Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan

January 2022

Prepared for:

SCV GSA

Santa Clarita Valley
Groundwater Sustainability Agency

Prepared by:

GSI Water Solutions, Inc.

GSI Water Solutions, Inc.
418 Chapala Street, Suite H, Santa Barbara, CA 93101

Luhdorff & Scalmanini Consulting Engineers

ESA

Geosyntec consultants

GHD

KJ Kennedy Jenks

RCS RICHARD C. SLADE & ASSOCIATES LLC
CONSULTING GROUNDWATER GEOLOGISTS

Santa Clarita Valley Groundwater Sustainability Agency

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Prepared for:
Board of Directors, Santa Clarita Valley Groundwater Sustainability Agency
c/o SCV Water – Santa Clarita
27234 Bouquet Canyon Road
Santa Clarita, CA 91350

GSI Water Solutions, Inc.

GSI Water Solutions, Inc. (GSI), Richard C. Slade & Associates LLC (RCS), Luhdorff and Scalmanini Consulting Engineers (LSCE), Environmental Science Associates (ESA), Geosyntec Consultants, Inc. (Geosyntec), and GHD, Inc. (GHD) are 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.

The GSP was prepared by the following authors:

Jeff Barry (GSI)
Project Manager and Principal Hydrogeologist

John Porcello (GSI)
Principal Hydrologist and Water Resources Consultant

REGISTERED GEOLOGIST
PAUL A. SORENSEN
NO. 154
CERTIFIED HYDROGEOLOGIST
STATE OF CALIFORNIA

Paul Sorensen (GSI)
Principal Hydrogeologist and Water Resources Consultant

PROFESSIONAL GEOLOGIST
ANTHONY S. HICKE
CERTIFIED HYDROGEOLOGIST
No. 858
STATE OF CALIFORNIA

Anthony Hicke, PG, CHG (RCS)
Senior Groundwater Geologist

PROFESSIONAL GEOLOGIST
WILLIAM L. HALLIGAN
No. 7056
STATE OF CALIFORNIA

William Halligan, PE (LSCE)
Senior Principal Hydrologist

Tom Barnes (ESA)
Southern California Water Resources Director

Mark Hanna, PhD, PE, LEED AP (Geosyntec)
Senior Principal Water Resources Engineer

Roy Thun, MBA, PG, ENV SP (GHD)
Senior Environmental Specialist

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Contents

Tables

Figures

Appendices

Abbreviations and Acronyms

µg	microgram
µg/L	micrograms per liter
AB	Assembly Bill
AF	acre-feet
AFY	acre-feet per year
ASR	aquifer storage and recovery
AVEK	Antelope Valley-East Kern Water Agency
Basin	Santa Clara River Valley Groundwater Basin, East Subbasin
Basin Operating Plan	Groundwater Management Plan, Santa Clara River Valley Groundwater Basin, East Subbasin, Los Angeles County, California
Basin Plan	Water Quality Control Plan: Los Angeles Region Basin Plan for the Coastal Watershed of Los Angeles and Ventura Counties
bc	basement complex
bgs	below ground surface
BMP	best management practice
BVRRB	Buena Vista and Rosedale Rio-Bravo Water Storage Districts
BVWSD	Buena Vista Water Storage District
CalGEM	California Geologic Energy Management Division
Caltrans	California Department of Transportation
CASGEM	California Statewide Groundwater Elevation Monitoring
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CGPS	continuous global positioning system
City	City of Santa Clarita
CLWA	Castaic Lake Water Agency
COC	constituent of concern
CRWQCB	California Regional Water Quality Control Board
DAC	disadvantaged community
DCR	Delivery Capability Report
DDT	dichlorodiphenyltrichloroethane
DDW	Division of Drinking Water
DEM	digital elevation model
DEW	drier with extreme warming
DMS	Data Management System
DQO	data quality objective
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
E-log	electronic log

ESA	Environmental Science Associates
ESI	Environmental Simulations, Inc.
ET	evapotranspiration
FivePoint	FivePoint Holdings, LLC
Forest Service	U.S. Department of Agriculture Forest Service
FPB	Fillmore and Piru Basins
ft	foot or feet
ft/day	foot or feet per day
ft/ft	foot per foot
ft/mile	foot per mile
ft^2/day	square feet per day
ft^3/ft^3	cubic feet per square foot per foot
GDE	groundwater dependent ecosystem
General Plan	City of Santa Clarita General Plan
GHB	general head boundary
GIS	geographic information system
GPS	global positioning system
GSA	Groundwater Sustainability Agency
GSI	GSI Water Solutions, Inc.
GSP	Groundwater Sustainability Plan
GSSI	Geoscience Support Services, Inc.
GWE	groundwater elevation
GWMP	Groundwater Management Plan
I-5	Interstate 5
ID	identification
iGDE	GDE indicators
in/hr	inch per hour
in/yr	inch or inches per year
InSAR	Interferometric Synthetic Aperture Radar
IRWMP	Integrated Regional Water Management Plan
JPA	Joint Exercise of Powers Agreement
KJ	Kennedy Jenks
L	liter
LA	Los Angeles
LA County	County of Los Angeles
LACDPW	Los Angeles County Department of Public Works
LACDRP	Los Angeles County Department of Regional Planning
LACFCD	Los Angeles County Flood Control District
LACWD	Los Angeles County Waterworks District No. 36, Val Verde
LADPW	Los Angeles County Department of Public Works
LADWP	Los Angeles Department of Water and Power

LARWQCB	Los Angeles Regional Water Quality Control Board
LiDAR	Light Detection and Ranging
LSCE	Luhdorff and Scalmanini Consulting Engineers
MA	management area
MCL	maximum contaminant level
mg/L	milligrams per liter
MGD	million gallons per day
mm	millimeter
MO	measurable objective
MOU	memorandum of understanding
msl	mean sea level
MT	minimum threshold
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NCCAG	Natural Communities Commonly Associated with Groundwater
NCWD	Newhall County Water District
Newhall Land	The Newhall Land and Farming Company
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWD	Newhall Water Division (formerly Newhall County Water District)
NWI	National Wetland Inventory
OVOV	One Valley One Vision
PCBs	polychlorinated biphenyls
PCE	tetrachloroethylene
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
Plan	Santa Clara River Valley East Groundwater Basin Groundwater Sustainability Plan
ppb	parts per billion
ppm	parts per million
PVC	polyvinyl chloride
Qa	Quaternary Alluvium
QA/QC	quality assurance/quality control
Qt	terrace deposits
QTs	Saugus Formation
QTsr	Sunshine Ranch Member
Qtsu	upper portion of Saugus Formation
RCH	Recharge Package for MODFLOW-USG
RCS	Richard C. Slade & Associates LLC
RL	reporting limit
RMS	representative monitoring site

RRBWBP	Rosedale-Rio Bravo Water Banking Program
RRBWSD	Rosedale-Rio Bravo Water Storage District
RWQCB	Regional Water Quality Control Board
S	storativity
SAC	Stakeholder Advisory Committee
SB	Senate Bill
SCAG	Southern California Association of Governments
SCV	Santa Clarita Valley
SCV Water	Santa Clarita Valley Water Agency
SCV-GSA	Santa Clarita Valley Groundwater Sustainability Agency
SCVGWFM	Santa Clarita Valley Groundwater Flow Model
SCVSD	Santa Clarita Valley Sanitation District of Los Angeles County
SCWD	Santa Clarita Water Division (formerly Santa Clarita Water Company)
SFR	Streamflow Routing Package for MODFLOW-USG
SGMA	Sustainable Groundwater Management Act
SMC	sustainable management criteria
SMCL	secondary maximum contaminant level
SMCs	sustainable management criteria
SMGA	Sustainable Groundwater Management Act
SNMP	Salt and Nutrient Management Plan
SWAMP	Surface Water Ambient Monitoring Program
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWRU	Stored Water Recovery Unit
T	transmissivity
Tc	Castaic Formation
TCE	trichloroethene
TDS	total dissolved solids
Tms	Modelo Formation
Tm	Mint Canyon Formation
TNC	The Nature Conservancy
Tp	Pico Formation
Tt	Towsley Formation or Tick Canyon Formation
Tv	Vasquez Formation
Tvb	Violin Breccia
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTS	unarmored three-spine stickleback
UWCD	United Water Conservation District
UWMP	Urban Water Management Plan

VOC	volatile organic compound
VWD	Valencia Water Division (formerly Valencia Water Company)
WDR	Waste Discharge Requirements (WDR)
WKWD	West Kern Water District
WMW	warmer with moderate warming
WQO	water quality objective
WRP	water reclamation plant
WUE SP	Water Use Efficiency Strategic Plan
WY	water year

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Definitions

California Water Code

Sec. 10721

Unless the context otherwise requires, the following definitions govern the construction of this part:

(a) Adjudication action means an action filed in the superior or federal district court to determine the rights to extract groundwater from a basin or store water within a basin, including, but not limited to, actions to quiet title respecting rights to extract or store groundwater or an action brought to impose a physical solution on a basin.

(b) Basin means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Chapter 3 (commencing with Section 10722).

(c) Bulletin 118 means the department's report entitled California's Groundwater: Bulletin 118 updated in 2003, as it may be subsequently updated or revised in accordance with Section 12924.

(d) Coordination agreement means a legal agreement adopted between two or more groundwater sustainability agencies that provides the basis for coordinating multiple agencies or groundwater sustainability plans within a basin pursuant to this part.

(e) De minimis extractor means a person who extracts, for domestic purposes, two acre- feet or less per year.

(f) Governing body means the legislative body of a groundwater sustainability agency.

(g) Groundwater means water beneath the surface of the earth within the zone below the water table in which the soil is completely saturated with water, but does not include water that flows in known and definite channels.

(h) Groundwater extraction facility means a device or method for extracting groundwater from within a basin.

(i) Groundwater recharge or recharge means the augmentation of groundwater, by natural or artificial means.

(j) Groundwater sustainability agency means one or more local agencies that implement the provisions of this part. For purposes of imposing fees pursuant to Chapter 8 (commencing with Section 10730) or taking action to enforce a groundwater sustainability plan, groundwater sustainability agency also means each local agency comprising the groundwater sustainability agency if the plan authorizes separate agency action.

(k) Groundwater sustainability plan or plan means a plan of a groundwater sustainability agency proposed or adopted pursuant to this part.

(l) Groundwater sustainability program means a coordinated and ongoing activity undertaken to benefit a basin, pursuant to a groundwater sustainability plan.

(m) In-lieu use means the use of surface water by persons that could otherwise extract groundwater in order to leave groundwater in the basin.

(n) Local agency means a local public agency that has water supply, water management, or land use responsibilities within a groundwater basin.

