the MCL. After four consecutive quarterly samples are less than 50 percent of the MCL, a system may request that the State Board reduce monitoring frequency to annual sampling. A system using approved surface water shall return to quarterly monitoring if any one sample is greater than or equal to 50 percent of the MCL.

(4) After any round of quarterly sampling is completed, each community and nontransient-noncommunity system which initiates annual monitoring shall take subsequent samples during the quarter which previously resulted in the highest analytical results.

(b) All public water systems shall monitor to determine compliance with the MCL for nitrite in Table 64431-A, by taking one sample at each sampling site during the compliance period beginning January 1, 1993.

(1) If the level of nitrite in a single sample is greater than the MCL, the water supplier shall proceed as for nitrate in accordance with paragraph (a)(1) of this section.

(2) The repeat monitoring frequency for systems with an analytical result for nitrite that is greater than or equal to 50 percent of the MCL shall be quarterly monitoring for at least one year. After four consecutive quarterly samples are less than the MCL, a system may request that the State Board reduce monitoring frequency to annual sampling, collecting subsequent samples during the quarter which previously resulted in the highest analytical results.

(3) The repeat monitoring frequency for systems with an analytical result for nitrite that is less than 50 percent of the MCL shall be one sample during each compliance period (every three years).

(c) All public water systems shall determine compliance with the MCL for nitrate plus nitrite in Table 64431-A. If the level exceeds the MCL, the water supplier shall proceed as for nitrate in accordance with paragraphs (a)(1) through (a)(4) of this section.

§64432.2. Monitoring and Compliance - Asbestos.

(a) All community and nontransient-noncommunity water systems are required to monitor to determine compliance with the MCL for asbestos in Table 64431-A during the year designated by the State Board of the first compliance period of each nine-year compliance cycle, beginning in the compliance period starting January 1, 1993. The State Board will designate the year based on historical monitoring frequency and laboratory capacity.

(1) If a groundwater system is vulnerable to asbestos contamination solely in its source water, it shall collect one sample at every entry point to the distribution system which is representative of each water source after treatment and proceed in accordance with Subsections 64432(c)(2) through (e) and Subsections 64432(g) through (l).

(2) All approved surface water systems shall be designated vulnerable to asbestos contamination in their source waters. If a surface water system is vulnerable solely in its source water, it shall proceed as in paragraph (1) above.

(3) If a system is vulnerable to asbestos contamination due to leaching of asbestos-cement pipe, with or without vulnerability to asbestos contamination in its source water, it shall take one sample at a tap served by asbestos-cement pipe under conditions where asbestos contamination is most likely to occur.

(b) If the level of asbestos exceeds the MCL in Table 64431-A, the supplier shall report to the State Board within 48 hours and monitor quarterly beginning in the next quarter after the violation occurred. A system may request that the State Board reduce monitoring frequency to one sample every compliance cycle, pursuant to §64432(j).

(c) If a system is not vulnerable either to asbestos contamination in its source water or due to leaching of asbestos-cement pipe, it may apply to the State Board for a waiver of the monitoring requirements in paragraphs (a)(1) through (3) of this section. The State Board will determine the vulnerability of groundwater sources on the basis of historical monitoring data and possible influence of serpentine formations. Vulnerability due to leaching of asbestos-cement pipe will be determined by the State Board on the basis of the presence of such pipe in the distribution system and evaluation of the corrosivity of the water. The period of the waiver shall be three years.

§64432.3. Monitoring and Compliance - Perchlorate.

(a) For initial monitoring for the perchlorate MCL, each community and nontransient-noncommunity water system shall collect two samples at each source in a year, five to seven months apart. At least one of the samples shall be collected during the period from May 1 through September 30 (vulnerable time), unless the State Board specifies a different vulnerable time for the water system due to seasonal conditions related to use, manufacture and/or weather.

(b) Data collected since January 3, 2001, that is in conformance with subsection (a) may be used to comply with the initial monitoring requirement.

(c) After meeting the initial monitoring requirements in subsection (a) and if no perchlorate is detected, during each compliance period each water system:

(1) Using groundwater, shall monitor once during the year designated by the State Board;

(2) Using approved surface water, shall monitor annually; and

(3) Monitoring at distribution entry points that have combined surface and groundwater sources, shall monitor annually; if perchlorate is detected in the water from the combined sources, the water system shall sample each source individually to determine which is contaminated.

(d) The water supplier shall require the laboratory to notify the supplier within 48 hours of the result whenever the level of perchlorate in a single sample exceeds the MCL, and shall ensure that a contact person is available to receive such analytical results 24-hours a day. The water supplier shall also require the laboratory to immediately notify the State Board of any perchlorate MCL exceedance if the laboratory cannot make direct contact with the designated contact person within 48 hours. Within 48 hours of notification of the result, the water supplier shall:

(1) Collect and analyze a confirmation sample, and

(2) If the average of the two perchlorate sample results exceeds the MCL, report the result to the State Board within 48 hours. If the average does not exceed the MCL, inform the State Board of the results within seven days from the receipt of the original analytical result.

(3) If a system is unable to resample within 48 hours, it shall issue a Tier 1 notice to the consumers in accordance with sections 64463 and 64463.1 and shall collect and analyze a confirmation sample within two weeks of notification of the results of the first sample.

(e) A water system shall monitor quarterly any source in which perchlorate has been detected. After four consecutive quarterly samples indicate that perchlorate is not present at or above the DLR, a system may request that the State Board reduce monitoring to the frequencies specified in paragraphs (c)(1) through (3).

(f) A water system serving less than 10,000 persons may apply to the State Board for a variance from the perchlorate MCL if it can demonstrate that the estimated annualized cost per household for treatment to comply with the MCL exceeds 1% of the median household income in the community within which the customers served by the water system reside.

§64432.8. Sampling of Treated Water Sources.

(a) Each water supplier utilizing treatment to comply with one or more MCL(s) in Table 64431-A shall collect monthly samples of the treated water at a site prior to the distribution system and analyze for the chemical(s) for which treatment is being applied. If the treated water exceeds an MCL, other than a nitrate, nitrite, nitrate plus nitrite, or perchlorate MCL, within 48 hours of receipt of the result the water supplier shall resample the treated water to confirm the result and report the initial result to the State Board. The result of the analysis of the confirmation sample shall be reported to the State Board within 24 hours of receipt of the confirmation result. For nitrate, nitrite, nitrate plus nitrite, or perchlorate treated water monitoring, the water supplier shall comply with the requirements of section 64432.1(a)(1) for nitrate, section 64432.1(b)(1) for nitrite, section 64432.1(c) for nitrate plus nitrite, and section 64432.3(d) for perchlorate.

(b) The State Board may require more frequent monitoring based on an evaluation of the treatment process used, the treatment effectiveness and efficiency, and the concentration of the inorganic chemical in the water source.

Article 4.1. Fluoridation

§64433. System Requirements and Exemptions.

(a) Any public water system with 10,000 service connections or more that does not have a fluoridation system shall install such a system pursuant to the requirements in this article if the State Board identifies a source of sufficient funds not excluded by Health and Safety Code section 116415 to cover capital and any associated costs necessary to install such a system. Installation shall be completed within two years of the date the funds are received by the water system; the water system may apply to the State Board for an extension of the deadline. Following installation, if the State Board identifies a source of sufficient funds not excluded by Health and Safety Code section 116415 to cover the noncapital operations and maintenance costs for the period of a year or more, the system shall fluoridate within three months of receiving the funds and shall continue fluoridating so long as such funds are received.

(b) Any public water system with 10,000 service connections or more that has a fluoridation system but ceased fluoridating prior to December 31, 1995 shall fluoridate the drinking water if its fluoridation system is determined to be capable of fluoridating the drinking water in compliance with §64433.2, based on a State Board review, and the State Board identifies a source of sufficient funds not excluded by Health and Safety Code section 116415 to cover the noncapital operations and maintenance costs for the period of a year or more. Such a system shall fluoridate within one month of receiving the funds and shall continue fluoridating so long as such funds are received.

(c) Any public water system required to install a fluoridation system pursuant to subsection (a) or required to fluoridate pursuant to subsection (b) shall annually submit an estimate of anticipated fluoridation operations and maintenance costs for the next fiscal year (July 1 through June 30) to the State Board by the January 1 preceding that fiscal year.

(d) Any public water system with 10,000 service connections or more that has naturally-occurring fluoride and cannot demonstrate that it maintains an average annual fluoride level that is equal to or greater than the low level specified in the temperature-appropriate "control range" in Table 64433.2-A shall be subject to subsections (a) and (b).

(e) Any public water system which achieves 10,000 service connections or more subsequent to July 1, 1996, that does not have a fluoridation system, or that has naturally-occurring fluoride and meets the criteria in subsection (d) shall provide an estimate to the State Board of capital and any associated costs necessary to install a fluoridation system within one year of achieving at least 10,000 service connections:

(f) Any public water system with 10,000 service connections or more shall be exempted from fluoridation in either of the following cases:

(1) The water system does not receive sufficient funds from a source identified by the State Board and not excluded by Health and Safety Code section 116415 to cover the capital and associated costs needed to install a fluoridation system; or

(2) The water system received sufficient capital funds from a source identified by the State Board and not excluded by Health and Safety Code section 116415 and subsequently installed a fluoridation system or the water system meets the criteria in subsection (b), and the water system did not receive sufficient funds from a source identified by the State Board and not excluded by Health and Safety Code section 116415 to cover the noncapital operation and maintenance costs to fluoridate. The water system shall be exempted for any fiscal year (July 1 through June 30) for which it does not receive the funds for noncapital operation and maintenance costs.

§64433.2. Optimal Fluoride Levels.

Any public water system that is fluoridating shall comply with the temperature-appropriate fluoride levels in Table 64433.2-A. The system shall determine, and submit to the State Board, its annual average of maximum daily air temperatures based on the five calendar years immediately preceding the current calendar year.

Table 64433.2-A
Optimal Fluoride Levels

Annual average of maximum daily air temperatures, degrees		*Optimal fluoride level, mg/L*	*Control Range, mg/L*	
Fahrenheit	Celsius		Low	High
50.0 to 53.7	10.0 to 12.0	1.2	1.1	1.7
53.8 to 58.3	12.1 to 14.6	1.1	1.0	1.6
58.4 to 63.8	14.7 to 17.7	1.0	0.9	1.5
63.9 to 70.6	17.8 to 21.4	0.9	0.8	1.4
70.7 to 79.2	21.5 to 26.2	0.8	0.7	1.3
79.3 to 90.5	26.3 to 32.5	0.7	0.6	1.2

§64433.3. Monitoring and Compliance--Fluoride Levels.

(a) If a water system has a single fluoridation system which treats all the water distributed to consumers, the supplier shall collect a daily sample for fluoride analysis, pursuant to §64415(b), either in the distribution system or at the entry point. If a water system does not fluoridate all its water and/or has more than one fluoridation system, the supplier shall collect one sample daily in the distribution system and rotate the sample sites in order to be representative of the water throughout the distribution system according to a monitoring plan the State Board has determined to be representative. For water systems fluoridating as of January 1, 1997, the plan shall be submitted by July 1, 1998. For all others, the plan shall be submitted prior to initiating fluoridation treatment. A water system shall monitor only when it is operating its fluoridation system.

(b) If more than 20 percent of the daily fluoride samples collected in a month by a water system pursuant to subsection (a) fall outside the control range of optimal levels as determined by temperature for that system pursuant to §64433.2, the system shall be out of compliance with §64433.2.

(c) At least once a month, any water supplier with an operating fluoridation system shall divide one sample and have one portion analyzed for fluoride by water system personnel and the other portion analyzed pursuant to §64415(a).

(d) Any water system with an operating fluoridation system shall sample the raw source waters annually and analyze for fluoride pursuant to §64415(a); samples collected pursuant to §64432(c)(1) may be used toward satisfying this requirement. All raw source water samples collected under this subsection are subject to compliance with the fluoride MCL in Table 64431-A.

(e) If any sample result obtained pursuant to subsection (a) does not fall within the temperature-appropriate fluoride level control range in Table 64433.2-A, the water supplier shall take action as detailed in the water system's approved fluoridation system operations contingency plan as specified in §64433.8.

§64433.5. Fluoridation System.
Each fluoridation system installed or modified after January 1, 1997, shall meet the following criteria, as a minimum:

(a) Operate only when a flow of water is detected. If the water system serves less than 200 service connections, a secondary flow-based control device shall be provided as back-up protection;

(b) Provide flow measuring and recording equipment for the fluoride addition;

(c) Provide design and reliability features to maintain the level of fluoride within the temperature-appropriate control range 95 per cent of the time;

(d) Provide for containment of spills; and

(e) Provide alarm features for fluoride chemical feed and fluoride spills.

§64433.7. Recordkeeping, Reporting, and Notification for Water Systems Fluoridating.

(a) By the tenth day of each month following the month being reported, each water supplier fluoridating its water supply shall send operational reports to the State Board which include the following:

(1) The fluoride compounds used and the calculated fluoride dose in mg/L;

(2) Information on any interruptions in the fluoridation treatment which may have occurred during the month including the duration of the interruptions, an explanation of causes, and what corrective actions were taken to insure that fluoridation treatment was resumed in a timely manner;

(3) The results of the daily monitoring for fluoride in the water distribution system, reported in terms of daily results, and ranges and the number of samples collected; and

(4) The results of monthly split sample(s) analyzed pursuant to §64433.3(c).

(b) For water systems that fluoridated the previous fiscal year (July 1 through June 30), the water supplier shall report the operations and maintenance costs for that year to the State Board by August 1.

(c) Whenever a water system initiates fluoridation, suspends fluoridation for more than ninety days, or reinitiates fluoridation after a suspension of more than ninety days, the water supplier shall notify the consumers, local health departments, pharmacists, dentists, and physicians in the area served by the water system, regarding the status of the fluoridation treatment. If a water system with more than one fluoridation system suspends the use of one or more of its fluoridation systems, but the level of fluoride being served to the consumers is in conformance with Table 64433.2-A, no notification shall be required.

(d) If a fluoride overfeed exceeding 10.0 mg/L occurs, the water system shall notify the State Board by the end of the business day of the occurrence or within 24 hours if the State Board office is closed.

(e) If the level of fluoride in the distribution system is found to be less than the control range in Table 64433.2-A in two or more samples in a month, the water system shall notify the State Board within three business days of the second occurrence. If the level of fluoride in the distribution system is found to be 0.1 mg/L or more above the control range up to 10.0 mg/L, the water supplier shall notify the State Board within three business days of the occurrence.

§64433.8. Fluoridation System Operations Contingency Plan.

(a) Water systems fluoridating as of July 1, 1996 shall submit a fluoridation system operations contingency plan by July 1, 1998. All other water systems shall submit the plan at least three months before initiating fluoridation treatment. All fluoridating water systems shall operate in accordance with a fluoridation system operations contingency plan determined by the State Board to include the elements in subsection (b).

(b) A fluoridation system operation contingency plan shall include, but not be limited to, the following elements:

(1) Actions to be implemented by the water supplier in the event that the fluoride level in a distribution system sample is found to be less than the control range in Table 64433.2-A, 0.1 mg/L above the control range up to a fluoride level of 2.0 mg/L, from 2.1 to a level of 4.0 mg/L, from 4.1 to a level of 10.0 mg/L, or above a level of 10.0 mg/L.

(2) The procedure for shutting down the fluoridation equipment if there is a fluoride overfeed and the need to do so is identified by the State Board and/or the water supplier;

(3) The procedure for investigating the cause of an underfeed or overfeed;

(4) A list of water system, county health department, and State Board personnel with day and evening phone numbers to be notified by the end of the business day of the occurrence or within 24 hours if the State Board office is closed in the event of an overfeed exceeding 10.0 mg/L; and

(5) The procedure for notifying the public if instructed to do so by the State Board in the event of a fluoride underfeed extending for more than three months or a fluoride overfeed exceeding 10.0 mg/L.

§64434. Water System Priority Funding Schedule.

Public water systems with 10,000 service connections or more that are not fluoridating as of July 1, 1996, shall install fluoridation systems and initiate fluoridation according to the order established in Table 64434-A, as the water systems receive funds from sources identified by the State Board, pursuant to Health and Safety Code section 116415.

Table 64434-A
Water System Priority Funding Schedule

System No.	*System Name*	*Priority*
3710010	Helix Water District	1
5610017	Ventura, City of	2
4110013	Daly City, City of	3
3710006	Escondido, City of	4
4210011	Santa Maria, City of	5
3410009	Fair Oaks Water District	6
1910083	Manhattan Beach, City of	7
3710025	Sweetwater Authority	8
4210010	Santa Barbara, City of	9
0910001	El Dorado Irrigation District	10
3410006	Citrus Heights Water District	11
4410010	Santa Cruz, City of	12
3610039	San Bernardino, City of	13
3310009	Eastern Municipal Water District	14
3710037	Padre Dam Municipal Water District	15
1910067	Los Angeles, City of	16
2810003	Napa, City of	17
3710020	San Diego, City of	18
3710034	Otay Water District	19
3310031	Riverside, City of	20
1910173	Whittier, City of	21
3410020	Sacramento, City of	22
1910139	California American Water Company - San Marino	23
3710021	San Dieguito Water District	24
3610024	Hesperia Water District	25
1910179	Burbank, City of	26
2710004	California American Water Company - Monterey	27
3310049	Western Municipal Water District	28
3010073	Moulton Niguel Water District	29
3010101	Santa Margarita Water District	30
1910239	Lakewood, City of	31
2110003	North Marin Water District	32
3010037	Yorba Linda Water District	33
3710015	Poway, City of	34
3110025	Placer County Water Agency	35

System No.	*System Name*	*Priority*
5010010	Modesto, City of	36
1910126	Pomona, City of	37
3410004	Carmichael Water District	38
1910043	Glendale, City of	39
3610018	Cucamonga Community Water District	40
3910011	Tracy, City of	41
1910234	Walnut Valley Water District	42
3910012	Stockton, City of	43
1910146	Santa Monica, City of	44
3710027	Vista Irrigation District	45
3010018	La Habra, City of	46
1910009	Valley County Water District	47
3310012	Elsinore Valley Municipal Water District	48
1910051	Inglewood, City of	49
3710005	Carlsbad Municipal Water District	50
4210004	Goleta Water District	51
1910213	Torrance, City of	52
1910152	South Gate, City of	53
1910155	Southern California Water Company - Southwest	54
1510017	Indian Wells Valley Water District	55
1910039	San Gabriel Valley Water Company - El Monte	56
1610003	Hanford, City of	57
3310037	Corona, City of	58
3010062	Garden Grove, City of	59
3610003	Apple Valley Ranchos Water Community	60
3610036	Chino Hills, City of	61
3010064	Westminster, City of	62
4310011	San Jose Water Company	63
3610012	Chino, City of	64
3910004	Lodi, City of	65
5610007	Oxnard, City of	66
1910019	Cerritos, City of	67
1910205	Suburban Water Systems - San Jose Hills	68
1910059	Suburban Water Systems - La Mirada	69
1910092	Monterey Park, City of	70
1910174	Suburban Water Systems - Whittier	71
1910026	Compton, City of	72
1910124	Pasadena, City of	73
3310022	Lake Hemet Municipal Water District	74
1910142	Southern California Water Company - San Dimas	75
4510005	Redding, City of	76

System No.	*System Name*	*Priority*
3610037	Redlands, City of	77
3910005	Manteca, City of	78
3710014	Oceanside, City of	79
3610038	Rialto, City of	80
4310022	Great Oaks Water Company	81
4310014	Sunnyvale, City of	82
3310021	Jurupa Community Services District	83
3410001	Arcade- Town & County	84
3610052	Victor Valley Water District	85
3010023	Newport Beach, City of	86
3610064	East Valley Water District	87
1910225	Las Virgenes Municipal Water District	88
3710001	California American Water Company - Coronado	89
3610034	Ontario, City of	90
3910001	California Water Service Company - Stockton	91
1910033	Dominguez Water Agency	92
5410015	Tulare, City of	93
5710006	Woodland, City of	94
3710029	Olivenhain Municipal Water District	95
1910003	Arcadia, City of	96
1910008	Azusa Valley Water Company	97
4410011	Watsonville, City of	98
3010003	Buena Park, City of	99
4310005	Milpitas, City of	100
1910017	Santa Clarita Water Company	101
1910240	Valencia Water Company	102
3610004	West San Bernardino Water District	103
0910002	South Tahoe Public Utilities District	104
5610059	Southern California Water Company - Simi Valley	105
3010027	Orange, City of	106
5410010	Porterville, City of	107
4410017	Soquel Creek Water District	108
4110023	San Bruno, City of	109
1910001	Alhambra, City of	110
3010022	Southern California Water Company-West Orange County	111
3010091	Los Alisos Water District	112
3610050	Upland, City of	113
3410024	Northridge Water District	114
1010003	Clovis, City of	115
3010004	Mesa Consolidated Water District	116
3610041	San Gabriel Valley Water Company - Fontana	117

System No.	*System Name*	*Priority*
3410010	Citizens Utilities Company of California - Suburban	118
3010038	Santa Ana, City of	119
3010092	Irvine Ranch Water District	120
1910211	Park Water Company - Bellflower	121
3010010	Fullerton, City of	122
4310007	Mountain View, City of	123
3010036	San Clemente, City of	124
3010079	El Toro Water District	125
5610020	Thousand Oaks, City of	126
3610029	Monte Vista Water District	127
1910004	Southern California Water Company - Artesia	128
4210016	Southern California Water Company - Orcutt	129
4110008	California Water Service Company - San Mateo	130
1310038	Rancho California Water District	131
3410017	Citizens Utilities Company of California - Parkway	132
1910024	Southern California Water Company - Claremont	133
1910044	Glendora, City of	134
3010001	Anaheim, City of	135
5710001	Davis, City of	136
1910134	California Water Service Company-Hermosa/Redondo	137
1010007	Fresno, City of	138
1910102	Palmdale Water District	139
4310012	Santa Clara, City of	140
2710010	California Water Service Company - Salinas	141
4910006	Petaluma, City of	142
1910036	California Water Service Company - East Los Angeles	143
3410013	Citizens Utilities Company of California - Lincoln Oaks	144
3310001	Coachella Valley Water District	145
5010019	Turlock, City of	146
5410016	California Water Service Company - Visalia	147
5610023	Waterworks District 8-Simi Valley	148
0410002	California Water Service Company - Chico	149
1910104	California Water Service Company - Palos Verdes	150
3410015	Southern California Water Company - Corodva	151
4910009	Santa Rosa, City of	152
1910194	Rowland Water District	153
1510003	California Water Service Company - Bakersfield	154
5610040	California American Water Company - Village District	155
3310005	Desert Water Agency	156
0110003	California Water Service Company - Livermore	157
3010046	Tustin, City of	158

System No.	*System Name*	*Priority*
4310001	California Water Service Company - Los Altos Suburban	159
4110007	California Water Service Company - San Carlos	160
1910070	Los Angeles, County Water Works District 4&34- Lancaster	161
1510031	Bakersfield, City of	162
4110009	California Water Service Company - South San Francisco	163
3010053	Huntington Beach, City of	164
4110006	California Water Service Company - Bear Gulch	165
1910034	Downey, City of	166
4110022	Redwood City	167

Article 5. Radioactivity

§64442. MCLs and Monitoring - Gross Alpha Particle Activity, Radium-226, Radium-228, and Uranium

(a) Each community and nontransient-noncommunity water system (system) shall comply with the primary MCLs in Table 64442 in the drinking water supplied to the public and use the DLRs for reporting monitoring results:

Table 64442
Radionuclide Maximum Contaminant Levels (MCLs)
and Detection Levels for Purposes of Reporting (DLRs)

Radionuclide	*MCL*	*DLR*
Radium-226	5 pCi/L (combined radium-226 & -228)	1 pCi/L
Radium–228		1 pCi/L
Gross Alpha particle activity (excluding radon and uranium)	15 pCi/L	3 pCi/L
Uranium	20 pCi/L	1 pCi/L

(b) Each system shall monitor to determine compliance with the MCLs in table 64442, as follows:

(1) Monitor at each water source, or every entry point to the distribution system that is representative of all sources being used under normal operating conditions; conduct all monitoring at the same sample site(s) unless a change is approved by the State Board, based on a review of the system and its historical water quality data;

(2) For quarterly monitoring, monitor during the same month (first, second or third) of each quarter during each quarter monitored;

(3) By December 31, 2007, complete initial monitoring that consists of four consecutive quarterly samples at each sampling site for each radionuclide in table 64442, except that nontransient-noncommunity water systems shall not be required to monitor radium-228 as a separate analyte, but shall monitor for compliance with the combined

radium MCL using the analytical method described in Prescribed Procedures for Measurement of Radioactivity in Drinking Water, Section 6, Alpha-emitting Radium Isotopes in Drinking Water, Method 903.0 (EPA/600/4-80-032, August 1980):

(A) Data collected for a sampling site between January 1, 2001, and December 31, 2004, may be used to satisfy the initial monitoring requirement, subject to the State Board's approval based on whether the analytical methods, DLRs, sampling sites, and the frequency of monitoring used were consistent with this article.

(B) For gross alpha particle activity, uranium, radium-226 and radium-228, the State Board may waive the final two quarters of initial monitoring at a sampling site if the results from the previous two quarters are below the DLR(s) and the sources are not known to be vulnerable to contamination.

(c) Any new system or new source for an existing system shall begin monitoring pursuant to Subsection (b) within the first quarter after initiating water service to the public.

(d) After initial monitoring, each system shall monitor for each radionuclide at each sampling site at a frequency determined by the monitoring result(s) [single sample result or average of sample results if more than one sample collected] from the most recent compliance period as follows:

(1) For nontransient-noncommunity water systems, the results for the total radium analyses shall be averaged.

(2) For community water systems, the results of radium-226 and radium-228 analyses shall be added and the average calculated.

(3) The values used for the radionuclide MCLs and DLRs shall be as specified in Table 64442.

(4) If the single sample result or average is:

A. Below the DLR, the system shall collect and analyze at least one sample every nine years (3 compliance periods).

B. At or above the DLR, but at or below ½ the MCL, the system shall collect and analyze at least one sample every six years.

C. Above ½ the MCL, but not above the MCL, the system shall collect and analyze at least one sample every three years.

(e) A system that monitors quarterly may composite up to four consecutive samples from a single sampling site if analysis is done within a year of the first sample's collection. If the result of the composited sample is greater than ½ the MCL, at least one additional quarterly sample shall be analyzed to evaluate the range and trend of results over time before allowing the system to reduce the monitoring frequency.

(f) A gross alpha particle activity measurement may be substituted for other measurements by adding the 95% confidence interval (1.65σ, where σ is the standard deviation of the net counting rate of the sample) to it; and if,

(1) For uranium and radium measurements (after initial radium-228 monitoring has been completed), the gross alpha measurement does not exceed 5 pCi/L; or

(2) For radium measurements (after initial radium-228 monitoring has been completed), the result obtained from subtracting the uranium measurement from the gross alpha measurement does not exceed 5 pCi/L.

(g) If any sample result is greater than an MCL:

(1) For a system monitoring less than quarterly, quarterly samples shall be collected and analyzed to determine compliance, pursuant to subsection (h);

(2) For a system that already has four consecutive quarterly results, compliance shall be determined pursuant to subsection (h).

(3) The system shall monitor quarterly until the results of four consecutive quarterly sample results do not exceed the MCL.

(h) A system with one or more sample results greater than an MCL shall determine compliance with the MCL as follows:

(1) At each sampling site, based on the analytical results for that site. Any confirmation sample result shall be averaged with the initial result.

(2) Using all monitoring results collected under this section during the previous 12 months, even if more than the minimum required number of samples was collected.

(3) By a running annual average of four consecutive quarters of sampling results. Averages shall be rounded to the same number of significant figures as the MCL for which compliance is being determined.

(A) If any sample result will cause the annual average at any sample site to exceed the MCL, the system shall be out of compliance immediately upon receiving the result;

(B) If a system has not analyzed the required number of samples, compliance shall be determined by the average of the samples collected at the site during the most recent 12 months; and

(C) If a sample result is less than the DLR in table 64442, zero shall be used to calculate the annual average, unless a gross alpha particle activity is being used in lieu of radium-226, total radium, and/or uranium. In that case, if the gross alpha particle activity result is less than the DLR, ½ the DLR shall be used to calculate the annual average.

(4) If compositing is allowed at a sampling site, by the results of a composite of four consecutive quarterly samples.

(5) If the system can provide documentation that a sample was subject to sampling or analytical errors, the State Board may invalidate the result based on its review of the documentation, the sampling result, and the historical sampling data.

(6) Each system shall ensure that the laboratory analyzing its samples collected for compliance with this article calculates and reports the sample-specific Minimum Detectable Activity at the 95% confidence level (MDA_{95}) along with the sample results. The MDA_{95} shall not exceed the DLR and shall be calculated as described in ANSI

N42.23 Measurement and Associated Instrumentation Quality Assurance for Radiobioassay Laboratories, Appendix A.7.6 (September 10, 1995).

§64443. MCLs and Monitoring - Beta Particle and Photon Radioactivity

(a) Each community and nontransient-noncommunity water system (system) shall comply with the primary MCLs in table 64443 and use the DLRs for reporting monitoring results:

Table 64443
Radionuclide Maximum Contaminant Levels (MCLs)
and Detection Levels for Purposes of Reporting (DLRs)

Radionuclide	*MCL*	*DLR*
Beta/photon emitters	4 millirem/year annual dose equivalent to the total body or any internal organ	Gross Beta particle activity: 4 pCi/L
Strontium-90	8 pCi/L (= 4 millirem/yr dose to bone marrow)	2 pCi/L
Tritium	20,000 pCi/L (= 4 millirem/yr dose to total body)	1,000 pCi/L

(b) Each system designated by the State Board as vulnerable to contamination by nuclear facilities and/or a determination of vulnerability by a Source Water Assessment, as defined in section 63000.84, shall monitor to determine compliance with the MCLs in table 64443, as follows:

(1) Beginning within one quarter after being notified by the State Board that the system is vulnerable, quarterly for beta/photon emitters and annually for tritium and strontium-90 at each water source, or every entry point to the distribution system that is representative of all sources being used under normal operating conditions, and shall conduct all monitoring at the same sample site(s) unless a change is approved by the State Board, based on a review of the system and its historical water quality data;

(2) For quarterly monitoring, during the same month (first, second or third) of each quarter during each quarter monitored; and

(3) If the gross beta particle activity minus the naturally-occurring potassium-40 beta particle activity at a sampling site has a running annual average less than or equal to 50 pCi/L (screening level), reduce monitoring to a single sample for beta/photon emitters, tritium and strontium-90 once every three years (compliance monitoring period).

(c) Each system designated by the State Board as utilizing waters contaminated by effluents from nuclear facilities on the basis of analytical data and/or a Source Water Assessment, shall:

(1) Beginning within one quarter after being notified by the State Board of the above designation, monitor on an ongoing basis pursuant to subparagraphs (A) through (C) at each sampling site:

(A) For beta/photon emitters, quarterly by analyzing three monthly samples and averaging the results or by analyzing a composite of three monthly samples;

(B) For iodine-131, quarterly by analyzing a composite of five consecutive daily samples, unless the State Board has directed the system to do more frequent monitoring based on a detection of iodine-131 in the sampled water; and

(C) For strontium-90 and tritium, annually by analyzing four quarterly samples and averaging the results or by analyzing a composite of four quarterly samples.

(2) If the gross beta particle activity minus the naturally-occurring potassium-40 beta particle activity at a sampling site has a running annual average (computed quarterly) less than or equal to 15 pCi/L (screening level), reduce the frequency of monitoring to a single sample for beta/photon emitters, iodine-131, strontium-90 and tritium once every three years (compliance monitoring period).

(d) If the gross beta particle activity minus the naturally-occurring potassium-40 beta particle activity exceeds a system's screening level pursuant to Subsection (b)(3) or (c)(2):

(1) The sample shall be analyzed to identify the primary radionuclides present and the doses shall be calculated and summed to determine compliance with the MCL for beta particle/photon radioactivity; and

(2) Except for strontium-90 and tritium for which the MCLs provide the average annual concentrations assumed to produce a total body or organ dose equivalent to 4 millirem/year, the concentration of manmade radionuclides shall be calculated using the 168 hour data list in "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," NBS (National Bureau of Standards) Handbook 69 as amended August 1963, U.S. Department of Commerce. (See Title 40, Code of Federal Regulations, section 141.66(d)(2).)

(e) If a system analyzes for naturally-occurring potassium-40 beta particle activity from the same or equivalent samples used for the gross beta particle activity analysis, the potassium-40 beta particle activity shall be calculated by multiplying elemental potassium concentrations (in mg/L) by a factor of 0.82 pCi/mg.

(f) A system required to monitor under this section may use environmental surveillance data (collected by the nuclear facility to detect any radionuclide contamination) in lieu of monitoring, subject to the State Board's determination that the data is applicable to the system based on a review of the data and the hydrogeology of the area. In the event that there is a release of radioactivity or radioactive contaminants from the nuclear facility, a system using environmental surveillance data shall begin the monitoring in paragraph (b)(1) or (c)(1)(A) through (C), whichever is most applicable.

(g) If a sample result is greater than an MCL:

(1) Compliance shall be determined as follows:

(A) At each sampling site, based on the analytical results for that site. Any confirmation sample result shall be averaged with the initial result.

(B) Using all monitoring results collected under this article during the previous 12 months, even if more than the minimum required number of samples was collected.

(C) By a running annual average of four consecutive quarters of sampling results where quarterly monitoring is required, or by an annual sample when applicable for tritium and strontium-90. Averages shall be rounded to the same number of significant figures as the MCL for which compliance is being determined.

1. If any sample result will cause the annual average at any sample site to exceed the MCL, the system shall be out of compliance immediately after being notified of the result;

2. If a system has not analyzed the required number of samples, compliance shall be determined by the average of the samples collected at the site during the most recent 12 months; and

3. If a sample result is less than the DLR in 64443, zero shall be used to calculate the annual average.

(D) If the system can provide documentation that a sample was subject to sampling or analytical errors, the State Board may invalidate the result based on its review of the documentation, the sampling result, and the historical sampling data.

(E) Each system shall ensure that the laboratory analyzing its samples collected for compliance with this article calculates and reports the sample-specific Minimum Detectable Activity at the 95% confidence level (MDA_{95}) along with the sample results. The MDA_{95} shall not exceed the DLR and is calculated as described in ANSI N42.23 Measurement and Associated Instrumentation Quality Assurance for Radiobioassay Laboratories, Appendix A.7.6 (September 10, 1995). (See Title 40, Code of Federal Regulations, section 141.66(d)(2).)

(2) If a sample has a gross beta/photon radioactivity level greater than the MCL:

(A) A system shall monitor monthly beginning the month after receiving a result greater than the MCL and continue monthly monitoring until an average of three consecutive monthly sample results does not exceed the MCL ;

(B) The system shall then monitor quarterly until the average of four consecutive quarterly sample results does not exceed the MCL; and

(C) Subsequently, the system shall conduct the monitoring in paragraph (b)(1) or (c)(1)(A) through (C), whichever is most applicable.

Article 5.5. Primary Standards -- Organic Chemicals

§64444. Maximum Contaminant Levels – Organic Chemicals.

The MCLs for the primary drinking water chemicals shown in table 64444-A shall not be exceeded in the water supplied to the public.

Table 64444-A
Maximum Contaminant Levels
Organic Chemicals

Chemical	*Maximum Contaminant Level, mg/L*
(a) Volatile Organic Chemicals (VOCs)	
Benzene	0.001
Carbon Tetrachloride	0.0005
1,2-Dichlorobenzene	0.6
1,4-Dichlorobenzene	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.0005
1,1-Dichloroethylene	0.006
cis-1,2-Dichloroethylene	0.006
trans-1,2-Dichloroethylene	0.01
Dichloromethane	0.005
1,2-Dichloropropane	0.005
1,3-Dichloropropene	0.0005
Ethylbenzene	0.3
Methyl-*tert*-butyl ether	0.013
Monochlorobenzene	0.07
Styrene	0.1
1,1,2,2-Tetrachloroethane	0.001
Tetrachloroethylene	0.005
Toluene	0.15
1,2,4-Trichlorobenzene	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.005
Trichloroethylene	0.005
Trichlorofluoromethane	0.15
1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2
Vinyl Chloride	0.0005
Xylenes	1.750*

Table 64444-A (continued)
Maximum Contaminant Levels
Organic Chemicals

Chemical	*Maximum Contaminant Level, mg/L*
(b) Synthetic Organic Chemicals (SOCs)	
Alachlor	0.002
Atrazine	0.001
Bentazon	0.018
Benzo(a)pyrene	0.0002
Carbofuran	0.018
Chlordane	0.0001
2,4-D	0.07
Dalapon	0.2
Dibromochloropropane	0.0002
Di(2-ethylhexyl)adipate	0.4
Di(2-ethylhexyl)phthalate	0.004
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Endrin	0.002
Ethylene Dibromide	0.00005
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor Epoxide	0.00001
Hexachlorobenzene	0.001
Hexachlorocyclopentadiene	0.05
Lindane	0.0002
Methoxychlor	0.03
Molinate	0.02
Oxamyl	0.05
Pentachlorophenol	0.001
Picloram	0.5
Polychlorinated Biphenyls	0.0005
Simazine	0.004
Thiobencarb	0.07
Toxaphene	0.003
1,2,3-Trichloropropane	0.000005
2,3,7,8-TCDD (Dioxin)	3×10^{-8}
2,4,5-TP (Silvex)	0.05

*MCL is for either a single isomer or the sum of the isomers.