(o) Operator means a person operating a groundwater extraction facility. The owner of a groundwater extraction facility shall be conclusively presumed to be the operator unless a satisfactory showing is made to the governing body of the groundwater sustainability agency that the groundwater extraction facility actually is operated by some other person.

(p) Owner means a person owning a groundwater extraction facility or an interest in a groundwater extraction facility other than a lien to secure the payment of a debt or other obligation.

(q) Personal information has the same meaning as defined in Section 1798.3 of the Civil Code.

(r) Planning and implementation horizon means a 50-year time period over which a groundwater sustainability agency determines that plans and measures will be implemented in a basin to ensure that the basin is operated within its sustainable yield.

(s) Public water system has the same meaning as defined in Section 116275 of the Health and Safety Code.

(t) Recharge area means the area that supplies water to an aquifer in a groundwater basin.

(u) Sustainability goal means the existence and implementation of one or more groundwater sustainability plans that achieve sustainable groundwater management by identifying and causing the implementation of measures targeted to ensure that the applicable basin is operated within its sustainable yield.

(v) Sustainable groundwater management means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results.

(w) Sustainable yield means the maximum quantity of water, calculated over a base 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.

(x) 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.

(y) Water budget means an accounting of the total groundwater and surface water entering and leaving a basin including the changes in the amount of water stored.

(z) Watermaster means a watermaster appointed by a court or pursuant to other law.

(aa) Water year means the period from October 1 through the following September 30, inclusive.

(ab) Wellhead protection area means the surface and subsurface area surrounding a water well or well field that supplies a public water system through which contaminants are reasonably likely to migrate toward the water well or well field.

Official California Code of Regulations (CCR)

Title 23. Waters

Division 2. Department of Water Resources

Chapter 1.5. Groundwater Management

Subchapter 2. Groundwater Sustainability Plans

Article 2. Definitions

23 CCR § 351

§ 351. Definitions.

The definitions in the Sustainable Groundwater Management Act, Bulletin 118, and Subchapter 1 of this Chapter, shall apply to these regulations. In the event of conflicting definitions, the definitions in the Act govern the meanings in this Subchapter. In addition, the following terms used in this Subchapter have the following meanings:

(a) "Agency" refers to a groundwater sustainability agency as defined in the Act.

(b) "Agricultural water management plan" refers to a plan adopted pursuant to the Agricultural Water Management Planning Act as described in Part 2.8 of Division 6 of the Water Code, commencing with Section 10800 et seq.

(c) "Alternative" refers to an alternative to a Plan described in Water Code Section 10733.6.

(d) "Annual report" refers to the report required by Water Code Section 10728.

(e) "Baseline" or "baseline conditions" refer to 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.

(f) "Basin" means a groundwater basin or subbasin identified and defined in Bulletin 118 or as modified pursuant to Water Code 10722 et seq.

(g) "Basin setting" refers to the information about the physical setting, characteristics, and current conditions of the basin as described by the Agency in the hydrogeologic conceptual model, the groundwater conditions, and the water budget, pursuant to Subarticle 2 of Article 5.

(h) “Best available science” refers to the use of sufficient and credible information and data, specific to the decision being made and the time frame available for making that decision, that is consistent with scientific and engineering professional standards of practice.

(i) “Best management practice” refers to a practice, or combination of practices, that are designed to achieve sustainable groundwater management and have been determined to be technologically and economically effective, practicable, and based on best available science.

(j) “Board” refers to the State Water Resources Control Board.

(k) “CASGEM” refers to the California Statewide Groundwater Elevation Monitoring Program developed by the Department pursuant to Water Code Section 10920 et seq., or as amended.

(l) “Data gap” refers to 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.

(m) “Groundwater dependent ecosystem” refers to ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface.

(n) “Groundwater flow” refers to the volume and direction of groundwater movement into, out of, or throughout a basin.

(o) “Interconnected surface water” refers to 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.

(p) “Interested parties” refers to persons and entities on the list of interested persons established by the Agency pursuant to Water Code Section 10723.4.

(q) “Interim milestone” refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

(r) “Management area” 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.

(s) “Measurable objectives” 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.

(t) “Minimum threshold” refers to a numeric value for each sustainability indicator used to define undesirable results.

(u) “NAD83” refers to the North American Datum of 1983 computed by the National Geodetic Survey, or as modified.

(v) “NAVD88” refers to the North American Vertical Datum of 1988 computed by the National Geodetic Survey, or as modified.

(w) “Plain language” means language that the intended audience can readily understand and use because that language is concise, well-organized, uses simple vocabulary, avoids excessive acronyms and technical language, and follows other best practices of plain language writing.

(x) “Plan” refers to a groundwater sustainability plan as defined in the Act.

(y) “Plan implementation” refers to an Agency's exercise of the powers and authorities described in the Act, which commences after an Agency adopts and submits a Plan or Alternative to the Department and begins exercising such powers and authorities.

(z) “Plan manager” is an employee or authorized representative of an Agency, or Agencies, appointed through a coordination agreement or other agreement, who has been delegated management authority for submitting the Plan and serving as the point of contact between the Agency and the Department.

(aa) “Principal aquifers” refer to aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems.

(ab) “Reference point” refers to a permanent, stationary and readily identifiable mark or point on a well, such as the top of casing, from which groundwater level measurements are taken, or other monitoring site.

(ac) “Representative monitoring” 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.

(ad) “Seasonal high” refers to the highest annual static groundwater elevation that is typically measured in the Spring and associated with stable aquifer conditions following a period of lowest annual groundwater demand.

(ae) “Seasonal low” refers to the lowest annual static groundwater elevation that is typically measured in the Summer or Fall, and associated with a period of stable aquifer conditions following a period of highest annual groundwater demand.

(af) “Seawater intrusion” refers to the advancement of seawater into a groundwater supply that results in degradation of water quality in the basin, and includes seawater from any source.

(ag) “Statutory deadline” refers to the date by which an Agency must be managing a basin pursuant to an adopted Plan, as described in Water Code Sections 10720.7 or 10722.4.

(ah) “Sustainability indicator” refers to any of the effects caused by groundwater conditions occurring throughout the basin that, when significant and unreasonable, cause undesirable results, as described in Water Code Section 10721(x).

(ai) “Uncertainty” refers to 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.

(aj) “Urban water management plan” refers to a plan adopted pursuant to the Urban Water Management Planning Act as described in Part 2.6 of Division 6 of the Water Code, commencing with Section 10610 et seq.

(ak) “Water source type” represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

(al) “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.

(am) “Water year” refers to the period from October 1 through the following September 30, inclusive, as defined in the Act.

(an) “Water year type” refers to the classification provided by the Department to assess the amount of annual precipitation in a basin.

Executive Summary

ES-1 Introduction

Even though you can't see it, groundwater is one of our most valuable resources. Some of the water you use for drinking, cooking, bathing, watering your yard, irrigating your land—even filling your pool—comes from groundwater pumped from aquifer systems underlying the Santa Clarita Valley. Without this important local supply, we would have to buy additional water from other sources. This imported water is more expensive and less reliable during drought. Managed by the Santa Clarita Valley Groundwater Sustainability Agency (SCV-GSA), the two local aquifers that comprise the Santa Clara River Valley East Groundwater Subbasin (Basin) are the primary sources of all local groundwater for prime farmland and hundreds of thousands of people living and working in the Santa Clara River Valley (Valley).

Under the Sustainable Groundwater Management Act (SGMA), which was passed in January of 2015 by the state legislature, local water agencies are required to develop a detailed road map for maintaining or bringing their groundwater basin into a healthy balance (i.e., a sustainable condition) within the next 20 years. When a basin is in a healthy balance, pumping water out of the aquifers is balanced with the inflow from rainfall that recharges the aquifers, thereby ensuring there is enough water for the Valley's population as well as for the Santa Clara River and the lush habitat for plants, fish, amphibians, reptiles, and birds that helps make this valley such an enjoyable place to live. We are very fortunate in our basin because we have a groundwater resource that is sustainable under a range of climate and pumping conditions and we believe, based on sound science, that this condition will continue into the foreseeable future without any undesirable results.

The SGMA law established deadlines for reaching sustainability (in this basin, our focus is on maintaining sustainability) and empowered local agencies to form groundwater sustainability agencies (GSAs) to manage groundwater basins and develop groundwater sustainability plans (GSPs), such as this document. In his signing statement, Governor Brown emphasized that "groundwater management in California is best accomplished locally." To that end, the Santa Clarita Valley Water Agency (SCV Water), the City of Santa Clarita (City), the County of Los Angeles (LA County), and the Los Angeles County Waterworks District No. 36, (LACWD), serving Val Verde, signed a legal agreement to collaborate as the SCV-GSA.

This Santa Clara River Valley East Groundwater Subbasin GSP provides information about the area affected by this plan, the basin setting, the quantitative methods (sustainable management criteria, or SMCs) for evaluating the health (sustainability) of the Basin, the monitoring networks, projects and management actions to achieve sustainability, and the implementation plan for the GSP. This document also includes the list of references and technical studies used in the development of this plan and several supporting appendices. The SCV-GSA has taken many steps, starting with stakeholder engagement, to complete the GSP in accordance with the requirements of the California Department of Water Resources (DWR). The following graphic shows the activities leading to the final accepted GSP.

ACTIVITIES LEADING TO AN ACCEPTED GSP

Work on the GSP began in 2017 with community workshops, an active website, and input from a stakeholder advisory committee made up of local environmental and business interests, groundwater pumpers, and residents. This public process has focused on balancing the perspectives and well-being of all groundwater users. This plan considers the sources and uses of water from the Basin and the changes that might occur due to population growth and other factors, particularly changes in rainfall, streamflows, and climate change. SCV-GSA also studied groundwater dependent ecosystems, or GDEs, which are habitats in which plants and animals rely on groundwater for survival.

This background helped SCV-GSA establish sustainable management criteria to avoid undesirable results for a number of sustainability indicators spelled out in SGMA, including chronic lowering of groundwater levels, reduced groundwater in storage, degraded water quality, land subsidence, and depletion of surface water. SGMA also requires that GSAs identify GDEs and DWR requires assessing the effects of changing groundwater levels on GDEs. The GSP includes a robust monitoring program and defines projects and management actions that have been developed to ensure long-term groundwater sustainability. Fortunately, we have learned through development of this plan that the Basin is operating in a sustainable manner and the river habitat is resilient over wet and dry periods.

Over the past five decades, many studies have been conducted in the Basin relating to water demand, water supply, and water quality. For the first time, all this information has been assembled in one place, this GSP. This GSP also considers the interests of all those who depend on groundwater in the Basin, including domestic well owners, agricultural interests, municipal well owners and operators, and interest groups and individuals who work to protect GDEs—all of whom are represented on the SCV-GSA Stakeholder Advisory Committee. This GSP has been planned and developed collaboratively by the SCV-GSA member organizations, with review and input from the Stakeholder Advisory Committee, and input from the public. The organization of this plan is as follows:

- **Section 1 – Introduction to the Santa Clara River Valley East Subbasin Groundwater Sustainability Plan:** An introduction to the GSP, including a description of its purpose and a brief description of the Basin.
- **Section 2 – Agencies' Information:** Information on the SCV-GSA as an organization and a brief description of each of the SCV-GSA member organizations, including information on the legal authority of the GSA to plan and coordinate groundwater sustainability for the Basin.
- **Section 3 – Description of Plan Area:** A detailed description of the Basin, land uses in the Basin, existing wells and monitoring programs, existing groundwater management plans and regulatory programs, any programs for conjunctive use, and urban land use programs.
- **Section 4 – Hydrogeologic Conceptual Model:** An explanation of the hydrogeologic conceptual model developed for the Basin that includes water sources and uses, a general description of water quality, and a description of the data gaps in the current model.
- **Section 5 – Groundwater Conditions:** A detailed description of the groundwater conditions, including groundwater levels and flow directions, changes in storage, the potential for seawater intrusion or land subsidence to occur, locations where surface water and groundwater are interconnected, the identification and distribution of groundwater-dependent ecosystems (GDEs), and a discussion of groundwater quality for drinking water and agricultural irrigation.
- **Section 6 – Water Budgets:** A presentation of the historical, current, and projected future water budgets for the Basin, including quantification of the estimated change in storage for the historical, current, and projected future water budgets.
- **Section 7 – Monitoring Networks:** A detailed description of the monitoring objectives and monitoring programs for groundwater levels, storage, water quality, land subsidence, and interconnected surface water; the locations of representative monitoring sites and a description of the data management and reporting system.
- **Section 8 – Sustainable Management Criteria:** Defines the sustainability goal for the Basin, describes the process through which SMCs were established; describes and defines SMCs pertaining to chronic lowering of groundwater levels, reduction in groundwater storage, seawater intrusion, degraded water quality, land subsidence, and depletion of interconnected surface water; defines management areas for the Basin, and describes how management-area operations will avoid undesirable results.
- **Section 9 – Management Actions and Projects:** A list and description of each project and management action to address data gaps, describe procedures that will be followed if undesirable results are observed, and obtain information needed to manage the Basin. Optional projects intended to improve resiliency to drought are also included.
- **Section 10 – Groundwater Sustainability Plan Implementation:** Presents a planning-level estimate of implementation costs and a schedule for proposed projects and management actions.
- **Section 11 – Notice and Communications:** Presents SCV-GSA's communications and engagement planning and implementation, public feedback and stakeholder comments on the plan, how feedback was incorporated into the plan, and responses to comments received.

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

ES-2 Hydrogeologic Conceptual Model (GSP Sections 4 and 5)

Sections 4 and 5 of the GSP present a narrative that describes the physical setting of the Basin and its groundwater conditions. This narrative is called a hydrogeologic conceptual model; it describes how the Basin groundwater system works. The hydrogeologic conceptual model is based on the available body of data and prior studies of the Basin's geology, hydrology, and water quality. In this GSP, the hydrogeologic conceptual model is the foundation on which water budget analyses are conducted and sustainable management criteria are developed. However, the hydrogeologic conceptual model is not a static narrative; it also incorporates the results of the water budget and SMC development efforts and will continue to evolve over time as data from future monitoring programs described in this GSP are collected and interpreted.

ES-2.1 Principal Aquifer Systems

Figure ES-1 is a diagram depicting the two principal aquifers in the Basin (the surficial Alluvial Aquifer and the Saugus Formation), their sources of recharge, and the mechanisms by which groundwater is discharged from these aquifers in the Basin. The thickness of the Alluvial Aquifer varies along the length of the Santa Clara River, reaching a maximum thickness of about 200 feet at several wells in the center of the Valley. The alluvial sediments generally thin progressively away from the valley center towards the surrounding hills. The Saugus Formation underlies the Alluvial Aquifer and is present throughout all but the easternmost portion of the Basin. The upper portion of the Saugus Formation is up to 5,000 feet thick and consists of coarse-grained sand and gravel beds that contain usable groundwater. Generally, the upper 500 to 2,000 feet of the upper portion of the Saugus Formation is accessed by groundwater supply wells. The lower portion of the Saugus Formation (the Sunshine Ranch Member) is up to 3,500 feet thick and is composed of fine-grained sediments with low permeability and does not provide groundwater in sufficient quantity or adequate quality for municipal or other uses.

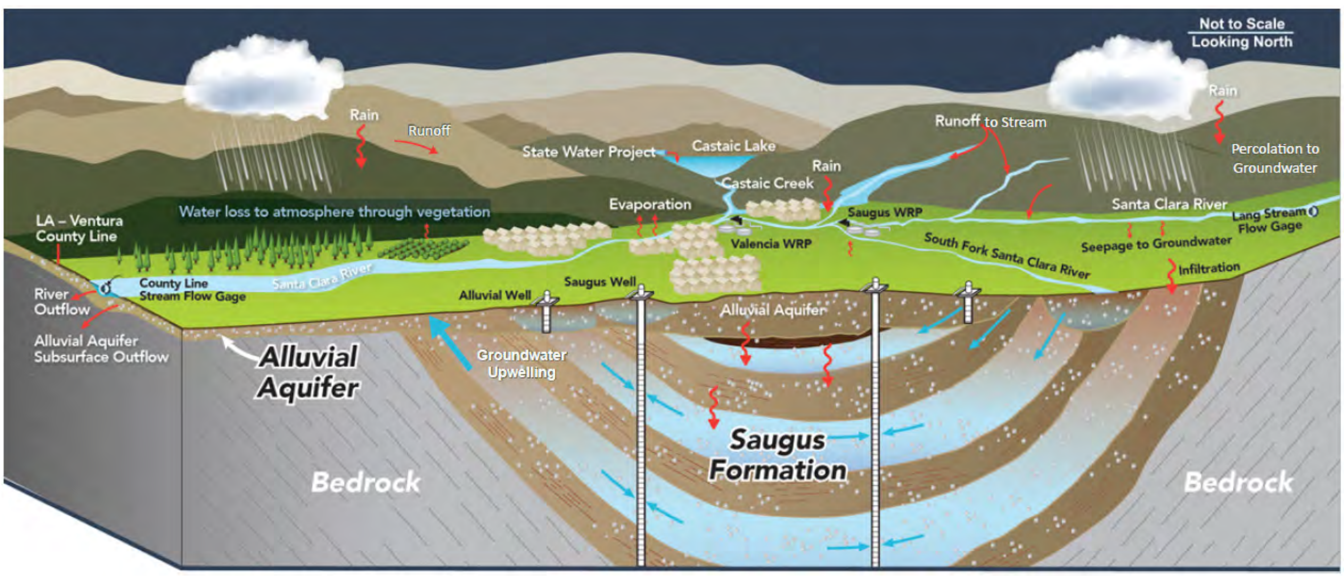


Figure ES-1. The Two Principal Aquifers in the Basin: the Alluvial Aquifer and the Saugus Formation

ES-2.2 Groundwater-Surface Water Interactions

The Santa Clara River is the primary surface water drainage feature in the Basin, flowing generally from east to west. The river is in direct connection with the Alluvial Aquifer system. In the eastern portion of the Basin, the river is ephemeral, with its periodic stormwater flows serving to recharge the Alluvial Aquifer. In the western and central portions of the Basin, groundwater discharges into the river beginning at approximately the mouth of San Francisquito Canyon (just east of I-5). The river also has an indirect connection with the Saugus Formation in the western portion of the Basin, which is an area where the Saugus Formation is discharging its water into the Alluvial Aquifer, and thereby providing an upwards driving force for groundwater to discharge into the Santa Clara River in certain localized reaches west of I-5 at certain times.

The amount and direction of the exchange between the Santa Clara River and the alluvial groundwater system in the Basin is dependent on a number of factors including cycles of wet/normal/dry rainfall conditions, water reclamation plant (WRP) discharges to the river, releases from Castaic Reservoir, evapotranspiration from riparian vegetation (native and invasive species) along the river corridor, stormwater flows, and groundwater pumping. Importation of State Water Project water into the Basin began in the 1980s and has increased the recharge into the Basin from urban irrigation and discharges from the WRPs, resulting in a net increase in the amount of water in the groundwater/surface water system.

ES-2.3 Recharge and Discharge in the Basin

Sources of natural recharge to groundwater in the Basin are:

- Streamflow infiltration from runoff along the Santa Clara River and its tributaries.
- Deep percolation of direct rainfall.
- Subsurface groundwater inflow from upstream areas along the Santa Clara River and its tributaries.
- Upward groundwater flow from certain portions of the Saugus Formation where it is overlain by alluvium, primarily in areas west of Bouquet Canyon.

Sources of anthropogenic (human-made) recharge to groundwater in the Basin are:

- Deep percolation of irrigation water as urban irrigation (landscape irrigation) in the developed areas of the groundwater basin and from areas that are farmed.
- Infiltration of reclaimed water that is actively treated by and discharged from the Saugus WRP and the Valencia WRP. Both plants are operated by the Los Angeles County Sanitation District and together discharge approximately 18 million gallons of treated water per day to the Santa Clara River, with an average annual discharge of approximately 20,000 acre-feet per year (AFY). A portion of the treated water from the Saugus WRP is discharged to the Santa Clara River northwest of the intersection of Bouquet Canyon Road and Valencia Boulevard, while the remainder is conveyed to the Valencia WRP for additional treatment and then released to the Santa Clara River west of Interstate 5.
- Treated water from septic systems in unsewered areas is an additional source of groundwater recharge.

Discharges from the Basin's groundwater system are:

- Groundwater extraction for municipal, agricultural, and domestic supply uses.
- Evapotranspiration (evaporation from plant leaves) by phreatophyte vegetation (plants living in proximity to the river and tributaries). Phreatophytes are native plants such as willows and cottonwoods, as well as invasive species such as *Arundo donax* (*Arundo*) and tamarisk, that root directly into or just above the water table in areas of shallow groundwater.
- Groundwater discharge from the Alluvial Aquifer to the Santa Clara River in the westernmost part of the Basin. The amount of flow into the river at any given time depends largely on water levels within the alluvium.
- Groundwater underflow out of the Basin into Ventura County, which occurs through a relatively thin veneer of alluvium that is present on top of the Pico Formation at the western basin boundary.