§64445. Initial Sampling - Organic Chemicals.

(a) Each community and nontransient-noncommunity water system shall collect four quarterly samples during the year designated by the State Board of each compliance period beginning with the compliance period starting January 1, 1993, from each water source at a site prior to any treatment and test for all applicable organic chemicals listed in table 64444-A. The State Board will designate the year based on historical monitoring frequency and laboratory capacity. For surface sources, the samples shall be taken at each water intake. For groundwater sources, the samples shall be taken at each well head. Where multiple intakes or wells draw from the same water supply, the State Board will consider sampling of representative sources as a means of complying with this section. Selection of representative sources shall be based on evidence which includes a hydrogeological survey and sampling results. Wells shall be allowed to flow for a minimum of 15 minutes before sampling to insure that the samples reflect the water quality of the source. In place of water source samples, a supplier may collect samples at sites located at the entry points to the distribution system. The samples shall be representative of each source after treatment. The system shall collect each sample at the same sampling site, unless a change is approved by the State Board.

(b) For any organic chemical added to table 64444-A, the water system shall initiate the quarterly monitoring for that chemical in January of the calendar year after the effective date of the MCL.

(c) A water system may request approval from the State Board to composite samples from up to five sampling sites, provided that the number of the sites to be composited is less than the ratio of the MCL to the DLR in §64445.1. Approval will be based on a review of three years of historical data, well construction and aquifer information for groundwater, and intake location, similarity of sources, and watershed characteristics for surface water. Compositing shall be done in the laboratory and analyses shall be conducted within 14 days of sample collection.

(1) Systems serving more than 3,300 persons shall composite only from sampling sites within a single system. Systems serving 3,300 persons or less may composite among different systems up to the 5-sample limit.

(2) If any organic chemical is detected in the composite sample, a follow-up sample shall be analyzed within 14 days from each sampling site included in the composite for the contaminants which were detected. The water supplier shall report the results to the State Board within 14 days of the follow-up sample collection. If available, duplicates of the original sample taken from each sampling site used in the composite may be used instead of resampling.

(d) A water system may apply to the State Board for a monitoring waiver for one or more of the organic chemicals on table 64444-A in accordance with the following:

(1) A source may be eligible for a waiver if it can be documented that the chemical has not been previously used, manufactured, transported, stored, or disposed of within the watershed or zone of influence and therefore, that the source can be designated nonvulnerable.

(2) If previous use of the chemical locally is unknown or the chemical is known to have been used previously and the source cannot be designated nonvulnerable pursuant to Paragraph (d)(1), it may still be eligible for a waiver based on a review related to susceptibility to contamination. The application to the State Board for a waiver based on susceptibility shall include the following:

(A) previous monitoring results;

(B) user population characteristics;

(C) proximity to sources of contamination;

(D) surrounding land uses;

(E) degree of protection of the water source;

(F) environmental persistence and transport of the chemical in water, soil and air;

(G) elevated nitrate levels at the water supply source; and

(H) historical system operation and maintenance data including previous State Board inspection results.

(3) To apply for a monitoring waiver for VOCs, the water system shall have completed the initial four quarters of monitoring pursuant to subsection (a) or three consecutive years of monitoring with no VOCs detected. If granted a waiver for VOC monitoring, a system using groundwater shall collect a minimum of one sample from every sampling site every six years and a system using surface water shall not be required to monitor for the term of the waiver. The term of a VOC waiver shall not exceed three years.

(4) To obtain a monitoring waiver for one or more of the SOCs, the water system may apply before doing the initial round of monitoring or shall have completed three consecutive years of annual monitoring with no detection of the SOC(s) listed. If the system is granted a waiver for monitoring for one or more SOC(s), no monitoring for the waived SOC(s) shall be required for the term of the waiver, which shall not exceed three years.

(e) For water sources designated by a water supplier as standby sources, the water supplier shall sample each source for any organic chemical added to table 64444-A once within the three-year period beginning in January of the calendar year after the effective date of the MCL.

(f) Water quality data collected prior to January 1, 1988, for VOCs, or January 1, 1990, for SOCs, and/or data collected in a manner inconsistent with this section shall not be used in the determination of compliance with the monitoring requirements for organic chemicals.

(g) MTBE data (i.e., a single sample) collected in a manner consistent with this section after January 1, 1998 in which no MTBE is detected, along with a designation of nonvulnerability pursuant to subsection (d), may be used to satisfy the initial monitoring requirements in subsection (a). If the requirements are satisfied in this way by a water system, the system shall begin annual monitoring pursuant to section 64445.1(b)(1).

(h) Water quality data collected in compliance with the monitoring requirements of this section by a wholesaler agency providing water to a public water system shall be acceptable for use by that system for compliance with the monitoring requirements of this section.

(i) Results obtained from groundwater monitoring performed for an organic chemical in accordance with this section and not more than two calendar years prior to the effective date of a regulation establishing the MCL for that organic chemical may be substituted to partially satisfy the initial monitoring requirements required by this section for that organic chemical. Requests to substitute groundwater monitoring results shall be made in accordance with the following:

1. Requests shall be made in writing by the water system to the State Board; and

2. If the State Board approves the request then results from a given calendar quarter will only be eligible to substitute for a single required initial monitoring result during that same quarter of initial monitoring. (e.g. the second quarter of 2016 may be substituted for the second quarter of 2018).

3. No more than three of the four quarterly samples as required by section 64445(a) or (b) may be substituted.

§64445.1. Repeat Monitoring and Compliance – Organic Chemicals.

(a) For the purposes of this article, detection shall be defined by the detection limits for purposes of reporting (DLRs) in table 64445.1-A:

Table 64445.1-A
Detection Limits for Purposes of Reporting (DLRs)
for Regulated Organic Chemicals

Chemical	*Detection Limit for Purposes of Reporting (DLR)(mg/L)*
(a) All VOCs, except as listed.	0.0005
Methyl-*tert*-butyl ether	0.003
Trichlorofluoromethane	0.005

Chemical	*Detection Limit for Purposes of Reporting (DLR)(mg/L)*
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.01
(b) SOCs	
Alachlor	0.001
Atrazine	0.0005
Bentazon	0.002
Benzo(a)pyrene	0.0001
Carbofuran	0.005
Chlordane	0.0001
2,4-D	0.01
Dalapon	0.01
Dibromochloropropane (DBCP)	0.00001
Di(2-ethylhexyl)adipate	0.005
Di(2-ethylhexyl)phthalate	0.003
Dinoseb	0.002
Diquat	0.004
Endothall	0.045
Endrin	0.0001
Ethylene dibromide (EDB)	0.00002
Glyphosate	0.025
Heptachlor	0.00001
Heptachlor epoxide	0.00001
Hexachlorobenzene	0.0005
Hexachlorocyclopentadiene	0.001
Lindane	0.0002
Methoxychlor	0.01
Molinate	0.002
Oxamyl	0.02
Pentachlorophenol	0.0002
Picloram	0.001
Polychlorinated biphenyls (PCBs) (as decachlorobiphenyl)	0.0005
Simazine	0.001
Thiobencarb	0.001
Toxaphene	0.001
1,2,3-Trichloropropane	0.000005
2,3,7,8-TCDD (Dioxin)	5×10^{-9}
2,4,5-TP (Silvex)	0.001

(b) When organic chemicals are not detected pursuant to table 64445.1-A.

(1) A water system which has not detected any of the VOCs on table 64444-A during the initial four quarters of monitoring, shall collect and analyze one sample annually. After a minimum of three years of annual sampling with no detection of a VOC in table 64444-A, a system using groundwater may reduce the monitoring frequency to one sample during each compliance period. A system using surface water shall continue monitoring annually.

(2) A system serving more than 3,300 persons which has not detected an SOC on table 64444-A during the initial four quarters of monitoring shall collect a minimum of two quarterly samples for that SOC in one year during the year designated by the State Board of each subsequent compliance period. The year will be designated on the basis of historical monitoring frequency and laboratory capacity.

(3) A system serving 3,300 persons or less which has not detected an SOC on table 64444-A during the initial four quarters of monitoring shall collect a minimum of one sample for that SOC during the year designated by the State Board of each subsequent compliance period. The year will be designated on the basis of historical monitoring frequency and laboratory capacity.

(c) When organic chemicals are detected pursuant to table 64445.1-A.

(1) Prior to proceeding with the requirements of paragraphs (2) through (7), the water supplier may first confirm the analytical result, as follows: Within seven days from the notification of an initial finding from a laboratory reporting the presence of one or more organic chemicals in a water sample, the water supplier shall collect one or two additional sample(s) to confirm the initial finding. Confirmation of the initial finding shall be shown by the presence of the organic chemical in either the first or second additional sample, and the detected level of the contaminant for compliance purposes shall be the average of the initial and confirmation sample(s). The initial finding shall be disregarded if two additional samples do not show the presence of the organic chemical.

(2) If one or both of the related organic chemicals heptachlor and heptachlor epoxide are detected, subsequent monitoring shall analyze for both chemicals until there has been no detection of either chemical for one compliance period.

(3) A groundwater sampling site at which one or more of the following chemicals has been detected shall be monitored quarterly for vinyl chloride: trichloroethylene, tetrachloroethylene, 1,2-dichloroethane, 1,1,1-trichloroethane, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, or 1,1-dichloroethylene. If vinyl chloride is not detected in the first quarterly sample, the sampling site shall be monitored once for vinyl chloride during each compliance period.

(4) If the detected level of organic chemicals for any sampling site does not exceed any shown in table 64444-A, the water source shall be resampled every three months and the samples analyzed for the detected chemicals. After one year of sampling an approved surface water system or two quarters of sampling a groundwater system, the State Board will consider allowing the water supplier to reduce the sampling to once per

year upon request, based on a review of previous sampling data. Systems shall monitor during the quarter(s) which previously yielded the highest analytical results.

(5) If the detected level of an organic chemical for any sampling site exceeds that listed in table 64444-A, the water supplier shall report this information to the State Board within 48 hours of receipt of the result. Unless use of the contaminated source is discontinued, the water supplier shall resample the contaminated source and compliance shall be determined as follows:

(A) Water systems serving more than 3,300 persons shall sample monthly for six months and shall submit the results to the State Board as specified in section 64469. If the average concentration of the initial finding, confirmation sample(s), and six subsequent monthly samples does not exceed the MCL shown in table 64444-A the water supplier may reduce the sampling frequency to once every three months. If the running annual average or the average concentration of the initial finding, confirmation sample(s), and six subsequent monthly samples exceeds the MCL shown in table 64444-A, the water system shall be deemed to be in violation of section 64444.

(B) Water systems serving 3,300 persons or less shall sample quarterly for a minimum of one year and shall submit the results to the State Board as specified in section 64469. If the running annual average concentration does not exceed the MCL in table 64444-A, the water supplier may reduce the sampling frequency to once every year during the quarter that previously yielded the highest analytical result. Quarterly monitoring shall resume if any reduced frequency sample result exceeds the MCL. If the running annual average concentration exceeds the MCL in table 64444-A, the water system shall be deemed to be in violation of section 64444.

(C) If any sample would cause the running annual average to exceed the MCL, the water system is immediately in violation. If a system takes more than one sample in a quarter, the average of all the results for that quarter shall be used when calculating the running annual average. If a system fails to complete four consecutive quarters of monitoring, the running annual average shall be based on an average of the available data.

(6) If any resample, other than those taken in accordance with paragraph (5), of a water sampling site shows that the concentration of any organic chemical exceeds a MCL shown in table 64444-A, the water supplier shall proceed in accordance with paragraphs (1) and (4), or paragraph (5).

(7) If an organic chemical is detected and the concentration exceeds ten times the MCL, the water supplier shall notify the State Board within 48 hours of the receipt of the results and the contaminated site shall be resampled within 48 hours to confirm the result. The water supplier shall notify the State Board of the result of the confirmation sample(s) within 24 hours of the receipt of the confirmation result(s).

(A) If the average concentration of the original and confirmation sample(s) is less than or equal to ten times the MCL, the water supplier shall proceed in accordance with paragraph (5).

(B) If the average concentration of the original and confirmation samples exceeds ten times the MCL, use of the contaminated water source shall immediately be discontinued, if directed by the State Board. Such a water source shall not be returned to service without written approval from the State Board.

§64445.2. Sampling of Treated Water Sources.

(a) Each water supplier utilizing treatment to comply with any MCL for an organic chemical listed in table 64444-A shall collect monthly samples of the treated water at a site prior to the distribution system. If the treated water exceeds the MCL, the water supplier shall resample the treated water to confirm the result and report the result to the State Board within 48 hours of the confirmation.

(b) The State Board will consider requiring more frequent monitoring based on an evaluation of (1) the treatment process used, (2) the treatment effectiveness and efficiency, and (3) the concentration of the organic chemical in the water source.

Article 12. Best available technologies (BAT)

§64447. Best Available Technologies (BAT) – Microbiological Contaminants.

The technologies identified by the State Board as the best available technology, treatment techniques, or other means available for achieving compliance with the total coliform MCL are as follows:

(a) Protection of wells from coliform contamination by appropriate placement and construction;

(b) Maintenance of a disinfectant residual throughout the distribution system;

(c) Proper maintenance of the distribution system; and

(d) Filtration and/or disinfection of approved surface water, in compliance with Section 64650, or disinfection of groundwater.

§64447.2. Best Available Technologies (BAT) - Inorganic chemicals.

The technologies listed in table 64447.2-A are the best available technology, treatment techniques, or other means available for achieving compliance with the MCLs in table 64431-A for inorganic chemicals.

Table 64447.2-A
Best Available Technologies (BAT)
Inorganic Chemicals

Chemical	*Best Available Technologies (BATs)*
Aluminum	10
Antimony	2, 7
Arsenic	1, 2, 5, 6, 7, 9, 13
Asbestos	2, 3, 8
Barium	5, 6, 7, 9
Beryllium	1, 2, 5, 6, 7
Cadmium	2, 5, 6, 7
Chromium	2, 5, 6[a], 7
Cyanide	5, 7, 11
Fluoride	1
Mercury	2[b], 4, 6[b], 7[b]
Nickel	5, 6, 7
Nitrate	5, 7, 9
Nitrite	5, 7
Perchlorate	5,12
Selenium	1, 2[c], 6, 7, 9
Thallium	1, 5

[a]BAT for chromium III (trivalent chromium) only.
[b]BAT only if influent mercury concentrations <10 μg/L.
[c]BAT for selenium IV only.

Key to BATs in table 64447.2:
1 = Activated Alumina
2 = Coagulation/Filtration (not BAT for systems < 500 service connections)
3 = Direct and Diatomite Filtration
4 = Granular Activated Carbon
5 = Ion Exchange
6 = Lime Softening (not BAT for systems < 500 service connections)
7 = Reverse Osmosis
8 = Corrosion Control
9 = Electrodialysis
10 = Optimizing treatment and reducing aluminum added
11 = Chlorine oxidation
12 = Biological fluidized bed reactor
13 = Oxidation/Filtration

§64447.3. Best Available Technologies (BAT) - Radionuclides.

The technologies listed in tables 64447.3-A, B and C are the best available technology, treatment technologies, or other means available for achieving compliance with the MCLs for radionuclides in tables 64442 and 64443.

Table 64447.3-A
Best Available Technologies (BATs)
Radionuclides

Radionuclide	*Best Available Technology*
Combined radium-226 and radium-228	Ion exchange, reverse osmosis, lime softening
Uranium	Ion exchange, reverse osmosis, lime softening, coagulation/filtration
Gross alpha particle activity	Reverse osmosis
Beta particle and photon radioactivity	Ion exchange, reverse osmosis

Table 64447.3-B
Best Available Technologies (BATs) and Limitations for Small Water Systems
Radionuclides

Unit Technologies	*Limitations (see footnotes)*	*Operator Skill Level Required*	*Raw Water Quality Range and Considerations*
1. Ion exchange	(a)	Intermediate	All ground waters; competing anion concentrations may affect regeneration frequency
2. Point of use, ion exchange	(b)	Basic	All ground waters; competing anion concentrations may affect regeneration frequency
3. Reverse osmosis	(c)	Advanced	Surface waters usually require pre-filtration
4. Point of use, reverse osmosis	(b)	Basic	Surface waters usually require pre-filtration
5. Lime softening	(d)	Advanced	All waters

6. Green sand filtration	(e)	Basic	All ground waters; competing anion concentrations may affect regeneration frequency
7. Co-precipitation with barium sulfate	(f)	Intermediate to advanced	Ground waters with suitable quality
8. Electrodialysis/electrodialysis reversal	(g)	Basic to intermediate	All ground waters
9. Pre-formed hydrous manganese oxide filtration	(h)	Intermediate	All ground waters
10. Activated alumina	(a), (i)	Advanced	All ground waters; competing anion concentrations may affect regeneration frequency
11. Enhanced coagulation/filtration	(j)	Advanced	Can treat a wide range of water qualities

Limitation Footnotes:

[a] The regeneration solution contains high concentrations of the contaminant ions, which could result in disposal issues.
[b] When point of use devices are used for compliance, programs for long-term operation, maintenance, and monitoring shall be provided by systems to ensure proper performance.
[c] Reject water disposal may be an issue.
[d] The combination of variable source water quality and the complexity of the water chemistry involved may make this technology too complex for small systems.
[e] Removal efficiencies can vary depending on water quality.
[f] Since the process requires static mixing, detention basins, and filtration, this technology is most applicable to systems with sufficiently high sulfate levels that already have a suitable filtration treatment train in place.
[g] Applies to ionized radionuclides only.
[h] This technology is most applicable to small systems with filtration already in place.
[i] Chemical handling during regeneration and pH adjustment may be too difficult for small systems without an operator trained in these procedures.
[j] This would involve modification to a coagulation/filtration process already in place.

Table 64447.3-C
Best Available Technologies (BATs) for Small Water Systems by System Size
Radionuclides

	Compliance Technologies for System Size Categories Based On Population Served		
	25-500	*501-3,300*	*3,301 - 10,000*
Contaminant	*Unit Technologies (Numbers Correspond to Table 64447.3-B)*		
Combined radium-226 and radium-228	1, 2 ,3, 4, 5, 6, 7, 8, 9	1, 2 ,3, 4, 5, 6, 7, 8, 9	1, 2 ,3, 4, 5, 6, 7, 8, 9
Gross alpha particle activity	3, 4	3, 4	3, 4
Beta particle activity and photon radioactivity	1, 2, 3, 4	1, 2, 3, 4	1, 2, 3, 4
Uranium	1, 2, 4, 10, 11	1, 2, 3, 4, 5, 10, 11	1, 2, 3, 4, 5, 10, 11

§64447.4. Best Available Technologies (BATs) - Organic Chemicals.
The technologies listed in table 64447.4-A are the best available technology, treatment technologies, or other means available for achieving compliance with the MCLs in table 64444-A for organic chemicals.