Groundwater wells completed in the Alluvial Aquifer in the eastern part of the Basin (at and upstream of the Saugus WRP) have water levels that are heavily influenced by climatic conditions, exhibiting gradual declines of several tens of feet over 5- to 10-year periods when there are below-normal periods of rainfall, followed by rapid recoveries during wet periods. Generally, one to two consecutive wet years can provide enough recharge to replenish the Alluvial Aquifer in the eastern part of the Basin. Alluvial Aquifer wells in the central and western portion of the Basin show smaller responses to rainfall cycles, particularly downstream of the

Valencia WRP where the Saugus Formation discharges groundwater into the Alluvial Aquifer. Saugus Formation wells also show smaller and more delayed responses to rainfall cycles than are seen in the eastern portion of the Alluvial Aquifer.

With some exceptions, the quality of groundwater in the Basin's two primary aquifer systems is suitable for drinking water and agricultural uses.

- Concentrations of salts and nutrients (e.g., total dissolved solids, chloride, sulfate, nitrate) meet federal drinking water standards, but in some cases, depending upon location, do not meet the state water quality objectives (WQOs) set by the Los Angeles Regional Water Quality Control Board (RWQCB). For example, concentrations of total dissolved solids (TDS, a measure of salt content) and sulfate exceed the WQO in some locations. A salt and nutrient management plan (SNMP) was approved by the RWQCB for the Basin in 2016 and this plan is used to manage salt and nutrient concentrations in the Basin.
- Groundwater contamination—including perchlorate, tetrachloroethylene (PCE), trichloroethylene (TCE), and per- and polyfluoroalkyl substances (PFAS)—has been detected in several wells. SCV Water is installing wellhead treatment on all affected wells to make sure water served to its customers meets drinking water standards and continues to closely monitor its wells. SCV Water is also actively coordinating with the state RWQCB and the Department of Toxic Substances Control, agencies that are investigating sources of contamination and managing the remediation of the contamination.

ES-2.4 Groundwater Dependent Ecosystems (GDEs)

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 seeps and springs; wetlands and lakes; terrestrial vegetation connected to shallow groundwater; and rivers, streams and estuaries. Figure ES-2 shows the locations of GDEs in the Basin, as identified through screening methods developed by The Nature Conservancy, field mapping and verification, and local data on the spatial and temporal variations in the water table depth below ground surface. Much of the acreage associated with the mapped GDEs occurs in the main stem of the Santa Clara River. However, many smaller potential GDEs are identified in the tributaries reaching into the higher elevations. Some potential GDEs in the higher elevations may be fed from higher elevation seepage disconnected from the main groundwater basin.

The GDEs consist of both riparian and aquatic habitat.

- **Riparian habitat** in the Basin supports several special status avian species including the least Bell's vireo and southwestern willow flycatcher. These species are found in the willow and riparian mixed hardwood forests occurring along the length of the Santa Clara River in the central and western portions of the Basin. Riparian habitat requires a reliable water source. Willow forests occur in areas where groundwater is available year-round. Willow root zones occur most prominently within 1 to 5 feet below the surface but may reach depths of up to 8 feet. Root depths of mature cottonwood trees may reach over 16 feet.
- **Aquatic habitat** in the Basin may support several special status species, including the arroyo toad and native fishes, including the unarmored three-spined stickleback fish (UTS), and the Santa Ana sucker. The UTS have been found in only a few locations in the watershed upstream of the Valencia WRP. Recently, the UTS has been located upstream of the Valencia WRP outfall, making the short upstream segment at the Santa Clara River Bridge (I-5 Bridge) where small volumes of groundwater upwelling occur, a particularly important location.

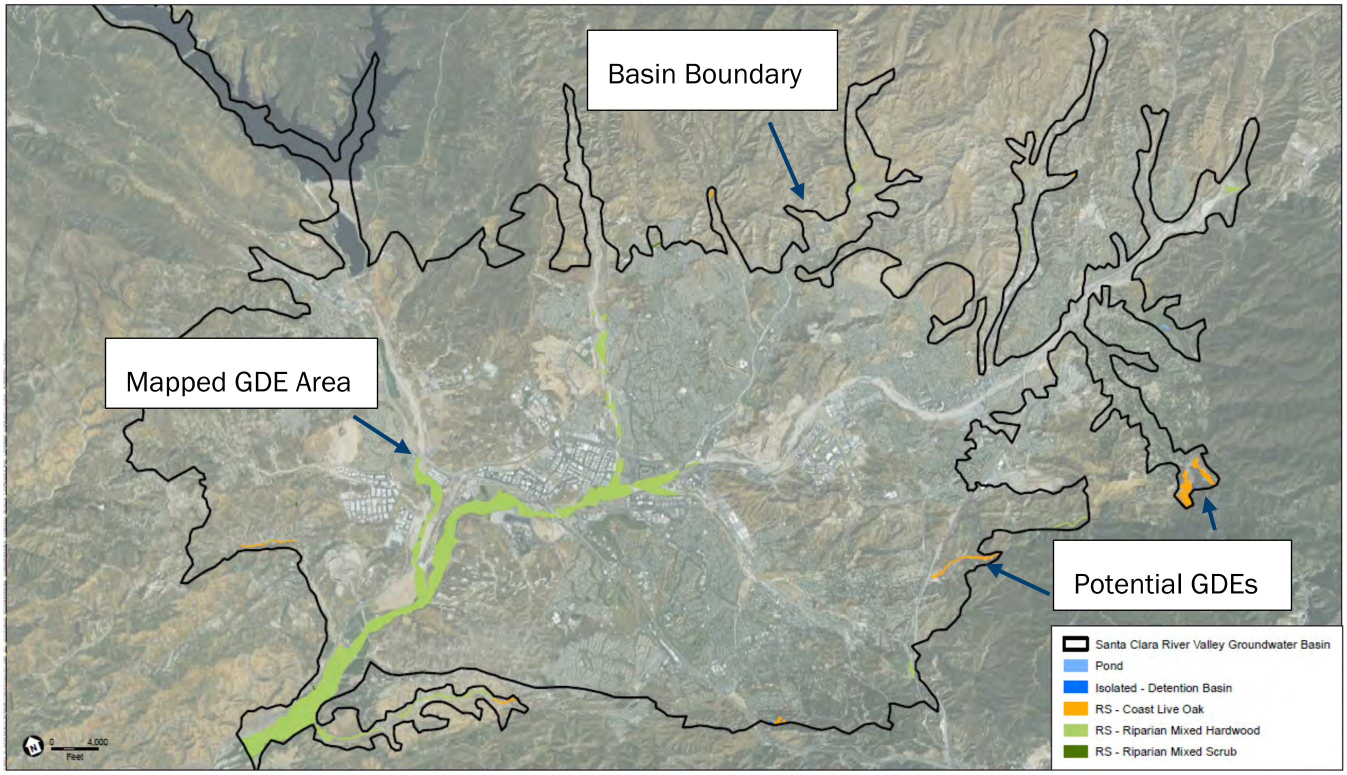
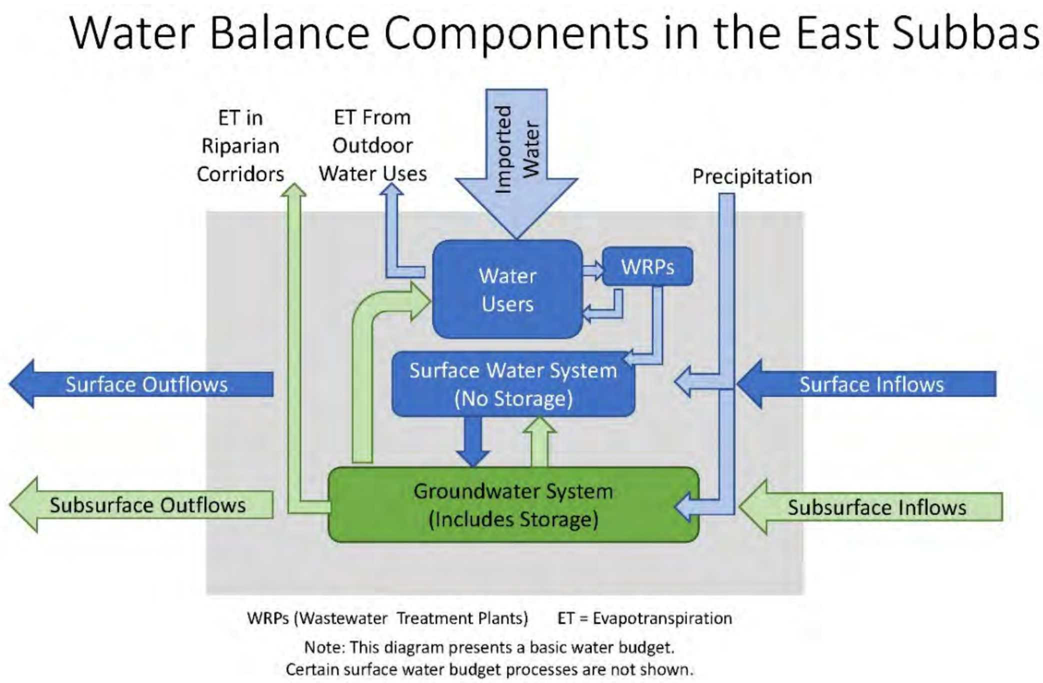


Figure ES-2. Distribution and Types of GDEs Mapped in the Basin

ES-3 Water Budgets (GSP Section 6)

A water budget defines the sources and uses of water in an area. The water budget for the Basin is a regional basin-wide water budget that accounts not just for groundwater, but also for surface water and for imported water supplies and uses. The regional water budget provides an accounting of all surface water and groundwater flowing into and out of the Basin over a specified period. A generalized depiction of the water budget processes (inflows and outflows) for surface water and groundwater in the Basin is shown below.



The interactions between surface water and groundwater can be complex and subtle. The water budget analysis presented in Section 6 first quantifies the water budgets under historical and current conditions in the Basin, then analyzes how future changes to supply, demand, hydrology, population, land use, and climatic conditions may affect the basin water budget. The historical, current, and projected water budgets in this GSP have been developed using a three-dimensional numerical computer model that simulates the natural and human-induced interactions that take place throughout the Basin between surface and groundwater. This numerical computer model conducts its calculations three times a month over a 95-year simulation period (reflecting historical rainfall patterns in the Basin) to estimate these interactions. The results from modeling the historical and current periods are consistent with observed groundwater levels and show that the Basin has been in a balanced condition in which inflows (recharge) balance outflows (e.g., pumping).

ES-3.1 Projected Water Budget

The projected water budget is the primary water budget analysis that is used to assess future conditions and to develop sustainable management criteria. The projected water budget simulates the effects of full build-out of land uses and human demands for water, which are expected to occur by the year 2050. Three alternative projected water budgets for future full build-out conditions (**no climate change**, **2030 climate change**, and **2070 climate change**) are presented in Section 6 for consideration as the projected water budget to use for evaluating basin sustainability under SGMA. The projected water budgets are examined to see how changes in climate could affect precipitation and evapotranspiration rates locally in the Basin, for the years 2030 and 2070 (as defined by DWR). The analysis of the projected water budget also includes a numerical groundwater flow model simulation that uses the historical climate without climate change, to help quantify the climate-change influence separately from the changes in land and water uses. All three of these projected water budgets are developed for the same 95-year historical climatic regime (1925 through 2019) that is used in the historical and current water budgets. DWR's local climate-change factors are applied to the historical climatic regime to describe the potential future effects of climate change on precipitation and evapotranspiration in 2030 and 2070.

Based on this analysis, the projected water budget that was used for further SGMA sustainability evaluations and groundwater management planning reflects full build-out conditions in the Basin, pumping in accordance with SCV Water's Basin Operating Plan *(Groundwater Management Plan, Santa Clara River Valley Groundwater Basin)*, and precipitation and evapotranspiration changes that are estimated by DWR to occur in 2030. This projected water budget is described as occurring for year 2042 conditions, as the year 2042 will be the end of the 20-year time frame for groundwater sustainability measures to be implemented under the GSP. The projected water budget for year 2042 conditions (full build-out with 2030 climate change) is shown in Figure ES-3, which presents a graphic showing the multiple groundwater inflows and outflows, with the inflows stacked as bars above the zero line and the outflows stacked as bars below the zero line. A yellow line shows the cumulative change over time in the volume of groundwater in storage in the Basin. Like the cumulative departure curve for precipitation, the cumulative change curve for groundwater storage indicates whether the Basin is experiencing long-term changes in groundwater storage, and, in particular, whether an overdraft condition might exist (as would be shown by a curve that is declining over a long period—i.e., sloping down and to the right over multiple decades). As shown in this plot, the cumulative change curve indicates that chronic declines in groundwater levels and groundwater storage are not projected to occur over long periods, which indicates that SCV Water's Basin Operating Plan for the Basin is unlikely to cause an overdraft condition in the local groundwater system (i.e., it is unlikely to exceed the basin yield) in the future under the assumed climatic conditions. A lack of chronic declines in groundwater levels and groundwater storage was also observed in the historical and current water budgets, as well as in the two other projected water budgets that simulated no climate change and a 2070 level of climate change.

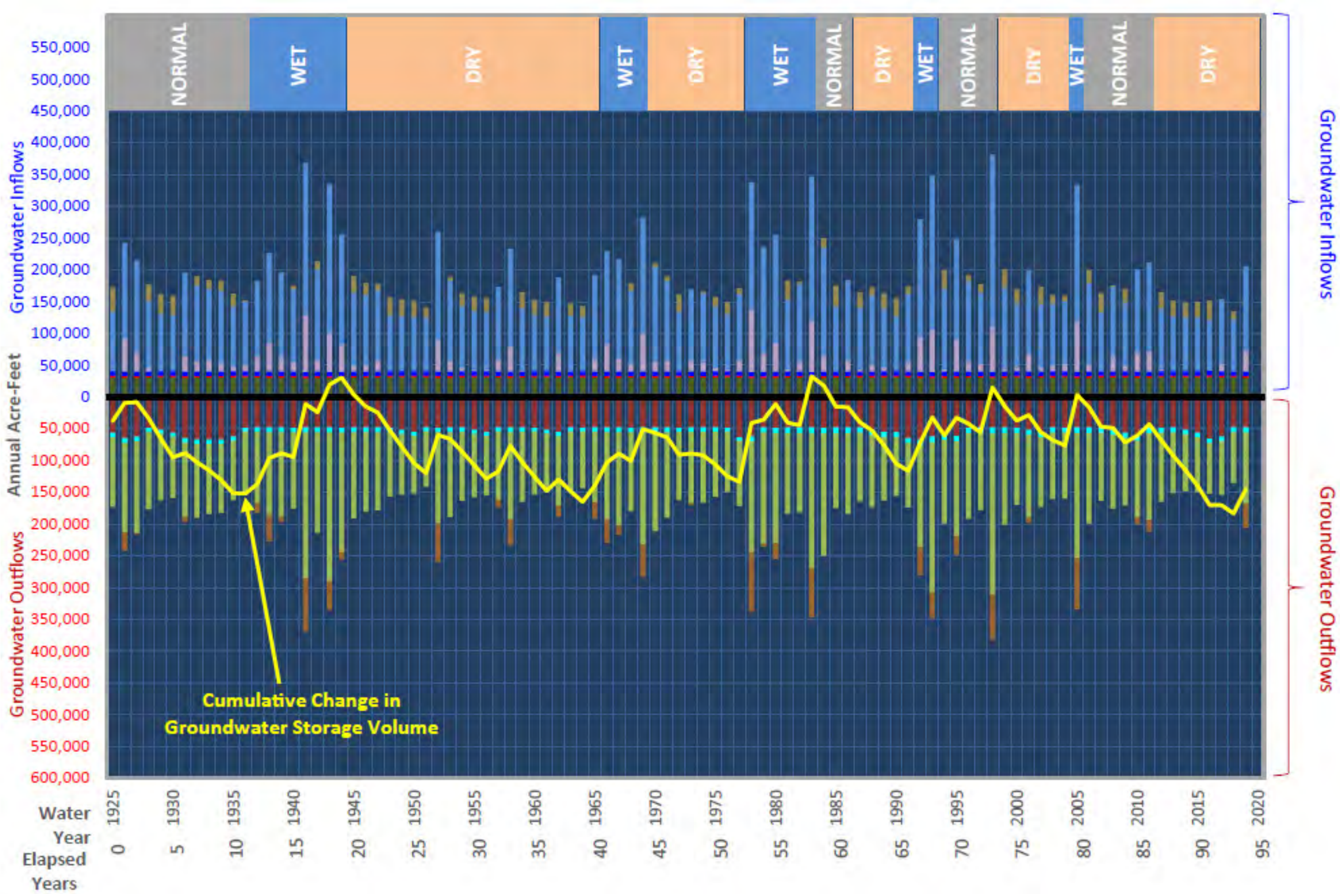


Figure ES-3. Projected Groundwater Budget for 2042 Conditions (Full Build-Out Conditions with 2030 Climate Change)

ES-3.2 Basin Yield

SGMA requires that basins be brought into balance within 20 years to avoid undesirable results and depletion of groundwater resources. A basin that is out of balance is characterized by a continual lowering of groundwater levels over time, a condition known as overdraft. Overdraft occurs when the average annual amount of groundwater extraction exceeds the long-term average annual supply of water to the basin. It is normal for groundwater basins to experience increases and decreases in storage in response to the normal dry and wet hydrologic cycles. In general, SGMA requires that a basin operate at or below its "basin yield" production volume, which is a long-term (multi-decadal) average annual production volume that does not create a long-term chronic overdraft condition

In all three of the projected water budgets described in Section 6, annual pumping volumes increase during dry years, which are defined as years when State Water Project water deliveries are significantly curtailed. The increase in groundwater pumping during these dry years (compared with normal years) occurs in the Saugus Formation. The projected water budgets for the Basin indicate that the *Basin Operating Plan* does not produce chronic declines in groundwater storage volumes or groundwater levels in the aquifer system on a long-term basis, including under the two different climate change scenarios evaluated. This means the basin yield volume for the Basin is likely higher than the average annual production volume of 52,200 AFY that was simulated for the projected water budget under full build-out of the land and water uses in the Basin.

The results of the projected water budget also indicate that, under the *Basin Operating Plan*, the Basin can be pumped at an annual rate of at least 67,500 AFY for multiple dry years without causing chronic water level declines. The number of consecutive dry years that the Basin can be pumped at or above 67,500 AFY without causing chronic water level declines has not been tested or determined. Thus, it is prudent to consider the basin yield volume for the Basin to be at least 52,200 AFY, based on the long-term average amount of pumping. However, as indicated by the projected water budget analyses, pumping at rates of 67,500 AFY (and potentially higher) can occur for multiple dry years without causing chronic groundwater level declines and exceeding the long-term basin yield for the Basin groundwater system.

ES-4 Monitoring Networks (GSP Section 7)

This section evaluates existing monitoring programs in the Basin and incorporates elements of existing monitoring programs into a GSP monitoring network program to be consistent with SGMA regulations. Existing monitoring programs considered relevant to monitoring of sustainability indicators were evaluated to identify monitoring sites and historical data that can be utilized in the development of a monitoring network for this GSP. Existing monitoring programs in the Basin that relate to sustainability indicators include efforts conducted by the following entities and agencies:

- Santa Clarita Valley Water Agency (SCV Water) groundwater elevation and quality monitoring programs (reported in the annual *Santa Clarita Valley Water Report*)
- County of Los Angeles Waterworks District 36 groundwater production well monitoring
- County of Los Angeles Flood Control District Groundwater Elevation monitoring
- Los Angeles County Department of Public Works (LACDPW) and U.S. Geological Survey streamflow monitoring
- LACDPW Land Surface Elevation Benchmark Surveys
- California Statewide Groundwater Elevation Monitoring (CASGEM) conducted by SCV Water – Santa Clara River Valley Basin – Santa Clara River Valley East
- University NAVSTAR Consortium (UNAVCO) Plate Boundary Observatory

- California Drinking Water Watch
- Department of Toxic Substances Control (Whittaker-Bermite Property)
- Santa Clarita Valley Water Agency Salt and Nutrient Management Plan monitoring
- Santa Clarita Valley Sanitation District of Los Angeles County
- Newhall Ranch Sanitation District of Los Angeles County

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

The GSP monitoring network is composed of aquifer-specific wells that are screened in one of the principal aquifers in the Basin (the Alluvial Aquifer or the Saugus Formation). The representative monitoring well network does not include composite wells that span both aquifers. The 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 measurable objectives for each applicable sustainability indicator.

The Basin currently has more than 70 wells that are actively monitored for water level and/or groundwater quality data. However, for the purposes of the GSP monitoring program, SCV-GSA identified a subset of these wells that meet SGMA regulations for establishing the monitoring network and other program requirements. These selected representative monitoring sites, or representative monitoring wells, provide geographical coverage across the areas where groundwater is pumped from each of the two principal aquifers, and each well has a historical data record lasting from a few years to several decades (23 California Code of Regulations § 354.36). This effort resulted in the selection of **16 wells in the Alluvial Aquifer** and **9 wells in the Saugus Formation**; see Figures 7-10 and 7-11 in Section 7 of the GSP for their locations and Tables 7-7 and 7-8 for well construction summaries and a listing of the sustainability indicator(s) for which each well will be monitored. The GSA has compiled well construction information for these wells, which allows the GSA to determine with certainty the aquifer being monitored. The geographic distribution of this selection of monitoring wells accounts for the ability to use each monitoring well site for multiple sustainability indicators. As a collective group, the representative monitoring wells will be used for monitoring groundwater elevation, storage, and water quality, which will enable the GSA to have a streamlined and efficient GSP monitoring program.