Table 64447.4-A
Best Available Technologies (BATs)
Organic Chemicals

Chemical	*Best Available Technologies*		
	Granular Activated Carbon	Packed Tower Aeration	Oxidation
(a) Volatile Organic Chemicals (VOCs)			
Benzene	X	X	
Carbon Tetrachloride	X	X	
1,2-Dichlorobenzene	X	X	
1,4-Dichlorobenzene	X	X	
1,1-Dichloroethane	X	X	
1,2-Dichloroethane	X	X	

Chemical	*Best Available Technologies*		
	Granular Activated Carbon	Packed Tower Aeration	Oxidation
1,1-Dichloroethylene	X	X	
cis-1,2-Dichloroethylene	X	X	
trans-1,2-Dichloroethylene	X	X	
Dichloromethane		X	
1,2-Dichloropropane	X	X	
1,3-Dichloropropene	X	X	
Ethylbenzene	X	X	
Methyl-*tert*-butyl ether		X	
Monochlorobenzene	X	X	
Styrene	X	X	
1,1,2,2-Tetrachloroethane	X	X	
Tetrachloroethylene	X	X	
Toluene	X	X	
1,2,4-Trichlorobenzene	X	X	
1,1,1-Trichloroethane	X	X	
1,1,2-Trichloroethane	X	X	
Trichlorofluoromethane	X	X	
Trichlorotrifluoroethane	X	X	
Trichloroethylene	X	X	
Vinyl Chloride		X	
Xylenes	X	X	
(b) Synthetic Organic Chemicals (SOCs)			
Alachlor	X	X	
Atrazine	X		
Bentazon		X	
Benzo(a)pyrene	X		
Carbofuran	X		
Chlordane	X		
2,4-D	X		
Dalapon	X		
Di(2-ethylhexyl)adipate	X	X	
Dinoseb	X		
Diquat	X		
1,2-Dibromo-3-chloropropane	X	X	
Di(2-ethylhexyl)phthalate	X		
Endothall	X		
Endrin	X		
Ethylene Dibromide	X	X	

Chemical	*Best Available Technologies*		
	Granular Activated Carbon	Packed Tower Aeration	Oxidation
Glyphosate			X
Heptachlor	X		
Heptachlor epoxide	X		
Hexachlorobenzene	X		
Hexachlorocyclopentadiene	X	X	
Lindane	X		
Methoxychlor	X		
Molinate	X		
Oxamyl	X		
Picloram	X		
Pentachlorophenol	X		
Polychlorinated Biphenyls	X		
Simazine	X		
Thiobencarb	X		
Toxaphene	X	X	
1,2,3-Trichloropropane	X		
2,3,7,8-TCDD (Dioxin)	X		
2,4,5-TP (Silvex)	X		

Article 14. Treatment Techniques

§64448. Treatment Technique Requirements.

(a) A public water system which uses acrylamide and/or epichlorohydrin in drinking water treatment shall certify annually in writing to the State Board that the combination of dose and monomer does not exceed the following levels:

(1) Acrylamide: 0.05% monomer in polyacrylamide dosed at 1 mg/L, or equivalent.

(2) Epichlorohydrin: 0.01% residual of epichlorohydrin dosed at 20 mg/L, or equivalent.

Article 16. Secondary Drinking Water Standards

§64449. Secondary Maximum Contaminant Levels and Compliance.

(a) The secondary MCLs shown in Tables 64449-A and 64449-B shall not be exceeded in the water supplied to the public by community water systems.

Table 64449-A
Secondary Maximum Contaminant Levels
"Consumer Acceptance Contaminant Levels"

Constituents	*Maximum Contaminant Levels/Units*
Aluminum	0.2 mg/L
Color	15 Units
Copper	1.0 mg/L
Foaming Agents (MBAS)	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Methyl-*tert*-butyl ether (MTBE)	0.005 mg/L
Odor—Threshold	3 Units
Silver	0.1 mg/L
Thiobencarb	0.001 mg/L
Turbidity	5 Units
Zinc	5.0 mg/L

Table 64449-B
Secondary Maximum Contaminant Levels
"Consumer Acceptance Contaminant Level Ranges"

	Maximum Contaminant Level Ranges		
Constituent, Units	*Recommended*	*Upper*	*Short Term*
Total Dissolved Solids, mg/L or	500	1,000	1,500
Specific Conductance, μS/cm	900	1,600	2,200
Chloride, mg/L	250	500	600
Sulfate, mg/L	250	500	600

(b) Each community water system shall monitor its groundwater sources or distribution system entry points representative of the effluent of source treatment every three years and its approved surface water sources or distribution system entry points representative of the effluent of source treatment annually for the following:

(1) Secondary MCLs listed in Tables 64449-A and 64449-B; and

(2) Bicarbonate, carbonate, and hydroxide alkalinity, calcium, magnesium, sodium, pH, and total hardness.

(c) If the level of any constituent in Table 64449-A exceeds an MCL, the community water system shall proceed as follows:

(1) If monitoring quarterly, determine compliance by a running annual average of four quarterly samples;

(2) If monitoring less than quarterly, initiate quarterly monitoring and determine compliance on the basis of an average of the initial sample and the next three consecutive quarterly samples collected;

(3) If a violation has occurred (average of four consecutive quarterly samples exceeds an MCL), inform the State Board when reporting pursuant to Section 64469;

(4) After one year of quarterly monitoring during which all the results are below the MCL and the results do not indicate any trend toward exceeding the MCL, the system may request the State Board to allow a reduced monitoring frequency.

(d) For the constituents shown on Table 64449-B, no fixed consumer acceptance contaminant level has been established.

(1) Constituent concentrations lower than the Recommended contaminant level are desirable for a higher degree of consumer acceptance.

(2) Constituent concentrations ranging to the Upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.

(3) Constituent concentrations ranging to the short term contaminant levelare acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.

(e) New services from community water systems serving water which carries constituent concentrations between the Upper and Short Term contaminant levels shall be approved only:

(1) If adequate progress is being demonstrated toward providing water of improved mineral quality.

(2) For other compelling reasons approved by the State Board.

(f) A community water system may apply to the State Board for a waiver from the monitoring frequencies specified in subsection (b), if the system has conducted at least three rounds of monitoring (three periods for groundwater sources or three years for approved surface water sources) and these analytical results are less than the MCLs. The water system shall specify the basis for its request. A system with a waiver shall collect a minimum of one sample per source while the waiver is in effect and the term of the waiver shall not exceed one compliance cycle (i.e., nine years).

(g) Nontransient-noncommunity and transient-noncommunity water systems shall monitor their sources or distribution system entry points representative of the effluent of source treatment for bicarbonate, carbonate, and hydroxide alkalinity, calcium, iron, magnesium, manganese, pH, specific conductance, sodium, and total hardness at least once. In addition, nontransient-noncommunity water systems shall monitor for the constituents in Tables 64449-A and B at least once.

§64449.2. Waivers for Secondary MCL Compliance.

(a) If the average of four consecutive quarters of sample results for a constituent that does not have a primary MCL is not greater than three times the secondary MCL or greater than the State Notification Level, an existing community water system is eligible to apply for a nine-year waiver of a secondary MCL in Table 64449-A, for the following:

(1) An existing source; or

(2) A new source that is being added to the existing water system, as long as:

(A) The source is not being added to expand system capacity for further development; and

(B) The concentration of the constituent of concern in the new source would not cause the average value of the constituent's concentration at any point in the water delivered by the system to increase by more than 20%.

(b) To apply for a waiver of a secondary MCL, the community water system shall conduct and submit a study to the State Board within one year of violating the MCL that includes the following:

(1) The water system complaint log, maintained pursuant to section 64470(a), along with any other evidence of customer dissatisfaction, such as a log of calls to the county health department;

(2) An engineering report, prepared by an engineer registered in California with experience in drinking water treatment, that evaluates all reasonable alternatives and costs for bringing the water system into MCL compliance and includes a recommendation for the most cost-effective and feasible approach;

(3) The results of a customer survey distributed to all the water system's billed customers that has first been approved by the State Board based on whether it includes:

(A) Estimated costs to individual customers of the most cost-effective alternatives presented in the engineering report that are acceptable to the State Board based on its review of their effectiveness and feasibility;

(B) The query: "Are you willing to pay for *(identify constituent)* reduction treatment?";

(C) The query: "Do you prefer to avoid the cost of treatment and live with the current water quality situation?"

(D) The statement: "If you do not respond to this survey, (*insert system name*) will assume that you are in support of the reduction treatment recommended by the engineering report."

(4) A brief report (agenda, list of attendees, and transcript) of a public meeting held by the water system to which customers were invited, and at which both the tabulated results of the customer survey and the engineering report were presented with a request for input from the public.

(c) A community water system may apply for a waiver for iron and/or manganese if, in addition to meeting the requirements in Subsection (b), an average of four consecutive quarter results for the source has not exceeded a State Notification Level for iron and/or manganese. In addition, the system shall include sequestering, as follows:

(1) As one of the alternatives evaluated in the Engineering Report;

(2) In the customer survey as a query: "Are you willing to pay for iron and/or manganese sequestering treatment?"

(d) Unless 50% or more of the billed customers respond to the survey, the community water system shall conduct another survey pursuant to Subsections (b) or (c) within three months from the date of the survey by sending the survey out to either all the customers again, or only the customers that did not respond to the survey. The water system shall not be eligible for a waiver until it achieves at least a 50% response rate on the survey.

(e) If the customer survey indicates that the percentage of billed customers that voted for constituent reduction treatment and the number of billed customers that did not respond to the survey at all exceeds 50% of the total number of billed customers, the community water system shall install treatment, except as provided in Subsection (f), within three years from the date the system completed the customer survey, pursuant to a schedule established by the State Board.

(f) For iron and/or manganese MCL waiver applications, if the percentage of survey respondents that voted for constituent reduction treatment plus the percentage of survey respondents that voted for sequestering exceeds the percentage that voted to avoid the cost and maintain the current water quality situation, the community water system shall implement either constituent reduction treatment or sequestering, on the basis of which was associated with the higher percentage result. If the highest percentage result is for sequestering, the system shall submit a sequestering implementation and assessment plan to the State Board that includes:

(1) A description of the pilot testing or other type of evaluation performed to determine the most effective sequestering agent for use in the system's water;

(2) The sequestering agent feed rate and the equipment to be used to insure that the rate is maintained for each source;

(3) An operations plan; and

(4) The projected cost of sequestering including capital, operations and maintenance costs.

(g) To apply for renewal of a waiver for a subsequent nine years, the system shall request approval from the State Board at least six months prior to the end of the current waiver period. The renewal request shall include all monitoring and treatment operations data for the constituent for which the waiver had been granted and any related customer complaints submitted to the water system. Based on its review of the data and customer complaints, the State Board may require the water system to conduct another customer survey pursuant to this section before making a determination on the waiver renewal.

§64449.4. Use of Sources that Exceed a Secondary MCL and Do Not Have a Waiver.
A source that exceeds one or more of the secondary MCLs in Table 64449-A and does not have a waiver may be used only if the source meets the requirements in Section 64414, and the community water system:

(a) Meters the source's monthly production and submits the results to the State Board by the 10th day of the next month;

(b) Counts any part of a day as a full day for purposes of determining compliance with Section 64414(c);

(c) As a minimum, conducts public notification by including information on the source's use (dates, constituent levels, and reasons) in the Consumer Confidence Report (Sections 64480 through 64483);

(d) Provides public notice prior to use of the source by electronic media, publication in a local newspaper, and/or information in the customer billing, if the situation is such that the water system can anticipate the use of the source (e.g., to perform water system maintenance); and

(e) Takes corrective measures such as flushing after the source is used to minimize any residual levels of the constituent in the water distribution system.

§64449.5. Distribution System Physical Water Quality.

(a) The water supplier shall determine the physical water quality in the distribution system. This determination shall be based on one or more of the following:

(1) Main flushing operations and flushing records.

(2) Consumer complaint records showing location, nature and duration of the physical water quality problem.

(3) Other pertinent data relative to physical water quality in the distribution system.

(b) If the State Board determines that a water system does not have sufficient data on physical water quality in the distribution system to make the determination required in paragraph (a), the water supplier shall collect samples for the following general physical analyses: color, odor, and turbidity. Samples shall be collected from representative points in the distribution system:

(1) For community water systems with 200 to 1,000 service connections: one sample per month.

(2) For community water systems with greater than 1,000 service connections: one sample for every four bacteriological samples required per month.

(3) For community water systems with less than 200 service connections: as established by the local health officer or the State Board.

(c) Odor samples required as a part of general physical analyses may be examined in the field as per Section 64415(b).

(d) The distribution system water of public water systems shall be free from significant amounts of particulate matter.

Article 18. Notification of Water Consumers and the State Board

§64463. General Public Notification Requirements.

(a) Each public (community, nontransient-noncommunity and transient-noncommunity) water system shall give public notice to persons served by the water system pursuant to this article.

(b) Each water system required to give public notice shall submit the notice to the State Board, in English, for approval prior to distribution or posting, unless otherwise directed by the State Board.

(c) Each wholesaler shall give public notice to the owner or operator of each of its retailer systems. A retailer is responsible for providing public notice to the persons it serves. If the retailer arranges for the wholesaler to provide the notification, the retailer shall notify the State Board prior to the notice being given.

(d) Each water system that has a violation of any of the regulatory requirements specified in section 64463.1(a), 64463.4(a), or 64463.7(a) in a portion of the distribution system that is physically or hydraulically isolated from other parts of the distribution system may limit distribution of the notice to only persons served by that portion of the system that is out of compliance, if the State Board has granted written approval on the basis of a review of the water system and the data leading to the violation or occurrence for which notice is being given.

(e) Each water system shall give new customers public notice of any acute violation as specified in section 64463.1(a) that occurred within the previous thirty days, any continuing violation, the existence of a variance or exemption, and/or any other ongoing occurrence that the State Board has determined poses a potential risk of adverse effects on human health [based on a review of estimated exposures and toxicological data associated with the contaminant(s)] and requires a public notice. Notice to new customers shall be given as follows:

(1) Community water systems shall give a copy of the most recent public notice prior to or at the time service begins; and

(2) Noncommunity water systems shall post the most recent public notice in conspicuous locations for as long as the violation, variance, exemption, or other occurrence continues.

§64463.1. Tier 1 Public Notice.

(a) A water system shall give public notice pursuant to this section and section 64465 if any of the following occurs:

(1) Violation of the total coliform MCL when:

(A) Fecal coliform or *E. coli* are present in the distribution system; or

(B) When any repeat sample tests positive for coliform and the water system fails to test for fecal coliforms or *E. coli* in the repeat sample;

(2) Violation of the MCL for nitrate, nitrite, or total nitrate and nitrite, or when the water system fails to take a confirmation sample within 24 hours of the system's receipt of the first sample showing an exceedance of the nitrate or nitrite MCL;

(3) Violation of a Chapter 17 treatment technique requirement resulting from a single exceedance of a maximum allowable turbidity level if:

(A) The State Board determines after consultation with the water system and a review of the data that a Tier 1 public notice is required; or

(B) The consultation between the State Board and the water system does not take place within 24 hours after the water system learns of the violation;

(4) Occurrence of a waterborne microbial disease outbreak, as defined in section 64651.91, or other waterborne emergency, a failure or significant interruption in water treatment processes, a natural disaster that disrupts the water supply or distribution system, or a chemical spill or unexpected loading of possible pathogens into the source water that has the potential for adverse effects on human health as a result of short-term exposure;

(5) Other violation or occurrence that has the potential for adverse effects on human health as a result of short-term exposure, as determined by the State Board based on a review of all available toxicological and analytical data;

(6) Violation of the MCL for perchlorate or when a system is unable to resample within 48 hours of the system's receipt of the first sample showing an exceedance of the perchlorate MCL as specified in section 64432.3(d)(3);

(7) For chlorite:

(A) Violation of the MCL for chlorite;

(B) When a system fails to take the required sample(s) within the distribution system, on the day following an exceedance of the MCL at the entrance to the distribution system; or

(C) When a system fails to take a confirmation sample pursuant to section 64534.2(b)(4); or

(8) Violation of the MRDL for chlorine dioxide; or when a system fails to take the required sample(s) within the distribution system, on the day following an exceedance of the MRDL at the entrance to the distribution system.

(b) As soon as possible within 24 hours after learning of any of the violations in subsection (a) or being notified by the State Board that it has determined there is a potential for adverse effects on human health [pursuant to paragraph (a)(4), (5), or (6)], the water system shall:

(1) Give public notice pursuant to this section;

(2) Initiate consultation with the State Board within the same timeframe; and

(3) Comply with any additional public notice requirements that are determined by the consultation to be necessary to protect public health.

(c) A water system shall deliver the public notice in a manner designed to reach residential, transient, and nontransient users of the water system and shall use, as a minimum, one of the following forms:

(1) Radio or television;

(2) Posting in conspicuous locations throughout the area served by the water system;

(3) Hand delivery to persons served by the water system; or

(4) Other method approved by the State Board, based on the method's ability to inform water system users.

§64463.4. Tier 2 Public Notice.

(a) A water system shall give public notice pursuant to this section if any of the following occurs:

(1) Any violation of the MCL, MRDL, and treatment technique requirements, except:

(A) Where a Tier 1 public notice is required under section 64463.1; or

(B) Where the State Board determines that a Tier 1 public notice is required, based on potential health impacts and persistence of the violations;

(2) All violations of the monitoring and testing procedure requirements in sections 64421 through 64426.1, article 3 (Primary Standards – Bacteriological Quality), for which the State Board determines that a Tier 2 rather than a Tier 3 public notice is required, based on potential health impacts and persistence of the violations;

(3) Other violations of the monitoring and testing procedure requirements in this chapter, and chapters 15.5, 17 and 17.5, for which the State Board determines that a Tier 2 rather than a Tier 3 public notice is required, based on potential health impacts and persistence of the violations; or

(4) Failure to comply with the terms and conditions of any variance or exemption in place.

(b) A water system shall give the notice as soon as possible within 30 days after it learns of a violation or occurrence specified in subsection (a), except that the water system may request an extension of up to 60 days for providing the notice. This extension would be subject to the State Board's written approval based on the violation or occurrence having been resolved and the State Board's determination that public health and welfare would in no way be adversely affected. In addition, the water system shall:

(1) Maintain posted notices in place for as long as the violation or occurrence continues, but in no case less than seven days;

(2) Repeat the notice every three months as long as the violation or occurrence continues. Subject to the State Board's written approval based on its determination that public health would in no way be adversely affected, the water system may be allowed to notice less frequently but in no case less than once per year. No allowance for reduced frequency of notice shall be given in the case of a total coliform MCL violation or violation of a Chapter 17 treatment technique requirement; and

(3) For turbidity violations pursuant to sections 64652.5(c)(2) and 64653(c), (d) and (f), as applicable, a water system shall consult with the State Board as soon as possible within 24 hours after the water system learns of the violation to determine whether a Tier 1 public notice is required. If consultation does not take place within 24 hours, the water system shall give Tier 1 public notice within 48 hours after learning of the violation.

(c) A water system shall deliver the notice, in a manner designed to reach persons served, within the required time period as follows:

(1) Unless otherwise directed by the State Board in writing based on its assessment of the violation or occurrence and the potential for adverse effects on public health and welfare, community water systems shall give public notice by;

(A) Mail or direct delivery to each customer receiving a bill including those that provide their drinking water to others (e.g., schools or school systems, apartment building owners, or large private employers), and other service connections to which water is delivered by the water system; and

(B) Use of one or more of the following methods to reach persons not likely to be reached by a mailing or direct delivery (renters, university students, nursing home patients, prison inmates, etc.):

1. Publication in a local newspaper;

2. Posting in conspicuous public places served by the water system, or on the Internet; or

3. Delivery to community organizations.

(2) Unless otherwise directed by the State Board in writing based on its assessment of the violation or occurrence and the potential for adverse effects on public health and welfare, noncommunity water systems shall give the public notice by:

(A) Posting in conspicuous locations throughout the area served by the water system; and

(B) Using one or more of the following methods to reach persons not likely to be reached by a public posting:

1. Publication in a local newspaper or newsletter distributed to customers;

2. E-mail message to employees or students;

3. Posting on the Internet or intranet; or

4. Direct delivery to each customer.

§64463.7. Tier 3 Public Notice.

(a) Each water system shall give public notice pursuant to this section if any of the following occurs:

(1) Monitoring violations;

(2) Failure to comply with a testing procedure, except where a Tier 1 public notice is required pursuant to section 64463.1 or the State Board determines that a Tier 2 public notice is required pursuant to section 64463.4; or

(3) Operation under a variance or exemption.

(b) Each water system shall give the public notice within one year after it learns of the violation or begins operating under a variance or exemption.

(1) The water system shall repeat the public notice annually for as long as the violation, variance, exemption, or other occurrence continues.

(2) Posted public notices shall remain in place for as long as the violation, variance, exemption, or other occurrence continues, but in no case less than seven days.

(3) Instead of individual Tier 3 public notices, a water system may use an annual report detailing all violations and occurrences for the previous twelve months, as long as the water system meets the frequency requirements specified in this subsection.

(c) Each water system shall deliver the notice in a manner designed to reach persons served within the required time period, as follows:

(1) Unless otherwise directed by the State Board in writing based on its assessment of the violation or occurrence and the potential for adverse effects on public health and welfare, community water systems shall give public notice by

(A) Mail or direct delivery to each customer receiving a bill including those that provide their drinking water to others (e.g., schools or school systems, apartment building owners, or large private employers), and other service connections to which water is delivered by the water system; and

(B) Use of one or more of the following methods to reach persons not likely to be reached by a mailing or direct delivery (renters, university students, nursing home patients, prison inmates, etc.):

1. Publication in a local newspaper;

2. Posting in conspicuous public places served by the water system, or on the Internet; or

3. Delivery to community organizations.

(2) Unless otherwise directed by the State Board in writing based on its assessment of the violation or occurrence and the potential for adverse effects on public health and welfare, noncommunity water systems shall give the public notice by:

(A) Posting in conspicuous locations throughout the area served by the water system; and

(B) Using one or more of the following methods to reach persons not likely to be reached by a posting:

1. Publication in a local newspaper or newsletter distributed to customers;
2. E-mail message to employees or students;
3. Posting on the Internet or intranet; or
4. Direct delivery to each customer.

(d) Community and nontransient-noncommunity water systems may use the Consumer Confidence Report pursuant to sections 64480 through 64483, to meet the initial and repeat Tier 3 public notice requirements in subsection 64463.7(b), as long as the Report meets the following:

(1) Is given no later than one year after the water system learns of the violation or occurrence;

(2) Includes the content specified in section 64465; and

(3) Is distributed pursuant to paragraph (b)(1) and (2) or subsection (c).

§64465. Public Notice Content and Format.

(a) Each public notice given pursuant to this article, except Tier 3 public notices for variances and exemptions pursuant to subsection (b), shall contain the following:

(1) A description of the violation or occurrence, including the contaminant(s) of concern, and (as applicable) the contaminant level(s);

(2) The date(s) of the violation or occurrence;

(3) Any potential adverse health effects from the violation or occurrence, including the appropriate standard health effects language from appendices 64465-A through G;

(4) The population at risk, including subpopulations particularly vulnerable if exposed to the contaminant in drinking water;

(5) Whether alternative water supplies should be used;

(6) What actions consumers should take, including when they should seek medical help, if known;

(7) What the water system is doing to correct the violation or occurrence;

(8) When the water system expects to return to compliance or resolve the occurrence;

(9) The name, business address, and phone number of the water system owner, operator, or designee of the water system as a source of additional information concerning the public notice;

(10) A statement to encourage the public notice recipient to distribute the public notice to other persons served, using the following standard language: "Please share this information with all the other people who drink this water, especially those who may not have received this public notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this public notice in a public place or distributing copies by hand or mail."; and

(11) For a water system with a monitoring and testing procedure violation, this language shall be included: "We are required to monitor your drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not your drinking water meets health standards. During [*compliance period dates*], we *['did not monitor or test'* or *'did not complete all monitoring or testing']* for *[contaminant(s)]*, and therefore, cannot be sure of the quality of your drinking water during that time."

(b) A Tier 3 public notice for a water system operating under a variance or exemption shall include the elements in this subsection. If a water system has violated its variance or exemption conditions, the public notice shall also include the elements in subsection (a).

(1) An explanation of the reasons for the variance or exemption;

(2) The date on which the variance or exemption was issued;

(3) A brief status report on the steps the water system is taking to install treatment, find alternative sources of water, or otherwise comply with the terms and schedules of the variance or exemption; and

(4) A notice of any opportunity for public input in the review of the variance or exemption.

(c) A public water system providing notice pursuant to this article shall comply with the following multilingual-related requirements:

(1) For a Tier 1 public notice:

(A) The notice shall be provided in English, Spanish, and the language spoken by any non-English-speaking group exceeding 10 percent of the persons served by the public water system, and the notice shall include a telephone number or address where such individuals may contact the public water system for assistance; and

(B) If any non-English-speaking group exceeds 1,000 persons served by the public water system, but does not exceed 10 percent served, the notice shall include information in the appropriate language(s) regarding the importance of the notice, and the telephone number or address where such individuals may contact the public water system to obtain a translated copy of the notice from the public water system or assistance in the appropriate language;

(2) For a Tier 2 or Tier 3 public notice:

(A) The notice shall contain information in Spanish regarding the importance of the notice, or contain a telephone number or address where Spanish-speaking residents may contact the public water system to obtain a translated copy of the notice or assistance in Spanish; and

(B) When a non-English speaking group other than Spanish-speaking exceeds 1,000 residents or 10 percent of the residents served by the public water system, the notice shall include:

1. Information in the appropriate language(s) regarding the importance of the notice; or

2. A telephone number or address where such residents may contact the public water system to obtain a translated copy of the notice or assistance in the appropriate language; and

(3) For a public water system subject to the Dymally-Alatorre Bilingual Services Act, Chapter 17.5, Division 7, of the Government Code (commencing with section 7290), meeting the requirements of this Article may not ensure compliance with the Dymally-Alatorre Bilingual Services Act.

(d) Each public notice given pursuant to this article shall:

(1) Be displayed such that it catches people's attention when printed or posted and be formatted in such a way that the message in the public notice can be understood at the eighth-grade level;

(2) Not contain technical language beyond an eighth-grade level or print smaller than 12 point; and

(3) Not contain language that minimizes or contradicts the information being given in the public notice.

Appendix 64465-A. Health Effects Language
Microbiological Contaminants.

Contaminant	***Health Effects Language***
Total Coliform	Coliforms are bacteria that are naturally present in the environment and are used as an indicator that other, potentially-harmful, bacteria may be present. Coliforms were found in more samples than allowed and this was a warning of potential problems.
Fecal coliform/*E. coli*	Fecal coliforms and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, some of the elderly, and people with severely compromised immune systems.
Turbidity	Turbidity has no health effects. However, high levels of turbidity can interfere with disinfection and provide a medium for microbial growth. Turbidity may indicate the presence of disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.

Appendix 64465-B. Health Effects Language
Surface Water Treatment

Contaminant	***Health Effects Language***
Giardia lamblia Viruses Heterotrophic plate count bacteria *Legionella* *Cryptosporidium*	Inadequately treated water may contain disease-causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.

Appendix 64465-C. Health Effects Language
Radioactive Contaminants.

Contaminant	***Health Effects Language***
Gross Beta particle activity	Certain minerals are radioactive and may emit forms of radiation known as photons and beta radiation. Some people who drink water containing beta and photon emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Strontium-90	Some people who drink water containing strontium-90 in excess of the MCL over many years may have an increased risk of getting cancer.
Tritium	Some people who drink water containing tritium in excess of the MCL over many years may have an increased risk of getting cancer.
Gross Alpha particle activity	Certain minerals are radioactive and may emit a form of radiation known as alpha radiation. Some people who drink water containing alpha emitters in excess of the MCL over many years may have an increased risk of getting cancer.
Combined Radium 226/228	Some people who drink water containing radium 226 or 228 in excess of the MCL over many years may have an increased risk of getting cancer.
Total Radium (for nontransient noncommunity water systems)	Some people who drink water containing radium 223, 224, or 226 in excess of the MCL over many years may have an increased risk of getting cancer.
Uranium	Some people who drink water containing uranium in excess of the MCL over many years may have kidney problems or an increased risk of getting cancer.

Appendix 64465-D. Health Effects Language
Inorganic Contaminants.

Contaminant	***Health Effects Language***
Aluminum	Some people who drink water containing aluminum in excess of the MCL over many years may experience short-term gastrointestinal tract effects**.**
Antimony	Some people who drink water containing antimony in excess of the MCL over many years may experience increases in blood cholesterol and decreases in blood sugar.
Arsenic	Some people who drink water containing arsenic in excess of the MCL over many years may experience skin damage or circulatory system problems, and may have an increased risk of getting cancer.
Asbestos	Some people who drink water containing asbestos in excess of the MCL over many years may have an increased risk of developing benign intestinal polyps.
Barium	Some people who drink water containing barium in excess of the MCL over many years may experience an increase in blood pressure.
Beryllium	Some people who drink water containing beryllium in excess of the MCL over many years may develop intestinal lesions.
Cadmium	Some people who drink water containing cadmium in excess of the MCL over many years may experience kidney damage.
Chromium	Some people who use water containing chromium in excess of the MCL over many years may experience allergic dermatitis.
Copper	Copper is an essential nutrient, but some people who drink water containing copper in excess of the action level over a relatively short amount of time may experience gastrointestinal distress. Some people who drink water containing copper in excess of the action level over many years may suffer liver or kidney damage. People with Wilson's Disease should consult their personal doctor.
Cyanide	Some people who drink water containing cyanide in excess of the MCL over many years may experience nerve damage or thyroid problems.
Fluoride	*For the Consumer Confidence Report:* Some people who drink water containing fluoride in excess of the federal MCL of 4 mg/L over many years may get bone disease, including pain and tenderness of the bones. Children who drink water containing fluoride in excess of the state MCL of 2 mg/L may get mottled teeth. *For a Public Notice:* This is an alert about your drinking water and a cosmetic dental problem that might affect children under nine years of age. At low levels, fluoride can help prevent cavities, but children drinking water containing more than 2 milligrams per liter (mg/L) of fluoride may develop cosmetic discoloration of their permanent teeth (dental fluorosis). The drinking water provided by your community water system [*name*] has a fluoride concentration of [*insert value*] mg/L. Dental fluorosis may result in a brown staining and/or pitting of the permanent teeth. This problem occurs only in developing teeth, before they erupt from

	the gums. Children under nine should be provided with alternative sources of drinking water or water that has been treated to remove the fluoride to avoid the possibility of staining and pitting of their permanent teeth. You may also want to contact your dentist about proper use by young children of fluoride-containing products. Older children and adults may safely drink the water. Drinking water containing more than 4 mg/L of fluoride can increase your risk of developing bone disease. For more information, please call [*water system contact name*] of [*water system name*] at [*phone number*]. Some home water treatment units are also available to remove fluoride from drinking water. To learn more about available home water treatment units, you may call the State Board's Residential Water Treatment Device Registration Unit at (916) 449-5600.
Lead	Infants and children who drink water containing lead in excess of the action level may experience delays in their physical or mental development. Children may show slight deficits in attention span and learning abilities. Adults who drink this water over many years may develop kidney problems or high blood pressure.
Mercury	Some people who drink water containing mercury in excess of the MCL over many years may experience mental disturbances, or impaired physical coordination, speech and hearing.
Nickel	Some people who drink water containing nickel in excess of the MCL over many years may experience liver and heart effects.
Nitrate	Infants below the age of six months who drink water containing nitrate in excess of the MCL may quickly become seriously ill and, if untreated, may die because high nitrate levels can interfere with the capacity of the infant's blood to carry oxygen. Symptoms include shortness of breath and blueness of the skin. High nitrate levels may also affect the oxygen-carrying ability of the blood of pregnant women.
Nitrite	Infants below the age of six months who drink water containing nitrite in excess of the MCL may become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blueness of the skin.
Perchlorate	Perchlorate has been shown to interfere with uptake of iodide by the thyroid gland, and to thereby reduce the production of thyroid hormones, leading to adverse effects associated with inadequate hormone levels. Thyroid hormones are needed for normal prenatal growth and development of the fetus, as well as for normal growth and development in the infant and child. In adults, thyroid hormones are needed for normal metabolism and mental function.
Selenium	Selenium is an essential nutrient. However, some people who drink water containing selenium in excess of the MCL over many years may experience hair or fingernail losses, numbness in fingers or toes, or circulation system problems.

Thallium	Some people who drink water containing thallium in excess of the MCL over many years may experience hair loss, changes in their blood, or kidney, intestinal, or liver problems.

Appendix 64465-E. Health Effects Language
Volatile Organic Contaminants.

Contaminant	***Health Effects Language***
Benzene	Some people who use water containing benzene in excess of the MCL over many years may experience anemia or a decrease in blood platelets, and may have an increased risk of getting cancer.
Carbon Tetrachloride	Some people who use water containing carbon tetrachloride in excess of the MCL over many years may experience liver problems and may have an increased risk of getting cancer.
1,2-Dichlorobenzene	Some people who drink water containing 1,2-dichlorobenzene in excess of the MCL over many years may experience liver, kidney, or circulatory system problems.
1,4-Dichlorobenzene	Some people who use water containing 1,4-dichlorobenzene in excess of the MCL over many years may experience anemia, liver, kidney, or spleen damage, or changes in their blood.
1,1-Dichloroethane	Some people who use water containing 1,1-dichloroethane in excess of the MCL over many years may experience nervous system or respiratory problems.
1,2-Dichloroethane	Some people who use water containing 1,2-dichloroethane in excess of the MCL over many years may have an increased risk of getting cancer.
1,1-Dichloroethylene	Some people who use water containing 1,1-dichloroethylene in excess of the MCL over many years may experience liver problems.
cis-1,2-Dichloroethylene	Some people who use water containing cis-1,2-dichloroethylene in excess of the MCL over many years may experience liver problems.
trans-1,2-Dichloroethylene	Some people who drink water containing trans-1,2-dichloroethylene in excess of the MCL over many years may experience liver problems.
Dichloromethane	Some people who drink water containing dichloromethane in excess of the MCL over many years may experience liver problems and may have an increased risk of getting cancer.
1,2-Dichloropropane	Some people who use water containing 1,2-dichloropropane in excess of the MCL over many years may have an increased risk of getting cancer.
1,3-Dichloropropene	Some people who use water containing 1,3-dichloropropene in excess of the MCL over many years may have an increased risk of getting cancer.
Ethylbenzene	Some people who use water containing ethylbenzene in excess of the MCL over many years may experience liver or kidney problems.

Methyl-tert-butyl ether	Some people who use water containing methyl-tert-butyl ether in excess of the MCL over many years may have an increased risk of getting cancer.
Monochlorobenzene	Some people who use water containing monochlorobenzene in excess of the MCL over many years may experience liver or kidney problems.
Styrene	Some people who drink water containing styrene in excess of the MCL over many years may experience liver, kidney, or circulatory system problems.
1,1,2,2-Tetrachloroethane	Some people who drink water containing 1,1,2,2-tetrachloroethane in excess of the MCL over many years may experience liver or nervous system problems.
Tetrachloroethylene	Some people who use water containing tetrachloroethylene in excess of the MCL over many years may experience liver problems, and may have an increased risk of getting cancer.
1,2,4-Trichlorobenzene	Some people who use water containing 1,2,4-trichlorobenzene in excess of the MCL over many years may experience adrenal gland changes.
1,1,1,-Trichloroethane	Some people who use water containing 1,1,1-trichloroethane in excess of the MCL over many years may experience liver, nervous system, or circulatory system problems.
1,1,2-Trichloroethane	Some people who use water containing 1,1,2- trichloroethane in excess of the MCL over many years may experience liver, kidney, or immune system problems.
Trichloroethylene (TCE)	Some people who use water containing trichloroethylene in excess of the MCL over many years may experience liver problems and may have an increased risk of getting cancer.
Toluene	Some people who use water containing toluene in excess of the MCL over many years may experience nervous system, kidney, or liver problems.
Trichlorofluoro-methane	Some people who use water containing trichlorofluoromethane in excess of the MCL over many years may experience liver problems.
1,1,2-Trichloro-1,2,2-trifluoroethane	Some people who use water containing 1,1,2-trichloro-1,2,2-tri~~ch~~fluoroethane in excess of the MCL over many years may experience liver problems.
Vinyl Chloride	Some people who use water containing vinyl chloride in excess of the MCL over many years may have an increased risk of getting cancer.
Xylenes	Some people who use water containing xylenes in excess of the MCL over many years may experience nervous system damage.

Appendix 64465-F. Health Effects Language
Synthetic Organic Contaminants.