This coverage allows for the collection of data to evaluate groundwater gradients and flow directions over time as well as the annual change in storage. Furthermore, the monitoring frequency of the wells will allow for the monitoring of seasonal highs and lows. Because wells were chosen with the existing length of historical data record in mind, future groundwater data will be comparable to the historical data.

ES-4.2 Monitoring for Land Subsidence

Monitoring of subsidence in the Basin will utilize InSAR data (satellite-based land surface elevation monitoring) and existing benchmarks established by LACDPW for subsidence monitoring in the Basin. Each year, SCV Water will survey on the order of 10 stations each January and August for land surface elevation. The locations of the LACDPW stations are shown on Figure 7-12 in Section 7 of the GSP. Locations will be selected for monitoring in collaboration with LACPW and SCV Water and will be selected because they are in an area of the Basin that is considered most susceptible to subsidence and where infrastructure (such as well V201, conveyance pipelines, and roadways) are located. The elevation of each benchmark station will be calibrated to benchmarks established by LACDPW so that consistency between historical elevations can be maintained.

ES-4.3 Monitoring Plan for Interconnected Surface Water and GDEs

The GSP monitoring plan also includes elements to ensure the avoidance of impacts to GDEs. It includes groundwater level monitoring at 10 locations within the identified GDE area; see Figure 8-7 for the locations of these wells, which consist of four existing and six new wells. The GDE monitoring program includes the following elements:

1. Install 6 shallow monitoring wells (also referred to as piezometers) at locations along the river corridor representing river segments and two locations in selected tributaries where GDEs are present.
2. Measure the elevation of the monitoring well measuring points and river channel (thalweg) nearest to the monitoring well.
3. Assess the relationship between water levels measured at the GDE monitoring wells, river flow, WRP discharges, rainfall, and nearby pumping to assess the validity of the data observed in the monitoring locations.
4. Calibrate the measured water levels with levels predicted by the groundwater flow model.
5. Conduct groundwater level monitoring to track water levels relative to the triggers identified in Section 8 of the GSP.
6. In monitoring wells that provide meaningful data, identify a trigger for each well based on historical low groundwater levels (actual data or estimate using the groundwater model). Identify an intermediate trigger above the historical low in areas where sensitive aquatic species reside (e.g., the I-5 Bridge).
7. Monitor flow at the Old Road Bridge streamflow gage (the only nearby gage) downstream from where sensitive species (e.g., UTS) are thought to exist in pools at the I-5 Bridge. Periodically visually observe and document surface water flow conditions at this location (I-5 Bridge and streamflow gage) if surface water gauging is not possible during low-flow conditions.

Section 8 of the GSP states that when a trigger is reached, an evaluation process will be initiated to determine whether the lowered groundwater levels are a result of pumping and could result in a significant and unreasonable impact on GDEs. The GSP monitoring plan includes a process to report the trigger event to the GSA Board as needed with an accompanying Trigger Evaluation Report that evaluates the need for management actions to be implemented. The evaluation would be conducted in a timely manner if it appears that groundwater levels are approaching or likely to exceed GDE trigger levels, as discussed in Section 8 of the GSP. Management actions for avoiding impacts to GDEs would be implemented if the lowering groundwater levels caused by groundwater extraction could result in permanent loss of GDEs anywhere in the GDE area or in cessation of surface flow during low-flow conditions in the river channel that currently provide essential habitat to UTS (sensitive aquatic species in the vicinity of I-5 Bridge).

ES-5 Sustainable Management Criteria (SMCs) (GSP Section 8)

Section 8 defines the criteria by which sustainability will be evaluated, defines conditions that constitute sustainable groundwater management, and discusses the process by which the SCV-GSA will characterize undesirable results and how it established minimum thresholds and measurable objectives for each sustainability indicator in the Basin. Section 8 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 the effects caused by groundwater conditions occurring throughout the Basin that, when significant and unreasonable, become undesirable results. Undesirable results are one or more of the following effects:

- Chronic lowering of groundwater levels

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

ES-5.1 Sustainability Goal

The Basin Sustainability Goal is presented below:

The SCV-GSA's sustainability goal is to manage the groundwater resources of the Basin for current and future beneficial uses of groundwater, including the river environment, through an adaptive management approach that builds on robust science and monitoring and considers economic, social, and other objectives of a wide variety of stakeholders.

This plan has two main objectives, reflecting the values of the local community to (1) maintain water supply for municipal, agricultural, and domestic uses in times of climate change and variability of imported supply, and (2) protect GDEs from permanent harm caused by groundwater pumping.

The context for the sustainability goal is the recognition that no undesirable effects have occurred in the Basin to date. Groundwater levels have declined during dry periods, and the Basin has refilled in wet periods. As described in Section 6, the *Basin Operating Plan* contemplates groundwater levels that could be lower than historical levels during dry years, to accommodate future build-out, conjunctive use operating strategies, and climate change. The principal question examined in Section 6 of the GSP is whether these lower groundwater levels will cause undesirable results. The groundwater model predicts that basin groundwater levels will continue to recover during wet years, even as groundwater levels are drawn down further in dry years. SGMA expressly allows for this result (Water Code §10721(x)(1)). Thus, undesirable results due to chronic lowering of groundwater levels or significant and unreasonable reduction of groundwater storage are unlikely to occur.

The other sustainability indicators will be closely monitored to ensure that lower groundwater levels do not cause unreasonable results (see Section 7). SCV-GSA will take action to close data gaps. In the case of depletions of interconnected surface water, trigger levels are set to recognize potential undesirable results in time to address them. Because the precise nature of these potential undesirable results is unknown, this plan includes a variety of possible management actions, to preserve flexibility in adaptive management (see Section 9).

ES-5.2 Qualitative Objectives for Meeting Sustainability Goals

Qualitative objectives are designed to help stakeholders understand the overall purpose (e.g., Avoid Chronic Lowering of Groundwater Levels) for sustainably managing groundwater resources 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 a healthy river environment in the Basin

- **Avoid Chronic Reduction of Groundwater Storage**
  - Maintain sufficient groundwater volumes in storage to sustain current and planned groundwater use in prolonged drought conditions while avoiding permanent degradation of environmental values
- **Avoid Land Subsidence**
  - Reduce or prevent land subsidence that causes significant and unreasonable effects to groundwater supply, land uses, infrastructure, and property interests
- **Avoid Degraded Groundwater Quality**
  - Maintain access to drinking water supplies
  - Maintain access to agricultural water supplies
  - Maintain quality consistent with current ecosystem uses
- **Avoid Depletion of Interconnected Surface Water**
  - Avoid significant and unreasonable effects (i.e., undesirable results) on beneficial uses in the Basin, including GDEs, caused by groundwater extraction
  - Maintain sufficient groundwater levels and surface water flow in the river and pools to sustain aquatic habitat where UTS and other native fishes are present (e.g., at the I-5 Bridge), to the extent that such decreases are caused by groundwater extraction

ES-5.3 General Process for Establishing Sustainable Management Criteria

This section presents the process that was used to develop the SMCs for the Basin, how public input from local stakeholders was considered, the criteria used to define undesirable results, and how minimum thresholds and measurable objectives were established.

ES-5.3.1 Obtain Public Input

The public input process was built on the GSA member agencies' long history of engaging local stakeholders and interested parties on water issues. This included the formation of the Stakeholder Advisory Committee, which has representatives from large, medium, and small pumpers; local residents; businesses; and environmental groups. 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 SCV Water staff and Stakeholder Advisory Committee members.

ES-5.3.2 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:

- Groundwater use must be causing significant and unreasonable effects in the Basin.
- A minimum threshold is exceeded in a specified number of representative wells over a prescribed period.
- 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.

ES-5.3.3 Develop Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

Information developed in previous sections of the GSP including hydrogeologic conceptual model, groundwater conditions and water level data, water budget, and surface water-groundwater interactions were used to define minimum thresholds and measurable objectives for each sustainability indicator. Minimum thresholds and measurable objectives are generally defined as follows:

- **Minimum Threshold** - A minimum threshold is the quantitative value that represents the groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with minimum thresholds at other monitoring sites, may cause an undesirable result(s) in the Basin.
- **Measurable Objective** - Measurable objectives are quantitative goals or targets that reflect the Basin's desired groundwater conditions and allow the GSA to achieve the sustainability goal within 20 years.

ES-5.4 Summary of Sustainable Management Criteria

Table ES-1 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 8.6 through 8.11 of this GSP.

Table ES-1. Summary of Sustainable Management Criteria

Potential Undesirable Results	Minimum Threshold	Measurable Objective	Other Notes
Chronic Lowering of Groundwater Levels			
Groundwater levels fall below minimum thresholds in 25 percent of representative wells in the Alluvial Aquifer or 50 percent of representative wells in the Saugus Formation throughout a 3-year period.	Lowest groundwater elevation from the 95-year future-conditions model or Lowest historically observed groundwater elevation in modern era (i.e., since 1980), whichever is lower (as shown in Table 8-2).	Average of the future modeled or historically observed groundwater elevations (using the same data set as for the minimum threshold as shown in Table 8-2).	An undesirable result occurs if the same group of representative monitoring sites experiences this condition throughout the 3-year period. Use static groundwater level measurements collected twice per year (in the spring and late summer).
Chronic Reduction of Groundwater in Storage			
Same as for chronic lowering of groundwater levels. An additional undesirable result is an inability to meet groundwater demands during a multi-year drought.	Same as for chronic lowering of groundwater levels.	Same as for chronic lowering of groundwater levels.	Same as for chronic lowering of groundwater levels.
Seawater Intrusion			
Not applicable (this is an inland basin)			
Degraded Groundwater Quality			
Degradation of groundwater quality beyond WQOs and assimilative capacities established in the SNMP in 20 percent of representative wells.	WQOs for TDS, chloride, nitrate, and sulfate or ambient water quality if it exceeds the WQO.	Prevent water quality degradation for salts and nutrients and for contaminants.	Minimum thresholds are not established for contaminants because state regulatory agencies have the responsibility and authority to regulate and direct actions that address contamination.
Land Subsidence			
Substantial interference with land uses, impacts on the use of critical infrastructure and roads, or subsidence greater than minimum thresholds at 10 percent of monitoring locations.	The subsidence measured between June of one year and June of the subsequent year shall be no more than an average of 0.1 foot in any single year and a cumulative 0.5 foot in any 5-year period observed at 10 percent or more monitoring locations.	Maintenance of current ground surface elevations trends.	Based on InSAR-measured subsidence during June of each year and LA County *benchmark* elevation monitoring twice per year.
Depletion of Interconnected Surface Water			
Permanent loss or significant degradation of existing native riparian or aquatic habitat due to lowered groundwater levels caused by groundwater pumping throughout the GDE area. In areas that currently provide essential habitat to UTS and native fishes (sensitive aquatic species in the vicinity of I-5 Bridge), cessation of surface flow and pools during low-flow conditions in the river channel caused by groundwater extraction is an undesirable result.	Surface water depletion caused by groundwater extraction as measured by groundwater levels falling below the lowest predicted future groundwater elevation measured at GDE-area monitoring wells.	Average of future modeled groundwater elevations (using the same data set as for the minimum threshold).	GDE trigger levels (see Table 8-6) that are at or above historical low elevations (as estimated from the model) will be used to initiate an assessment of GDE conditions caused by groundwater extraction and management actions that might be needed to protect GDEs.

Notes

GDE = groundwater-dependent ecosystem
SNMP = Salt and Nutrient Management Plan
TDS = total dissolved solids
WQO = water quality objective

Figure ES-4 and ES-5 illustrate the minimum thresholds and measurable objectives for groundwater levels in the Alluvial Aquifer and Saugus Formation, respectively. As can be seen in these figures, the minimum threshold has been established at the projected future low water level in each aquifer based on the water levels predicted at each representative well by the groundwater model. Based on the modeling results, groundwater levels above the minimum threshold do not result in undesirable results and represent sustainable conditions. Additional details about the approach that will be taken if minimum thresholds are reached are presented in Section 9, Projects and Management Actions.

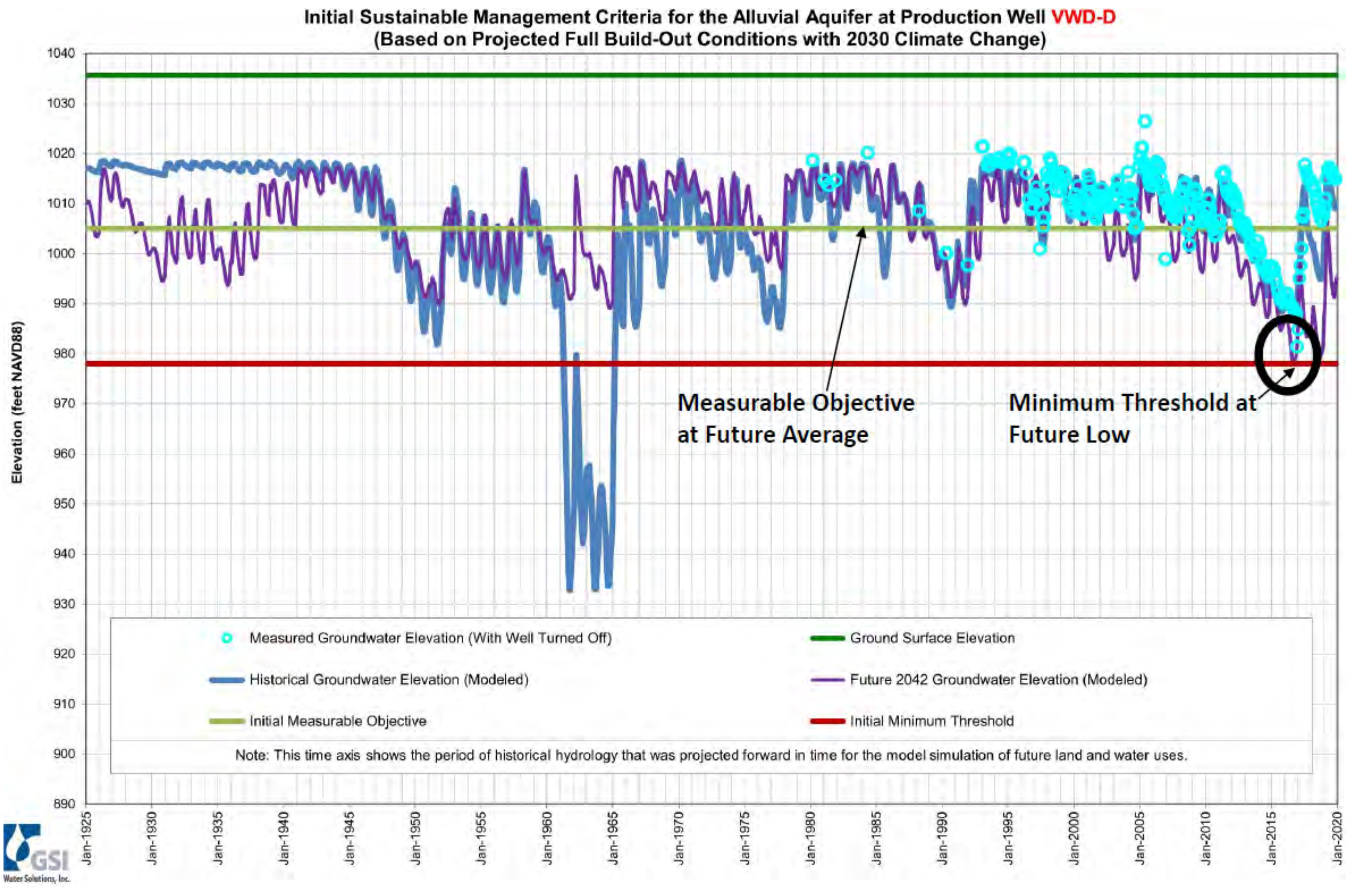


Figure ES-4. Initial Sustainable Management Criteria for the Alluvial Aquifer at Well VWD-D

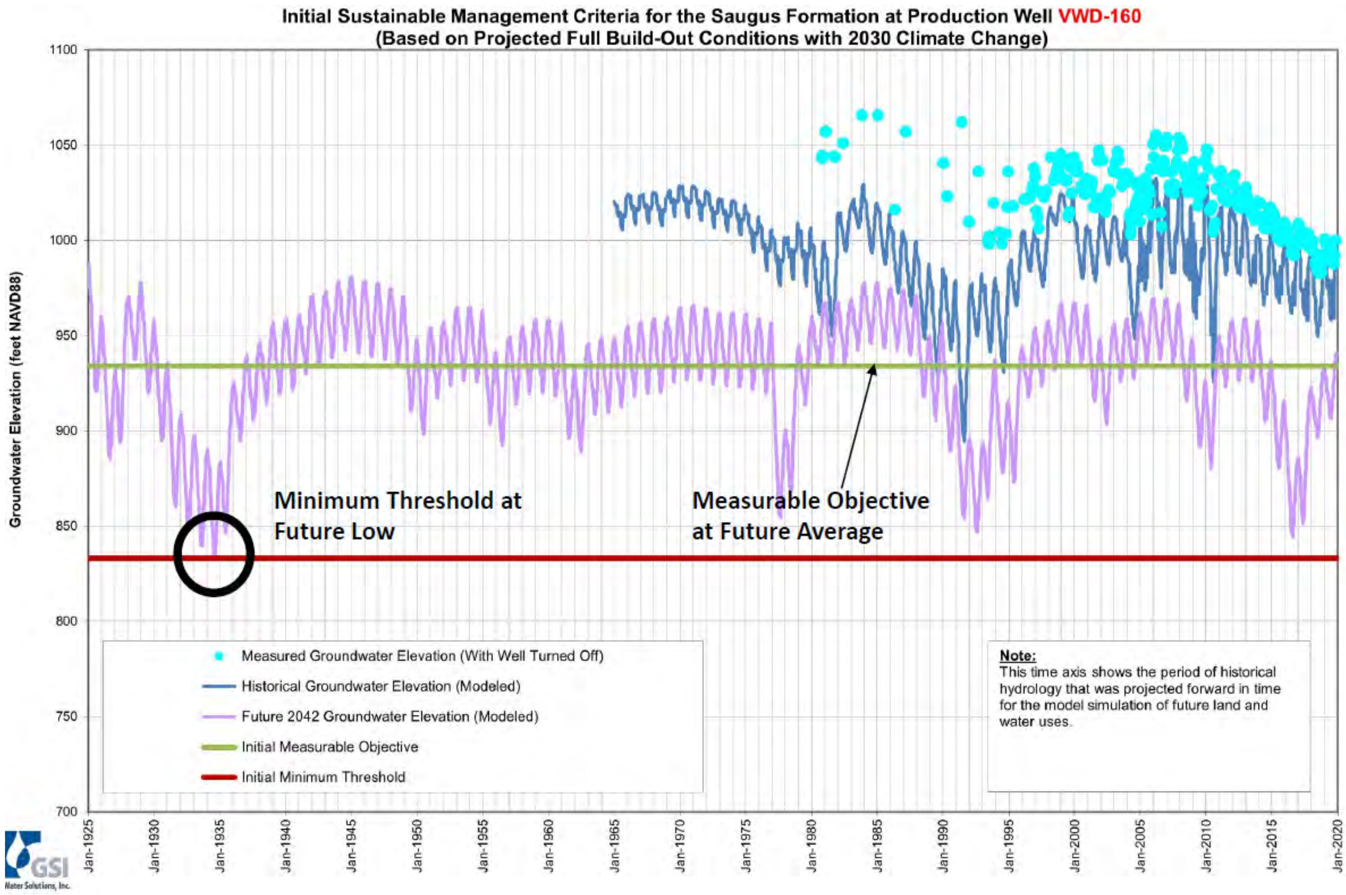


Figure ES-5. Initial Sustainable Management Criteria for the Saugus Formation at Well VWD-160

Because the members of SCV-GSA wish to maintain a healthy river corridor and avoid impacts to GDEs caused by groundwater extraction in the future, GDE trigger levels have been established for representative wells completed in various portions of the alluvial aquifer. GDE triggers include the following:

- Groundwater levels within GDE areas that are at the lowest historical (within previous 50 years) groundwater levels if caused by groundwater extraction
- Groundwater levels that are 2 feet above the lowest historical (within previous 50 years) levels where UTS and other native fishes are present (e.g., the I-5 Bridge area) that rely on surface flow and pools

Figures ES-6 and ES-7 illustrate the trigger level concept at one of the representative well locations. It is believed that the historical low level avoids significant and unreasonable effects on GDEs because the vegetation and species living within the GDE area have adapted to fluctuating groundwater levels in response to varying climatic and pumping conditions in the past.