Contaminant	***Health Effects Language***
2,4-D	Some people who use water containing the weed killer 2,4-D in excess of the MCL over many years may experience kidney, liver, or adrenal gland problems.
2,4,5-TP (Silvex)	Some people who drink water containing Silvex in excess of the MCL over many years may experience liver problems.
Alachlor	Some people who use water containing alachlor in excess of the MCL over many years may experience eye, liver, kidney, or spleen problems, or experience anemia, and may have an increased risk of getting cancer.
Atrazine	Some people who use water containing atrazine in excess of the MCL over many years may experience cardiovascular system problems or reproductive difficulties.
Bentazon	Some people who drink water containing bentazon in excess of the MCL over many years may experience prostate and gastrointestinal effects.
Benzo(a)pyrene [PAH]	Some people who use water containing benzo(a)pyrene in excess of the MCL over many years may experience reproductive difficulties and may have an increased risk of getting cancer.
Carbofuran	Some people who use water containing carbofuran in excess of the MCL over many years may experience problems with their blood, or nervous or reproductive system problems.
Chlordane	Some people who use water containing chlordane in excess of the MCL over many years may experience liver or nervous system problems, and may have an increased risk of getting cancer.
Dalapon	Some people who drink water containing dalapon in excess of the MCL over many years may experience minor kidney changes.
Dibromochloro-propane (DBCP)	Some people who use water containing DBCP in excess of the MCL over many years may experience reproductive difficulties and may have an increased risk of getting cancer.
Di (2-ethylhexyl) adipate	Some people who drink water containing di(2-ethylhexyl) adipate in excess of the MCL over many years may experience weight loss, liver enlargement, or possible reproductive difficulties.
Di (2-ethylhexyl) phthalate	Some people who use water containing di(2-ethylhexyl) phthalate well in excess of the MCL over many years may experience liver problems or reproductive difficulties, and may have an increased risk of getting cancer.
Dinoseb	Some people who drink water containing dinoseb in excess of the MCL over many years may experience reproductive difficulties.
Dioxin (2,3,7,8-TCDD)	Some people who use water containing dioxin in excess of the MCL over many years may experience reproductive difficulties and may have an increased risk of getting cancer.

Diquat	Some people who drink water containing diquat in excess of the MCL over many years may get cataracts.
Endothall	Some people who drink water containing endothall in excess of the MCL over many years may experience stomach or intestinal problems.
Endrin	Some people who drink water containing endrin in excess of the MCL over many years may experience liver problems.
Ethylene dibromide (EDB)	Some people who use water containing ethylene dibromide in excess of the MCL over many years may experience liver, stomach, reproductive system, or kidney problems, and may have an increased risk of getting cancer.
Glyphosate	Some people who drink water containing glyphosate in excess of the MCL over many years may experience kidney problems or reproductive difficulties.
Heptachlor	Some people who use water containing heptachlor in excess of the MCL over many years may experience liver damage and may have an increased risk of getting cancer.
Heptachlor epoxide	Some people who use water containing heptachlor epoxide in excess of the MCL over many years may experience liver damage, and may have an increased risk of getting cancer.
Hexachlorobenzene	Some people who drink water containing hexachlorobenzene in excess of the MCL over many years may experience liver or kidney problems, or adverse reproductive effects, and may have an increased risk of getting cancer.
Hexachlorocyclo-pentadiene	Some people who use water containing hexachlorocyclopentadiene in excess of the MCL over many years may experience kidney or stomach problems.
Lindane	Some people who drink water containing lindane in excess of the MCL over many years may experience kidney or liver problems.
Methoxychlor	Some people who drink water containing methoxychlor in excess of the MCL over many years may experience reproductive difficulties.
Molinate (Ordram)	Some people who use water containing molinate in excess of the MCL over many years may experience reproductive effects.
Oxamyl [Vydate]	Some people who drink water containing oxamyl in excess of the MCL over many years may experience slight nervous system effects.
PCBs [Polychlorinated biphenyls]	Some people who drink water containing PCBs in excess of the MCL over many years may experience changes in their skin, thymus gland problems, immune deficiencies, or reproductive or nervous system difficulties, and may have an increased risk of getting cancer.
Pentachlorophenol	Some people who use water containing pentachlorophenol in excess of the MCL over many years may experience liver or kidney problems, and may have an increased risk of getting cancer.
Picloram	Some people who drink water containing picloram in excess of the MCL over many years may experience liver problems.

Simazine	Some people who use water containing simazine in excess of the MCL over many years may experience blood problems.
Thiobencarb	Some people who use water containing thiobencarb in excess of the MCL over many years may experience body weight and blood effects.
Toxaphene	Some people who use water containing toxaphene in excess of the MCL over many years may experience kidney, liver, or thyroid problems, and may have an increased risk of getting cancer.
1,2,3-Trichloropropane	Some people who drink water containing 1,2,3-trichloropropane in excess of the MCL over many years may have an increased risk of getting cancer.

Appendix 64465-G. Health Effects Language
Disinfection Byproducts, Byproduct Precursors, and Disinfectant Residuals

Contaminant	***Health Effects Language***
TTHMs [Total Trihalomethanes]	Some people who drink water containing trihalomethanes in excess of the MCL over many years may experience liver, kidney, or central nervous system problems, and may have an increased risk of getting cancer.
Haloacetic Acids	Some people who drink water containing halocetic acids in excess of the MCL over many years may have an increased risk of getting cancer.
Bromate	Some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of getting cancer.
Chloramines	Some people who use water containing chloramines well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chloramines well in excess of the MRDL could experience stomach discomfort or anemia.
Chlorine	Some people who use water containing chlorine well in excess of the MRDL could experience irritating effects to their eyes and nose. Some people who drink water containing chlorine well in excess of the MRDL could experience stomach discomfort.
Chlorite	Some infants and young children who drink water containing chlorite in excess of the MCL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorite in excess of the MCL. Some people may experience anemia.
Chlorine dioxide (2 consecutive daily samples at the entry point to the distribution system that are greater than the MRDL)	Some infants and young children who drink water containing chlorine dioxide in excess of the MRDL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorine dioxide in excess of the MRDL. Some people may experience anemia. *Add for public notification only:* The chlorine dioxide violations reported today are the result of exceedances at the treatment facility

	only, not within the distribution system that delivers water to consumers. Continued compliance with chlorine dioxide levels within the distribution system minimizes the potential risk of these violations to consumers.
Chlorine dioxide (one or more distribution system samples are above the MRDL)	Some infants and young children who drink water containing chlorine dioxide in excess of the MRDL could experience nervous system effects. Similar effects may occur in fetuses of pregnant women who drink water containing chlorine dioxide in excess of the MRDL. Some people may experience anemia. *Add for public notification only:* The chlorine dioxide violations reported today include exceedances of the State standard within the distribution system that delivers water to consumers. These violations may harm human health based on short-term exposures. Certain groups, including fetuses, infants, and young children, may be especially susceptible to nervous system effects from excessive chlorine dioxide exposure.
Control of DBP precursors (TOC)	Total organic carbon (TOC) has no health effects. However, total organic carbon provides a medium for the formation of disinfection byproducts. These byproducts include trihalomethanes (THMs) and haloacetic acids (HAAs). Drinking water containing these byproducts in excess of the MCL may lead to adverse health effects, liver or kidney problems, or nervous system effects, and may lead to an increased risk of getting cancer.

Appendix 64465-H. Health Effects Language
Other Treatment Techniques

Contaminant	***Health Effects Language***
Acrylamide	Some people who drink water containing high levels of acrylamide over a long period of time may experience nervous system or blood problems, and may have an increased risk of getting cancer.
Epichlorohydrin	Some people who drink water containing high levels of epichlorohydrin over a long period of time may experience stomach problems, and may have an increased risk of getting cancer.

§64466. Special Notice for Unregulated Contaminant Monitoring Results.
Water systems required to monitor pursuant to section 64450 (Unregulated Chemicals – Monitoring) and/or Federal Register 64(180), p 50556-50620, September 17, 1999, shall notify persons served by the water system of the availability of the results, as follows:

(a) No later than 12 months after the results are known;

(b) Pursuant to sections 64463.7(c) and (d)(1) and (3); and

(c) Include a contact and telephone number where information on the results may be obtained.

Article 19. Records, Reporting and Recordkeeping

§64469. Reporting Requirements.

(a) Analytical results of all sample analyses completed in a calendar month shall be reported to the State Board no later than the tenth day of the following month.

(b) Analytical results of all sample analyses completed by water wholesalers in a calendar month shall be reported to retail customers and the State Board no later than the tenth day of the following month.

(c) Analytical results shall be reported to the State Board electronically using the Electronic Deliverable Format as defined in The Electronic Deliverable Format [EDF] Version 1.2i Guidelines & Restrictions dated April 2001 and Data Dictionary dated April 2001.

(d) Within 10 days of giving initial or repeat public notice pursuant to Article 18 of this Chapter, except for notice given under section 64463.7(d), each water system shall submit a certification to the State Board that it has done so, along with a representative copy of each type of public notice given.

§64470. Recordkeeping.

(a) A water supplier shall maintain records on all water quality and system water outage complaints received, both verbal and written, and corrective action taken. These records shall be retained for a period of five years for State Board review.

(b) A water supplier shall retain, on or at a convenient location near the water utility premises, records as indicated below:

(1) Records of microbiological analyses and turbidity analyses from at least the most recent five years and chemical analyses from at least the most recent 10 years. Actual laboratory reports may be kept, or data may be transferred to tabular summaries, provided the following information is included:

(A) The date, place, and time of sampling; and identification of the person who collected the sample;

(B) Identification of the sample as a routine sample, check sample, raw or finished water or other special sample;

(C) Date of report;

(D) Name of the laboratory and either the person responsible for performing the analysis or the laboratory director;

(E) The analytical technique or method used; and

(F) The results of the analysis.

(2) Records and resultant corrective actions shall be kept not less than three years following the final action taken to correct a particular violation;

(3) Copies of any written reports, summaries, or communications relating to sanitary surveys of the system conducted by the water supplier, a private consultant or any local, state or federal agency, for not less than 10 years following completion of the sanitary survey involved;

(4) Variances or exemptions granted to the system, for not less than five years following the expiration of such variance or exemption;

(5) Copies of any Tier 1, Tier 2, and Tier 3 public notices, for not less than three years; and

(6) Copies of monitoring plans developed pursuant to sections 64416, 64422, and 64534.8 for the same period of time as the records of analyses taken under the plan are required to be kept pursuant to paragraph (1).

Article 20. Consumer Confidence Report

§64480. Applicability and Distribution.

(a) Except as provided in subsection (b), each community and nontransient-noncommunity (NTNC) water system shall prepare and deliver the first Consumer Confidence Report by July 1, 2001, and subsequent reports by July 1 annually thereafter. The first Consumer Confidence Report shall contain data collected during, or prior to, calendar year 2000, as prescribed by section 64481(d)(1). Each Consumer Confidence Report thereafter shall contain data collected during, or prior to, the previous calendar year.

(b) A new community or NTNC water system shall deliver its first Consumer Confidence Report by July 1 of the year after its first full calendar year in operation and subsequent reports by July 1 annually thereafter.

(c) A community or NTNC water system that sells water to another community or NTNC water system shall deliver the applicable information required in section 64481 to the purchasing system by no later than April 1 of each year or on a date mutually agreed upon by the seller and the purchaser, and specifically included in a contract between the parties.

§64481. Content of the Consumer Confidence Report.

(a) A Consumer Confidence Report shall contain information on the source of the water delivered, including:

(1) The type of water delivered by the water system (e.g., surface water, ground water) and the commonly used name (if any) and location of the body (or bodies) of water; and

(2) If a source water assessment has been completed, notification that the assessment is available, how to obtain it, the date it was completed or last updated, and a

brief summary of the system's vulnerability to potential sources of contamination, using language provided by the State Board if the State Board conducted the assessment.

(b) For any of the following terms used in the Consumer Confidence Report, the water system shall provide the specified language below:

(1) Regulatory Action Level: "The concentration of a contaminant which, if exceeded, triggers treatment or other requirements that a water system must follow."

(2) Maximum Contaminant Level or MCL: "The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible. Secondary MCLs are set to protect the odor, taste, and appearance of drinking water."

(3) Maximum Contaminant Level Goal or MCLG: "The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency."

(4) Public Health Goal or PHG: "The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency."

(5) Primary Drinking Water Standard or PDWS: "MCLs, MRDLs, and treatment techniques for contaminants that affect health, along with their monitoring and reporting requirements."

(6) Treatment technique: "A required process intended to reduce the level of a contaminant in drinking water."

(7) Variances and exemptions: "State Board permission to exceed an MCL or not comply with a treatment technique under certain conditions."

(8) Maximum residual disinfectant level or MRDL: "The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants."

(9) Maximum residual disinfectant level goal or MRDLG: "The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants."

(c) If any of the following are detected, information for each pursuant to subsection (d) shall be included in the Consumer Confidence Report:

(1) Contaminants subject to an MCL, regulatory action level, MRDL, or treatment technique (regulated contaminants), as specified in sections 64426.1, 64431, 64442, 64443, 64444, 64448, 64449, 64533, 64533.5, 64536, 64536.2, 64653 and 64678;

(2) Contaminants specified in 40 Code of Federal Regulations part 141.40 (7-1-2007 edition) for which monitoring is required (unregulated contaminants);

(3) Microbial contaminants detected as provided under subsection (e); and

(4) Sodium and hardness.

(d) For contaminants identified in subsection (c), the water system shall include in the Consumer Confidence Report one table or several adjacent tables that have been developed pursuant to this subsection. Any additional monitoring results that a water system chooses to include in its Consumer Confidence Report shall be displayed separately.

(1) The data in the table(s) shall be derived from data collected to comply with U.S. Environmental Protection Agency (USEPA) and State Board monitoring and analytical requirements during calendar year 2000 for the first Consumer Confidence Report and subsequent calendar years thereafter. Where a system is allowed to monitor for regulated contaminants less often than once a year, the table(s) shall include the date and results of the most recent sampling and the Consumer Confidence Report shall include a brief statement indicating that the data presented in the table(s) are from the most recent testing done in accordance with the regulations. No data older than 9 years need be included.

(2) For detected regulated contaminants referenced in subsection (c)(1), the table(s) shall include:

(A) The MCL expressed as a number equal to or greater than 1.0;

(B) For a primary MCL, the public health goal (PHG) in the same units as the MCL; or if no PHG has been set for the contaminant, the table shall include the USEPA maximum contaminant level goal in the same units as the MCL;

(C) For a detected contaminant that does not have an MCL, the table(s) shall indicate whether there is a treatment technique or specify the regulatory action level or MRDL (and MRDLG) applicable to that contaminant, and the Consumer Confidence Report shall include the appropriate language specified in subsection (b);

(D) For detected contaminants subject to an MCL, except turbidity and total coliforms, the sample result(s) collected at compliance monitoring sampling points shall be reported in the same units as the MCL as follows:

1. When compliance is determined by the results of a single sample, an initial sample averaged with one or two confirmation sample(s), or an average of four quarterly or six monthly samples, results shall be reported as follows:

A. For a single sampling point, or multiple sampling points for which data is being individually listed on the Consumer Confidence Report: the sample result and, if more than one sample was collected, the average and range of the sample results;

B. For multiple sampling points, each of which has been sampled only once and for which data is being summarized together on the Consumer Confidence Report: the average and range of the sample results. If the waters from the sampling points are entering the distribution system at the same point, a flow-weighted average may be reported; and

C. For multiple sampling points, one or more of which has been sampled more than once and for which data is being summarized together on the Consumer Confidence Report: the average of the individual sampling point averages and range of all the sample results. If the waters from the sampling points are entering the distribution system at the same point, a flow-weighted average may be reported.

2. When compliance with the MCL is determined by calculating a running annual average of all samples taken at a monitoring location:

A. The highest running annual average of the monitoring location and the range of sample results or, if monitoring locations are summarized together for the Consumer Confidence Report, the highest running annual average of any of the monitoring locations and the range of sample results from all the monitoring locations; and

B. For TTHM and HAA5 monitored pursuant to section 64534.2(d): the highest locational running annual average (LRAA) for TTHM and HAA5 and the range of individual sample results for all monitoring locations. If more than one location exceeds the TTHM or HAA5 MCL, include the LRAA for all locations that exceed the MCL.

3. When compliance with the MCL is determined on a system-wide basis by calculating a running annual average of all monitoring location averages: the highest running annual average and the range of sample results from all the sampling points.

4. When compliance with the MCL is determined on the basis of monitoring after treatment installed to remove a contaminant: the average level detected in the water entering the distribution system and the range of sample results; and

5. If an MCL compliance determination was made in the year for which sample results are being reported and that determination was based on an average of results from both the previous and reporting years, then the compliance determination average shall be reported, but the range shall be based only on results from the year for which data is being reported.

(E) For turbidity:

1. When it is reported pursuant to the requirements of section 64652.5 (filtration avoidance): the highest value; and

2. When it is reported pursuant to section 64653 (filtration): the highest single measurement based on compliance reporting and the lowest monthly percentage of samples meeting the turbidity limits specified in section 64653 for the filtration technology being used;

(F) For lead and copper: the 90th percentile value of the most recent round of sampling, the number of sites sampled, and the number of sampling sites exceeding the action level;

(G) For total coliform:

1. The highest monthly number of positive samples for systems collecting fewer than 40 samples per month; or

2. The highest monthly percentage of positive samples for systems collecting at least 40 samples per month.

(H) For fecal coliform or *E. coli*: the total number of positive samples during the year; and

(I) The likely source(s) of any detected contaminants having an MCL, MRDL, regulatory action level, or treatment technique. If the water system lacks specific information on the likely source, the table(s) shall include one or more of the typical sources for that contaminant listed in appendix 64481-A or 64481-B that are most applicable to the system.

(3) The table(s) shall clearly identify any data indicating violations of MCLs, regulatory action levels, MRDLs, or treatment techniques and the Consumer Confidence Report shall give information on each violation including the length of the violation, potential adverse health effects (PDWS only), and actions taken by the system to address the violation. To describe the potential health effects, the system shall use the relevant language pursuant to appendices 64465-A through H; and

(4) For detected unregulated contaminants for which monitoring is required (except *Cryptosporidium*), the table(s) shall contain the average and range at which the contaminant was detected.

(e) If the system has performed any monitoring for *Cryptosporidium* that indicates that *Cryptosporidium* may be present in the source water or the finished water, the Consumer Confidence Report shall include a summary of the monitoring results and an explanation of their significance.

(f) If the system has performed any monitoring for radon that indicates that radon is present in the finished water, the Consumer Confidence Report shall include the monitoring results and an explanation of their significance.

(g) For the year covered by the report, the Consumer Confidence Report shall note any violations of paragraphs (1) through (7) and give related information, including any potential adverse health effects, and the steps the system has taken to correct the violation.

(1) Monitoring and reporting of compliance data.

(2) Filtration, disinfection, and recycled provisions prescribed by sections 64652, 64652.5, 64653, 64653.5(b), or 64654. For systems that have failed to install adequate filtration or disinfection equipment or processes, or have had a failure of such equipment or processes that constitutes a violation, the Consumer Confidence Report shall include the health effects language pursuant to appendix 64465-B as part of the explanation of potential adverse health effects.

(3) One or more actions prescribed by the lead and copper requirements in sections 64673, 64674, 64683 through 64686, and 64688. To address potential adverse health effects, the Consumer Confidence Report shall include the applicable language pursuant to appendix 64465-D for lead, copper, or both.

(4) Treatment technique requirements for Acrylamide and Epichlorohydrin in section 64448; to address potential adverse health effects, the Consumer Confidence Report shall include the relevant language from appendix 64465-H.

(5) Recordkeeping of compliance data.

(6) Special monitoring requirements prescribed by section 64449(b)(2) and (g).

(7) Terms of a variance, an exemption, or an administrative or judicial order.

(h) If a system is operating under the terms of a variance or an exemption issued under section 116430 or 116425 of the Health and Safety Code, the Consumer Confidence Report shall contain:

(1) An explanation of the reasons for the variance or exemption;

(2) The date on which the variance or exemption was issued;

(3) A brief status report on the steps the system is taking to install treatment, find alternative sources of water, or otherwise comply with the terms and schedules of the variance or exemption; and

(4) A notice of any opportunity for public input in the review, or renewal, of the variance or exemption.

(i) A Consumer Confidence Report shall contain the language in paragraphs (1) through (4).

(1) "The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs, and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity."

(2) "Contaminants that may be present in source water include:

Microbial contaminants, such as viruses and bacteria, that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Inorganic contaminants, such as salts and metals, that can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Pesticides and herbicides, that may come from a variety of sources such as agriculture, urban stormwater runoff, and residential uses.

Organic chemical contaminants, including synthetic and volatile organic chemicals, that are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, agricultural application, and septic systems.

Radioactive contaminants, that can be naturally-occurring or be the result of oil and gas production and mining activities."

(3) "In order to ensure that tap water is safe to drink, the U.S. Environmental Protection Agency (USEPA) and the State Water Resources Control Board (State Board) prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. State Board regulations also establish limits for contaminants in bottled water that provide the same protection for public health."

(4) "Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline (1-800-426-4791)."

(j) A Consumer Confidence Report shall prominently display the following language: "Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infection by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791)."

(k) A Consumer Confidence Report shall include the telephone number of the owner, operator, or designee of the water system as a source of additional information concerning the report.

(l) A Consumer Confidence Report shall contain information in Spanish regarding the importance of the report or contain a telephone number or address where Spanish-speaking residents may contact the system to obtain a translated copy of the report or assistance in Spanish. For each non-English speaking group other than Spanish-speaking that exceeds 1,000 residents or 10% of the residents in a community, the Consumer Confidence Report shall contain information in the appropriate language(s) regarding the importance of the report or contain a telephone number or address where such residents may contact the system to obtain a translated copy of the report or assistance in the appropriate language.

(m) A Consumer Confidence Report shall include information (e.g., time and place of regularly scheduled board meetings) about opportunities for public participation in decisions that may affect the quality of the water.

Appendix 64481-A.
Typical Origins of Contaminants with Primary MCLs, MRDLs Regulatory Action Levels, and Treatment Techniques

Contaminant	*Major origins in drinking water*
Microbiological	
Total coliform bacteria	Naturally present in the environment
Fecal coliform and *E. coli*	Human and animal fecal waste
Turbidity	Soil runoff

Surface water treatment	
Giardia lamblia	Naturally present in the environment
Viruses	
Heterotrophic plate count bacteria	
Legionella	
Cryptosporidium	

Radioactive	
Gross Beta particle activity	Decay of natural and man-made deposits
Strontium-90	Decay of natural and man-made deposits
Tritium	Decay of natural and man-made deposits
Gross Alpha particle activity	Erosion of natural deposits
Combined Radium 226/228	Erosion of natural deposits
Total Radium (for nontransient noncommunity water systems)	Erosion of natural deposits
Uranium	Erosion of natural deposits

Inorganic	
Aluminum	Erosion of natural deposits; residue from some surface water treatment processes
Antimony	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	Erosion of natural deposits; runoff from orchards; glass and electronics production wastes
Asbestos	Internal corrosion of asbestos cement water mains; erosion of natural deposits
Barium	Discharges of oil drilling wastes and from metal refineries; erosion of natural deposits

Beryllium	Discharge from metal refineries, coal-burning factories, and electrical, aerospace, and defense industries
Cadmium	Internal corrosion of galvanized pipes; erosion of natural deposits; discharge from electroplating and industrial chemical factories, and metal refineries; runoff from waste batteries and paints
Chromium	Discharge from steel and pulp mills and chrome plating; erosion of natural deposits
Copper	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives
Cyanide	Discharge from steel/metal, plastic and fertilizer factories
Fluoride	Erosion of natural deposits; water additive that promotes strong teeth; discharge from fertilizer and aluminum factories
Lead	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits
Mercury	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and cropland
Nickel	Erosion of natural deposits; discharge from metal factories
Nitrate	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Nitrite	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Perchlorate	Perchlorate is an inorganic chemical used in solid rocket propellant, fireworks, explosives, flares, matches, and a variety of industries. It usually gets into drinking water as a result of environmental contamination from historic aerospace or other industrial operations that used or use, store, or dispose of perchlorate and its salts.
Selenium	Discharge from petroleum, glass, and metal refineries; erosion of natural deposits; discharge

	from mines and chemical manufacturers; runoff from livestock lots (feed additive)
Thallium	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Synthetic organic

2,4-D	Runoff from herbicide used on row crops, range land, lawns, and aquatic weeds
2,4,5-TP (Silvex)	Residue of banned herbicide
Acrylamide	Added to water during sewage/wastewater treatment
Alachlor	Runoff from herbicide used on row crops
Atrazine	Runoff from herbicide used on row crops and along railroad and highway right-of-ways
Bentazon	Runoff/leaching from herbicide used on beans, peppers, corn, peanuts, rice, and ornamental grasses
Benzo(a)pyrene [PAH]	Leaching from linings of water storage tanks and distribution mains
Carbofuran	Leaching of soil fumigant used on rice and alfalfa, and grape vineyards
Chlordane	Residue of banned insecticide
Dalapon	Runoff from herbicide used on right-of-ways, and crops and landscape maintenance
Dibromochloropropane (DBCP)	Banned nematocide that may still be present in soils due to runoff/leaching from former use on soybeans, cotton, vineyards, tomatoes, and tree fruit
Di(2-ethylhexyl) adipate	Discharge from chemical factories
Di(2-ethylhexyl) phthalate	Discharge from rubber and chemical factories; inert ingredient in pesticides
Dinoseb	Runoff from herbicide used on soybeans, vegetables, and fruits
Dioxin [2,3,7,8-TCDD]	Emissions from waste incineration and other combustion; discharge from chemical factories
Diquat	Runoff from herbicide use for terrestrial and aquatic weeds
Endothall	Runoff from herbicide use for terrestrial and aquatic weeds; defoliant
Endrin	Residue of banned insecticide and rodenticide
Epichlorohydrin	Discharge from industrial chemical factories; impurity of some water treatment chemicals
Ethylene dibromide (EDB)	Discharge from petroleum refineries; underground gas tank leaks; banned nematocide that may still be present

	in soils due to runoff and leaching from grain and fruit crops
Glyphosate	Runoff from herbicide use
Heptachlor	Residue of banned insecticide
Heptachlor epoxide	Breakdown of heptachlor
Hexachlorobenzene	Discharge from metal refineries and agricultural chemical factories; byproduct of chlorination reactions in wastewater
Hexachlorocyclopentadiene	Discharge from chemical factories
Lindane	Runoff/leaching from insecticide used on cattle, lumber, and gardens
Methoxychlor	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, and livestock
Molinate [Ordram]	Runoff/leaching from herbicide used on rice
Oxamyl [Vydate]	Runoff/leaching from insecticide used on field crops, fruits and ornamentals, especially apples, potatoes, and tomatoes
Pentachlorophenol	Discharge from wood preserving factories, cotton and other insecticidal/herbicidal uses
Picloram	Herbicide runoff
Polychlorinated biphenyls [PCBs]	Runoff from landfills; discharge of waste chemicals
Simazine	Herbicide runoff
Thiobencarb	Runoff/leaching from herbicide used on rice
Toxaphene	Runoff/leaching from insecticide used on cotton and cattle
1,2,3-Trichloropropane	Discharge from industrial and agricultural chemical factories; leaching from hazardous waste sites; used as cleaning and maintenance solvent, paint and varnish remover, and cleaning and degreasing agent; byproduct during the production of other compounds and pesticides.

Volatile organic

Benzene	Discharge from plastics, dyes and nylon factories; leaching from gas storage tanks and landfills
Carbon tetrachloride	Discharge from chemical plants and other industrial activities
1,2-Dichlorobenzene	Discharge from industrial chemical factories
1,4-Dichlorobenzene	Discharge from industrial chemical factories

1,1-Dichloroethane	Extraction and degreasing solvent; used in manufacture of pharmaceuticals, stone, clay and glass products; fumigant
1,2-Dichloroethane	Discharge from industrial chemical factories
1,1-Dichloroethylene	Discharge from industrial chemical factories
cis-1,2-Dichloroethylen	Discharge from industrial chemical factories; major biodegradation byproduct of TCE and PCE groundwater contamination
trans-1,2-Dichloroethylene	Discharge from industrial chemical factories; minor biodegradation byproduct of TCE and PCE groundwater contamination
Dichloromethane	Discharge from pharmaceutical and chemical factories; insecticide
1,2-Dichloropropane	Discharge from industrial chemical factories; primary component of some fumigants
1,3-Dichloropropene	Runoff/leaching from nematocide used on croplands
Ethylbenzene	Discharge from petroleum refineries; industrial chemical factories
Methyl-tert-butyl ether (MTBE)	Leaking underground storage tanks; discharge from petroleum and chemical factories
Monochlorobenzene	Discharge from industrial and agricultural chemical factories and drycleaning facilities
Styrene	Discharge from rubber and plastic factories; leaching from landfills
1,1,2,2-Tetrachloroethane	Discharge from industrial and agricultural chemical factories; solvent used in production of TCE, pesticides, varnish and lacquers
Tetrachloroethylene (PCE)	Discharge from factories, dry cleaners, and auto shops (metal degreaser)
1,2,4-Trichlorobenzene	Discharge from textile-finishing factories
1,1,1-Trichloroethan	Discharge from metal degreasing sites and other factories; manufacture of food wrappings
1,1,2-Trichloroethan	Discharge from industrial chemical factories
Trichloroethylene (TCE)	Discharge from metal degreasing sites and other factories
Toluene	Discharge from petroleum and chemical factories; underground gas tank leaks
Trichlorofluoromethane	Discharge from industrial factories; degreasing solvent; propellant and refrigerant
1,1,2-Trichloro-1,2,2-Trifluoroethane	Discharge from metal degreasing sites and other factories; drycleaning solvent; refrigerant

Vinyl chloride	Leaching from PVC piping; discharge from plastics factories; biodegradation byproduct of TCE and PCE groundwater contamination
Xylenes	Discharge from petroleum and chemical factories; fuel solvent

Disinfection Byproducts, Disinfection Byproduct Precursors, and Disinfectant Residuals

Total trihalomethanes (TTHM)	Byproduct of drinking water disinfection
Haloacetic acids (five) (HAA5)	Byproduct of drinking water disinfection
Bromate	Byproduct of drinking water disinfection
Chloramines	Drinking water disinfectant added for treatment
Chlorine	Drinking water disinfectant added for treatment
Chlorite	Byproduct of drinking water disinfection
Chlorine dioxide	Drinking water disinfectant added for treatment
Control of disinfection byproduct precursors (Total Organic Carbon)	Various natural and manmade sources

Appendix 64481-B.
Typical Origins of Contaminants with Secondary MCLs

Contaminant	*Major origins in drinking water*
Aluminum	Erosion of natural deposits; residual from some surface water treatment processes
Color	Naturally-occurring organic materials
Copper	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives
Foaming Agents (MBAS)	Municipal and industrial waste discharges
Iron	Leaching from natural deposits; industrial wastes
Manganese	Leaching from natural deposits
Methyl-tert-butyl ether (MTBE)	Leaking underground storage tanks; discharge from petroleum and chemical factories;
Odor---Threshold	Naturally-occurring organic materials
Silver	Industrial discharges
Thiobencarb	Runoff/leaching from rice herbicide
Turbidity	Soil runoff

Zinc	Runoff/leaching from natural deposits; industrial wastes
Total dissolved solids	Runoff/leaching from natural deposits
Specific Conductance	Substances that form ions when in water; seawater influence
Chloride	Runoff/leaching from natural deposits; seawater influence
Sulfate	Runoff/leaching from natural deposits; industrial wastes

§64482. Required Additional Health Information.

(a) A system that detects arsenic at levels above 0.005 mg/L, but below or equal to the MCL, shall include the following in its Consumer Confidence Report: "While your drinking water meets the federal and state standard for arsenic, it does contain low levels of arsenic. The arsenic standard balances the current understanding of arsenic's possible health effects against the costs of removing arsenic from drinking water. The U.S. Environmental Protection Agency continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems."

(b) A system that detects nitrate at levels above 5 mg/L (as nitrogen), but below the MCL, shall include the following in its Consumer Confidence Report: "Nitrate in drinking water at levels above 10 mg/L is a health risk for infants of less than six months of age. Such nitrate levels in drinking water can interfere with the capacity of the infant's blood to carry oxygen, resulting in a serious illness; symptoms include shortness of breath and blueness of the skin. Nitrate levels above 10 mg/L may also affect the ability of the blood to carry oxygen in other individuals, such as pregnant women and those with certain specific enzyme deficiencies. If you are caring for an infant, or you are pregnant, you should ask advice from your health care provider. If a system cannot demonstrate to the State Board with at least five years of the most current monitoring data that its nitrate levels are stable, it shall also add the following language to the preceding statement on nitrate: "Nitrate levels may rise quickly for short periods of time because of rainfall or agricultural activity."

(c) A system that detects lead above the action level in more than 5%, and up to and including 10%, of sites sampled, shall include the following in its Consumer Confidence Report: "Infants and young children are typically more vulnerable to lead in drinking water than the general population. It is possible that lead levels at your home may be higher than at other homes in the community as a result of materials used in your home's plumbing. If you are concerned about elevated lead levels in your home's water, you may wish to have your water tested and/or flush your tap for 30 seconds to 2 minutes before using tap water. Additional information is available from the USEPA Safe Drinking Water Hotline (1-800-426-4791)."

§64483. Consumer Confidence Report Delivery and Recordkeeping.

(a) Each water system shall mail or directly deliver one copy of the Consumer Confidence Report to each customer.

(b) The system shall make a good faith effort to reach consumers who are served by the water system but are not bill-paying customers, such as renters or workers, using a mix of methods appropriate to the particular system such as: Posting the Consumer Confidence Reports on the Internet; mailing to postal patrons in metropolitan areas; advertising the availability of the Consumer Confidence Report in the news media; publication in a local newspaper; posting in public places such as cafeterias or lunch rooms of public buildings; delivery of multiple copies for distribution by single-biller customers such as apartment buildings or large private employers; and delivery to community organizations.

(c) No later than the date the water system is required to distribute the Consumer Confidence Report to its customers, each water system shall mail a copy of the report to the State Board, followed within 3 months by a certification that the report has been distributed to customers, and that the information is correct and consistent with the compliance monitoring data previously submitted to the State Board.

(d) No later than the date the water system is required to distribute the Consumer Confidence Report to its customers, each privately-owned water system shall mail a copy of the report to the California Public Utilities Commission.

(e) Each water system shall make its Consumer Confidence Report available to the public upon request.

(f) Each water system serving 100,000 or more persons shall post its current year's Consumer Confidence Report on a publicly-accessible site on the Internet.

(g) Each water system shall retain copies of its Consumer Confidence Reports for no less than 3 years.

CHAPTER 15.5 DISINFECTANT RESIDUALS, DISINFECTION BYPRODUCTS, AND DISINFECTION BYPRODUCT PRECURSORS

Article 1. General Requirements and Definitions

§64530. Applicability of this Chapter.

(a) Community water systems and nontransient noncommunity water systems that treat their water with a chemical disinfectant in any part of the treatment process or which provide water that contains a chemical disinfectant shall comply with the requirements of

Management Practice Implementation and Assessment

8. Dischargers must implement management practices and assessment, as necessary, to improve and protect water quality, protect beneficial uses, achieve compliance with applicable water quality objectives, achieve the numeric targets, numeric interim quantifiable milestones, and numeric limits established in this Order. Management practices implementation and assessment must be documented in the appropriate section of the Farm Plan (e.g., irrigation and nutrient management practices and assessment must be documented in the INMP section of the Farm Plan). Dischargers must report on management practice implementation and assessment in the ACF, as described in the MRP.

CEQA Mitigation Measure Implementation, Monitoring, and Reporting

9. Impacts and mitigation measures identified in CEQA Mitigation Monitoring and Reporting Program are set forth in the Final Environmental Impact Report (FEIR) at Appendix D, which is incorporated by reference. Mitigation measures identified in the FEIR for this Order and required to be implemented as described in Appendix D, will substantially reduce environmental effects of the project. The mitigation measures included in this Order have eliminated or substantially lessened all significant effects on the environment, where feasible. Where noted, some of the mitigation measures are within the responsibility and jurisdiction of other public agencies. Such mitigation measures can and should be adopted, as applicable, by those other agencies.

10. Dischargers must report on mitigation measure implementation electronically in the Annual Compliance Form (ACF), as described in the MRP. Draft mitigation monitoring and reporting is available for review in the FEIR.

Part 2, Section C.1. Groundwater Protection

1. Dischargers may not be subject to all provisions of **Part 2, Section C.1** if they are members in good standing with the third-party alternative compliance pathway program included within **Part 2, Section C.2**.

Phasing

2. Ranches are assigned the Groundwater Phase Area of the groundwater basin where the ranch is located based on the relative level of water quality and beneficial use impairment and risk to water quality. All ranches are assigned a Groundwater Phase Area of 1, 2, or 3. Groundwater Phase 1 areas represent greater water quality impairment and higher risk to water quality relative to Groundwater Phase 2 and 3 areas.

3. The requirements and implementation schedules for groundwater protection are based on the groundwater phase areas, listed in **Table C.1-1** and shown on the maps in **Figure C.1-1**.

4. In the event that a ranch spans multiple Groundwater Phase areas, the ranch will be assigned the earlier phase. For example, a ranch that spans both Groundwater Phase 1 and Groundwater Phase 2 areas will be assigned to Groundwater Phase 1.

5. The Groundwater Phase Area assigned to each ranch will be displayed on the ranch eNOI in GeoTracker.

Irrigation and Nutrient Management Plan

6. Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses both groundwater and surface water. This section applies to the groundwater related INMP requirements and the surface water related INMP requirements are contained within **Part 2, Section C.3** of this Order. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of the INMP related to groundwater protection must include:

    a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the ACF, Total Nitrogen Applied (TNA) report, and INMP Summary report.
    b. Planning and management practice implementation and assessment that results in compliance with the fertilizer nitrogen application limits in **Table C.1-2** and the nitrogen discharge targets and limits in **Table C.1-3**.
    c. Descriptions of all irrigation, nutrient, and salinity management practices implemented and assessed on the ranch.
    d. When INMP certification is required, e.g., as a follow-up action or as a consequence for not meeting the quantifiable milestones and time schedules below, the INMP certification shall include the following:

    The person signing this Irrigation and Nitrogen Management Plan (INMP) certifies, under penalty of law, that the INMP was prepared under his/her direction and supervision, that the information and data reported is to the best of his/her knowledge and belief, true, accurate, and complete, and that he/she is aware that there are penalties for knowingly submitting false information. The qualified professional signing the INMP may rely on the information and data provided by the Discharger and is not required to independently verify the information and data.

The qualified professional signing the INMP below further certifies that he/she used sound irrigation and nitrogen management planning practices to develop irrigation and nitrogen application recommendations and that the recommendations are informed by applicable training to minimize nitrogen loss to surface water and groundwater. The qualified professional signing the INMP is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by the Discharger in a manner that is inconsistent with the INMP's recommendations for nitrogen application. This certification does not create any liability or claims for environmental violations.

Qualified professional certification:
"I, ____________________, certify this INMP in accordance with the statement above."

___________________________ (Signature)

The discharger additionally agrees as follows:

"I, ____________________, Discharger, have provided information and data to the certifier above that is, to the best of my knowledge and belief, true, accurate, and complete, that I understand that the certifier may rely on the information and data provided by me and is not required to independently verify the information and data, and that I further understand that the certifier is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by me in a manner that is inconsistent with the INMP's recommendations for nitrogen application. I further understand that the certification does not create any liability for claims for environmental violations."

Quantifiable Milestones and Time Schedules

7. As shown in **Table C.1-2**, the fertilizer nitrogen application limits go into effect during the second year of the this Order (December 31, 2023).

8. As shown in **Table C.1-3**, the nitrogen discharge targets go in to effect during the second year of this Order (December 31, 2023) and nitrogen discharge limits go in to effect during the fifth year of this Order (December 31, 2027).

Fertilizer Nitrogen Application Limits

9. Dischargers must not apply fertilizer nitrogen (**A_{FER}**) at rates greater than the limits in **Table C.1-2.** Compliance with fertilizer nitrogen application limits is assessed for each specific crop reported in the TNA report or INMP Summary report.

Nitrogen Discharge Targets and Limits

10. This Order requires Dischargers to submit information on nitrogen applied (**A**) and nitrogen removed (**R**). This Order also establishes nitrogen discharge targets and limits based on the calculation of nitrogen applied minus nitrogen removed (**A-R**) using the formulas below. Nitrogen must not be discharged at rates greater than the targets and limits in **Table C.1-3**. Compliance with nitrogen discharge targets and limits is assessed annually for the entire ranch in the INMP Summary report through one of the **three compliance pathways** shown below. Compliance with all pathways is not required.

Compliance Pathway 1:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R = \text{Nitrogen Discharge}$$

OR

Compliance Pathway 2:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$$

OR

Compliance Pathway 3:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R = \text{Nitrogen Discharge}$$

In all formulas, $R = R_{HARV} + R_{SEQ} + R_{SCAVENGE} + R_{TREAT} + R_{OTHER}$

a. **A_{FER}** is the amount of fertilizer nitrogen applied in pounds per acre.
b. **C** is the compost discount factor used to represent the amount of compost nitrogen mineralized during the year that the compost was applied.
c. **A_{COMP}** is the total amount of compost nitrogen applied in pounds per acre.
d. **O** is the organic fertilizer discount factor used to represent the amount of nitrogen mineralized during the first 12 weeks in the year it was applied.
e. **A_{ORG}** is the total amount of organic fertilizer or amendment nitrogen applied in pounds per acre.

f. $\mathbf{A_{IRR}}$ is the amount of nitrogen applied in the irrigation water estimated from the volume required for crop evapotranspiration (ET) in pounds per acre.
g. **R** is the amount of nitrogen removed from the field through harvest, sequestration, or other removal methods, in pounds per acre.
h. $\mathbf{R_{HARV}}$ is the amount of nitrogen removed from the field through harvest or other removal of crop material.
i. $\mathbf{R_{SEQ}}$ is the amount of nitrogen removed from the field through sequestration in woody materials of permanent or semi-permanent crops.
j. $\mathbf{R_{SCAVENGE}}$ is the amount of nitrogen removed from the field through nitrogen scavenging cover crops and/or nitrogen scavenging high carbon amendments during the wet/rainy season.
k. $\mathbf{R_{TREAT}}$ is the amount of nitrogen removed from the ranch through a quantifiable treatment method (e.g., bioreactor).
l. $\mathbf{R_{OTHER}}$ is the amount of nitrogen removed from the ranch through other methods not previously quantified.

11. The Central Coast Water Board encourages the use of irrigation water nitrogen as a method of reducing the amount of fertilizer nitrogen applied to crops. The use of irrigation water nitrogen is typically referred to as “pump and fertilize” and is incentivized through compliance pathway 2 and 3 in **Table C.1-3**. The amount of irrigation water nitrogen is not used in the compliance calculation in these compliance pathways. The amount of irrigation water nitrogen must be reported regardless of the compliance pathway.

12. The Central Coast Water Board encourages the use of compost to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state’s Healthy Soils Initiative. All compost nitrogen ($\mathbf{A_{COMP}}$) applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of compost is incentivized through the option for Dischargers to use a compost “discount” factor (**C**). Dischargers may use the compost discount factor provided by the Central Coast Water Board in the MRP or may determine their own discount factor. The discounted compost nitrogen must, at a minimum, represent the amount of compost mineralized during the year the compost was applied to the ranch. If the Discharger uses their own compost discount factor, they must maintain records of the method used to determine the compost discount factor in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.

13. The Central Coast Water Board encourages the use of organic fertilizers and amendments to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state’s Healthy Soils Initiative. All organic fertilizer and amendment nitrogen ($\mathbf{A_{ORG}}$) applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of organic fertilizers and amendments is incentivized through the option for Dischargers to

use an organic fertilizer “discount” factor (**O**). Dischargers may use the organic fertilizer discount factor associated with the products C:N ratio, provided by the Central Coast Water Board in the MRP. The discounted organic fertilizer nitrogen must, at a minimum, represent the amount of organic fertilizer mineralized during the first 12 weeks the organic fertilizer was applied to the ranch. The Discharger must maintain records of the organic products used and their associated C:N ratios in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request. The following products are not eligible to receive an organic fertilizer discount: a) products with no organic compounds (long chain carbon) molecules, such as conventional fertilizer, slow release fertilizers, b) products that do not depend on microbial mineralization to release nitrogen to mineral form to make it available for crop uptake, c) products without C:N ratio information available, and d) organic liquid fertilizers that are in the liquid and/or emulsified form.

14. The amount of **crop material** removed through harvest or other methods (**R_{HARV}**) must be calculated using the formula described below. Dischargers must either use the crop-specific conversion coefficient values found in the MRP or develop their own conversion coefficient values following the approved method in the MRP. If Dischargers develop their own conversion coefficient, they must maintain information on the method used in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.

    R_{HARV} = Conversion Coefficient x Material Removed

    a. The **Conversion Coefficient** is a crop-specific coefficient used to convert from units of material removed per acre to units of nitrogen removed per acre.
    b. **Material Removed** is the amount of nitrogen-containing material removed from the field, in units of pounds per acre.

15. The amount of nitrogen removed through **sequestration** in woody material of permanent or semi-permanent crops (**R_{SEQ}**) must be estimated by the Discharger. Dischargers must maintain records detailing how they estimated the amount of nitrogen sequestered in their permanent crops. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

16. The Central Coast Water Board encourages Dischargers to implement best management practices that reduce nitrogen leaching in the wet/rainy season. Dischargers may claim a nitrogen scavenging credit (**$R_{SCAVENGE}$**) provided by the Central Coast Water Board in the MRP, one time per year for each ranch acre where nitrogen scavenging cover crops or nitrogen scavenging high carbon amendments are utilized during the wet/rainy season. The total acres receiving

the nitrogen scavenging credit may not exceed the ranch acres. Dischargers electing to claim the nitrogen scavenging credit must ensure that their cover crop and/or high carbon amendment best management practice meets the definitions of a nitrogen scavenging cover crop and/or nitrogen scavenging high carbon amendment, as noted in the MRP and Definitions. Substantiating records for this credit must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

17. The Central Coast Water Board encourages Dischargers to develop and implement innovative methods for removing nitrogen from the environment to improve water quality. Dischargers may use treatment methods (e.g., bioreactors) to remove nitrogen from groundwater or surface water and may count this towards their nitrogen removal (**R**) value if they are able to quantify the amount of nitrogen removed from ranch discharge to groundwater or surface water. This quantified removal through treatment or other innovative methods must be reported as $\mathbf{R_{TREAT}}$. Dischargers electing to account for this nitrogen removal must monitor the volume and concentration of water entering and exiting their treatment system and calculate the amount of nitrogen removed. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

18. If Dischargers remove additional nitrogen through means other than removing crop material ($\mathbf{R_{HARV}}$), sequestration ($\mathbf{R_{SEQ}}$), scavenging credit ($\mathbf{R_{SCAVENGE}}$), or treatment methods ($\mathbf{R_{TREAT}}$), they must quantify and report this additional removal as $\mathbf{R_{OTHER}}$. Dischargers must maintain records detailing how they calculated $\mathbf{R_{OTHER}}$. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

19. The discharge of nitrogen in excess of the nitrogen discharge **targets** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, and increased monitoring and/or reporting.

20. The discharge of nitrogen in excess of the nitrogen discharge **limits** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, increased monitoring and reporting, and/or progressive enforcement actions.

21. Dischargers who apply more fertilizer nitrogen ($\mathbf{A_{FER}}$) than the fertilizer nitrogen application limits in **Table C.1-2** to any specific crop **and** who are able to demonstrate compliance with the **final** nitrogen discharge limits, as shown in **Table C.1-3**, are exempt from the fertilizer nitrogen application limit.

22. Dischargers who can quantifiably demonstrate that their ranches pose no threat to surface water quality or groundwater quality may submit a technical report to the Executive Officer for review. If approved, the Discharger is not required to conduct the nitrogen application (**A**) or removal (**R**) monitoring and reporting or to submit the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. The technical report must demonstrate that nitrogen applied at the ranch does not percolate below the root zone in an amount that could degrade groundwater and does not migrate to surface water through discharges, including drainage, runoff, or sediment erosion. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.

23. Dischargers who can quantifiably demonstrate that their ranch is achieving the **final** nitrogen discharge limits , as shown in **Table C.1-3,** are not required to submit the nitrogen removal (**R**) reporting in the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. Example situations where this may apply include participation in an approved third-party program that certifies that the Discharger is meeting the final discharge limit and will continue to do so for the duration of the Discharger's participation in the approved third-party program, or by submitting a technical report, subject to Executive Officer review, that quantifies the amount of nitrogen discharge based on the volume and nitrogen concentration of all discharges from the ranch. In these situations, confirmation of membership in the approved third-party program or Executive Officer approval of a submitted technical report constitute compliance with the nitrogen removed (**R**) reporting requirement in the INMP Summary report. This exemption only applies to removal (**R**) in the INMP Summary report; all other requirements, including the TNA report, still apply as described in this Order. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the nitrogen removal (R) reporting information in the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.

24. Dischargers, groups of dischargers or commodity groups who can quantify the amount of nitrogen discharged from their ranch or for specific crops or via specific management practices by directly monitoring it at the points of discharge can propose an alternative monitoring methodology to comply with the nitrogen

discharge targets and limits, in lieu of using the A-R compliance formulas. Example situations where this may apply includes greenhouse, nursery, container production or intensive crop production where irrigation and drain water is captured and allows for direct monitoring of discharges. For these types of situations, it may be easier to monitor nitrogen discharge than to calculate the amount of nitrogen removed at harvest for each one of the many different crops and plants being grown. Dischargers must submit a request to the Executive Officer with a technical report of the methodology proposed to quantify nitrogen discharges. The methodology must include enough information to quantify the amount of nitrogen discharged and confirm compliance with the nitrogen discharge targets and limits, as shown in **Table C.1-3 or Table C.2-2** (for Dischargers participating in the Third-Party Alternative Compliance Pathway Program for Groundwater Protection described in **Part 2, Section C.2)**. Acceptable methodologies must include direct measurements of the volume and nitrogen concentration of the water discharged from each ranch per acre and year. Executive Officer approval of the method(s) must be granted before the discharger begins reporting nitrogen discharge based on the proposed methodology. Dischargers who obtain Executive Officer approval to directly monitor their nitrogen discharge from their ranches will not be required to submit nitrogen removal (R) reporting in the INMP Summary report. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway program for groundwater protection.

25. The initial 2027 nitrogen discharge limits, as shown in **Table C.1-3** will be re-evaluated based on Discharger reported nitrogen applied and removed data, new science, and management practice implementation and assessment before becoming effective.

Monitoring and Reporting

26. Dischargers must report on management practice implementation and assessment electronically in the **ACF**, as described in the MRP.

27. Dischargers must record and report total nitrogen applied to all crops grown on the ranch, electronically in the TNA report form, as described in the MRP.

28. Dischargers must track and record the following elements of the INMP Summary report that are not included in the TNA report: total nitrogen removed from the ranch and information on irrigation water application and discharge volumes. Dischargers must submit this information electronically in the INMP Summary report form as described in the MRP.

29. The INMP Summary report contains the same nitrogen application information as the TNA report, plus additional information related to nitrogen removed and irrigation management. **Therefore, the INMP Summary report satisfies the**

TNA report requirement and an additional TNA report is not required to be submitted when the INMP Summary report is submitted to the Central Coast Water Board.

30. Dischargers must conduct **irrigation well monitoring and reporting prior to the start of groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.

31. Dischargers must conduct **on-farm domestic well monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.

32. Dischargers must conduct **groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP. This requirement applies to all Dischargers enrolled in this Order, regardless of how many wells are currently present on their ranch.

    a. Dischargers who elect to perform groundwater quality trend monitoring and reporting as part of a **third-party** effort must form or join a third-party. The third-party must submit a work plan for Executive Officer review by the dates and covering the areas specified in the MRP unless it is associated with the Third-Party Alternative Compliance Pathway for Groundwater Protection described in **Part 2, Section C.2**. The work plan must be approved by the Executive Officer prior to implementation. Once approved by the Executive Officer, the work plan must be implemented.
    b. Dischargers who elect to perform groundwater quality trend monitoring and reporting individually must submit a work plan for Executive Officer review, by the date specified in the MRP, based on their ranch location. The work plan must be approved by the Executive Office prior to implementation. The work plan must describe how the ranch-level groundwater quality trend monitoring program will evaluate groundwater quality trends over time and assess the impacts of agricultural discharges on groundwater quality. Once approved by the Executive Officer, the work plan must be implemented. Dischargers without a well on their property may comply with individual ranch-level groundwater quality trend monitoring and reporting requirements by implementing one of the options specified in the MRP.

33. When required by the Executive Officer based on groundwater quality data or significant and repeated exceedance of the nitrogen discharge targets or limits, Dischargers must complete **ranch-level groundwater discharge monitoring and reporting**, either individually or as part of a third-party effort as described in the MRP. Water Board staff will coordinate with Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming requirement. When ranch-level groundwater discharge monitoring and reporting is required, a work

plan, including a SAP and QAPP, must be submitted for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. Ranch-level groundwater discharge monitoring may be discontinued with the approval of the Executive Officer when the Discharger comes into compliance with the nitrogen discharge targets or limits, or the discharge has otherwise ceased.

Part 2, Section C.2. Third-Party Alternative Compliance Pathway for Groundwater Protection

1. Dischargers that are members in good standing in the third-party alternative compliance pathway program are subject to the provisions of this **Part 2, Section C.2**, unless otherwise stated. For purposes of this section, such Dischargers are referred to as "participating Dischargers."

   Participating dischargers:

   a. Are not subject to fertilizer nitrogen application limits in **Table C.1-2**, which are enforceable by the Central Coast Water Board.
   b. Are not subject to nitrogen discharge limits in **Table C.1-3**, which are enforceable by the Central Coast Water Board.
   c. Are subject to targets, which if exceeded result in consequences outlined in this **Part 2, Section C.2**.
   d. Are not subject to ranch-level groundwater discharge monitoring and reporting.
   e. Are generally provided more time to achieve fertilizer nitrogen application targets and nitrogen discharge targets, relative to non-participating dischargers.

2. Prior to the initiation of the work plan process outlined below and in the MRP for this third-party alternative compliance pathway program, entities wishing to implement the third-party alternative compliance pathway program described in this **Part 2, Section C.2** must submit a third-party alternative compliance pathway program proposal consistent with the third-party program requirements outlined in **Part 2, Section A** of this Order, as well as the request for proposal process and associated third-party program expectations document forthcoming after Order adoption. For purposes of this section, the entity approved to implement the third-party alternative compliance pathway is referred to as the approved third-party alternative compliance pathway program administrator.

3. Participating Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses groundwater. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of

APPENDIX G-4

Stream Channel Cross Sections

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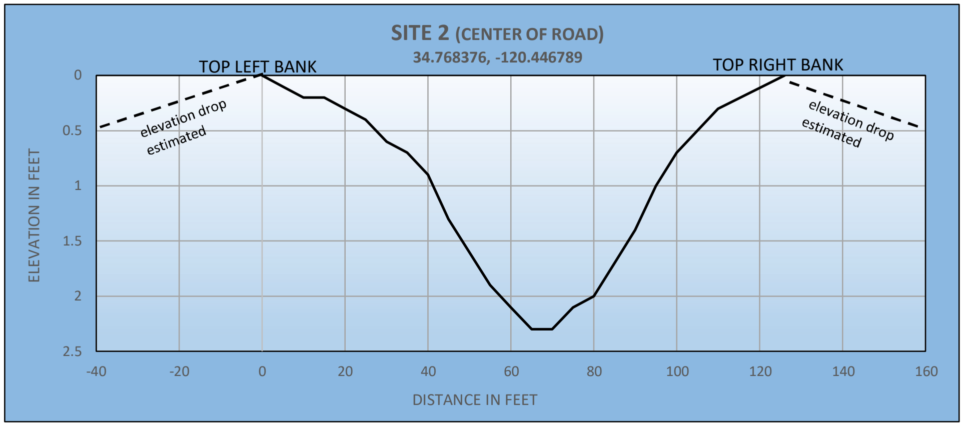
SITE 2

-20	
0	0
5	0.1
10	0.2
15	0.2
20	0.3
25	0.4
30	0.6
35	0.7
40	0.9
45	1.3
50	1.6
55	1.9
60	2.1
65	2.3
70	2.3
75	2.1
80	2
85	1.7
90	1.4
95	1
100	0.7
110	0.3
126	0
136	



SITE 1

-20	
0	0
27	0.2
36	0.5
50	0.9
55	1.3
60	1.7
65	1.8
67	1.9
70	2.4
72	2.5
74	2.5
78	2.5
80	2.1
83	2
85	1.8
90	1.5
95	1.1
100	0.9
105	0.5
110	0.2
117	0
140