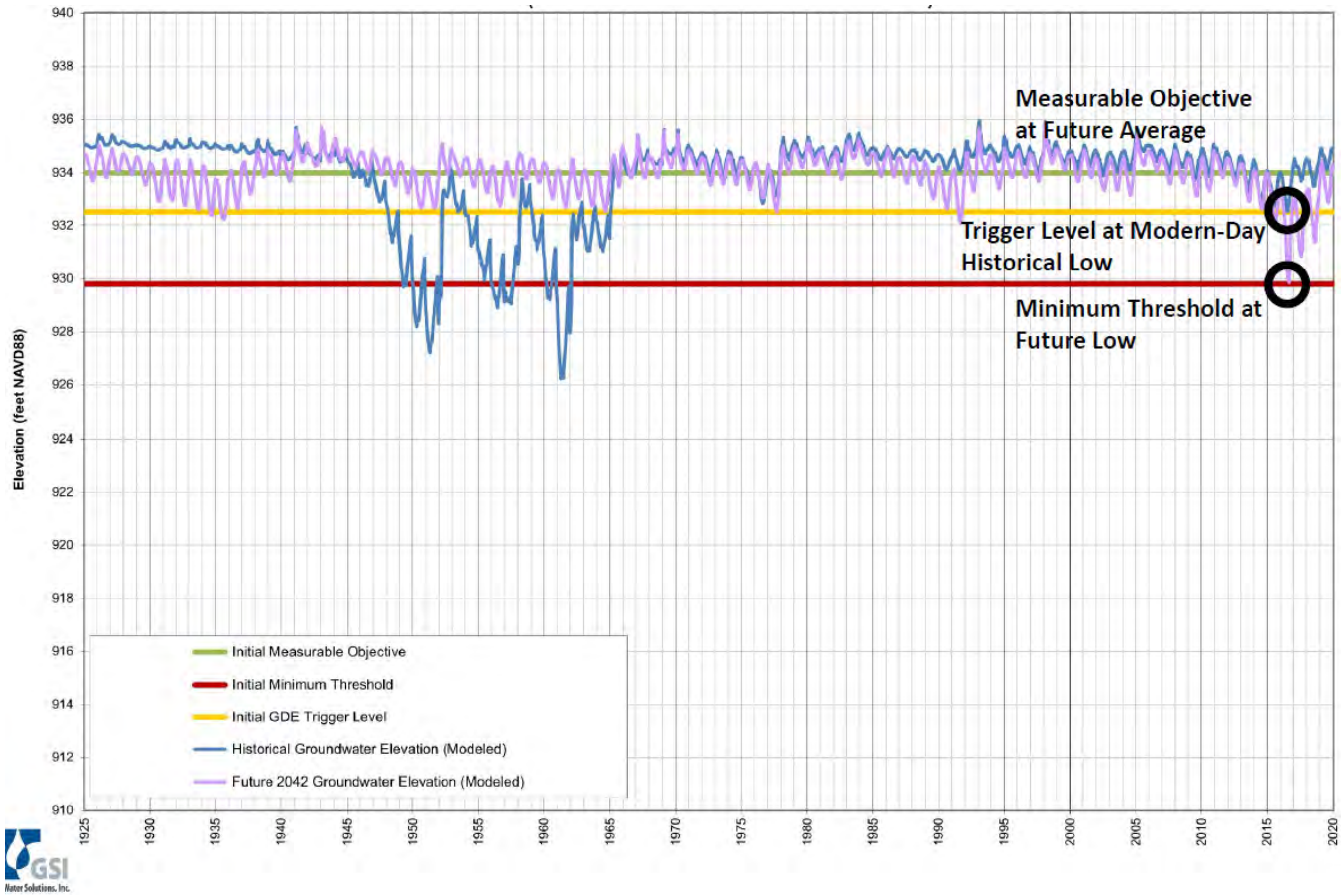


Figure ES-6. Initial Trigger Levels at GDE Monitoring Well GDE-D (Santa Clara River at Mouth of Castaic Creek)

The area in the river near the I-5 Bridge requires special attention because sensitive aquatic species (e.g., the UTS) live in pools within this area. It is important that flow be maintained in this area; therefore, an intermediate trigger level of 2 feet above the historical low has been established in this area.

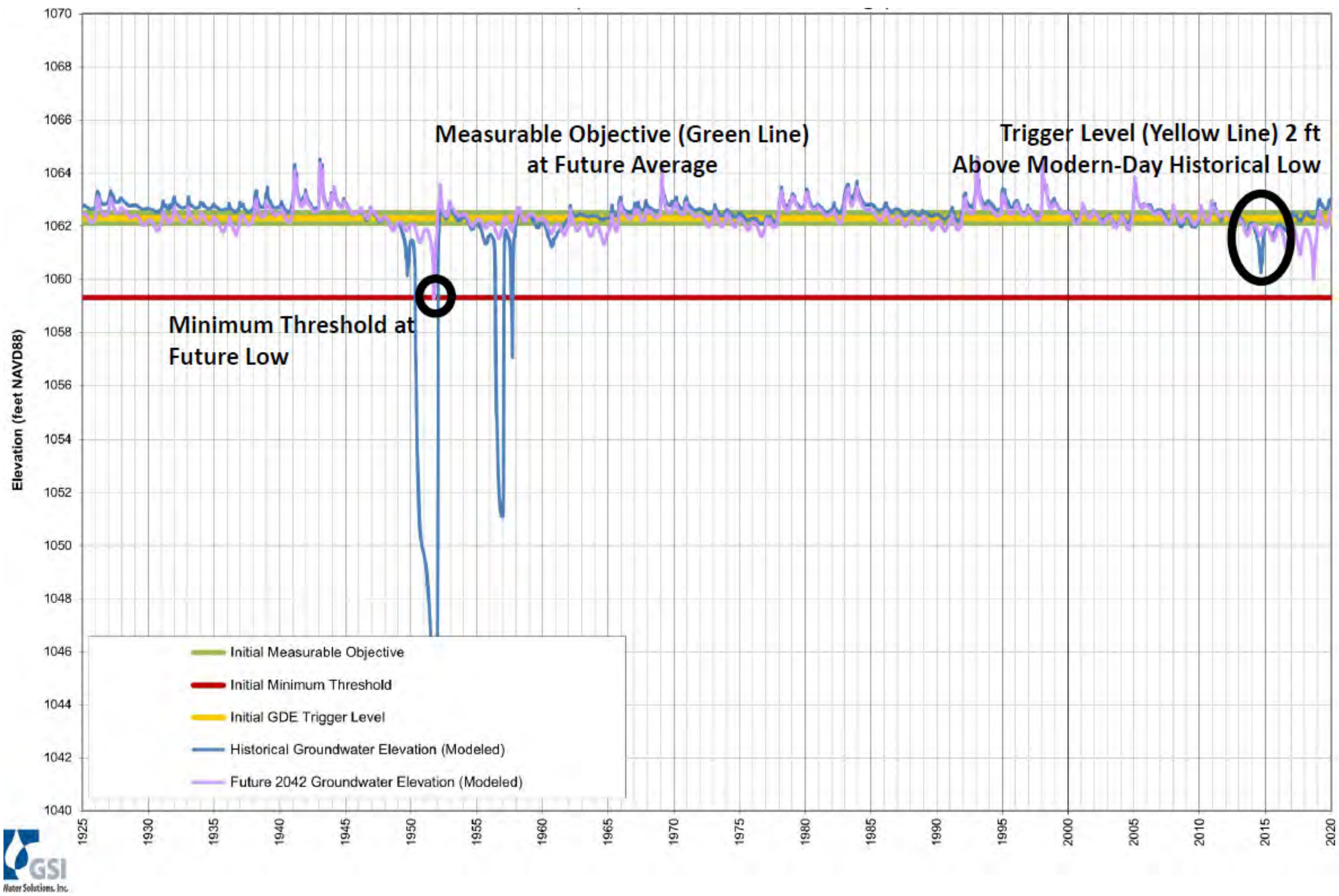


Figure ES-7. Initial Trigger Levels at GDE Monitoring Well GDE-B (Santa Clara River at I-5 Bridge)

If these GDE triggers are approached or reached, an evaluation will be performed to determine whether it is caused by groundwater extraction. Based on this evaluation, management actions may be implemented as described in Section 9 to avoid water levels falling below historical lows and trigger levels. A discussion of how GDEs were identified, how impacts to GDEs will be defined, trigger levels, and management actions if trigger levels are reached is incorporated into the development of SMCs and is presented in Appendix E. See Section 9.5.5 for further discussions of the actions that will be taken if GDE trigger levels are reached.

ES-6 Management Actions and Projects (GSP Section 9)

This section describes the management actions that will be developed and implemented in the Basin to attain and maintain sustainability in accordance with SGMA regulations. Management actions described herein are intended to optimize local groundwater use to avoid undesirable results, consistent with SGMA regulations. Many are also intended to help improve the understanding of the Basin, enhance the monitoring program, enhance improved water use practices, and improve information upon which the GSA may make decisions. The management actions described in this section include the following:

- Addressing data gaps
- Monitoring, reporting, and outreach
- Promoting best water use practices
- Actions if minimum thresholds are reached or undesirable results confirmed

- Actions if GDE triggers are reached
- Other management actions to promote sustainable groundwater management

This section also describes optional projects that in concept involve new or improved infrastructure to make new water supplies available to the Basin. These optional projects may be implemented to improve the resiliency of basin groundwater resources to extended drought. The optional projects are based on previous and ongoing feasibility studies conducted by SCV Water and its predecessor agencies.

Basin-wide management actions are described below.

ES-6.1 Addressing Data Gaps

Data gaps that have been identified thus far include the following:

- Water levels within the GDE area
- Reference point elevation for all monitoring locations, including the riverbed in selected areas by GDE monitoring wells
- Domestic well water quality
- Subsidence benchmarks for monitoring land surface elevation
- Upland GDE verification and assessment

ES-6.1.1 Installation of Piezometers within the GDE Area

GDE monitoring sites are needed within the GDE area (see Figure 8-2 in Section 8) to allow the GSA to monitor groundwater levels and assess whether groundwater pumping has or will cause impacts to GDEs related to lowered groundwater levels and depleted surface water. Eight GDE monitoring sites have been tentatively identified. Six piezometers will be installed in proximity to the existing Santa Clara River channel. Two other existing alluvial wells will be utilized; one along Castaic Creek, and one located along San Francisquito Creek. These locations were selected to provide meaningful groundwater level data in reaches of the river and tributaries that are connected to surface water. Exact locations will be determined after consultation with landowners, the California Department of Fish and Wildlife, and the Los Angeles County Flood Control District.

ES-6.1.2 Reference Point Elevation Survey

A survey of the reference point elevations is needed for all existing and planned new wells that are part of the basin monitoring program for the following reasons:

- Not all wells in the program have been surveyed
- Different datums have been used in the past

The planned reference point survey will ensure that all groundwater level data are referenced to the same vertical datum in the future. Further, some elevation surveys in the riverbed near GDE monitoring wells will be needed to better determine depth to groundwater beneath the riverbed.

ES-6.1.3 Domestic Well Water Quality

Domestic wells are presently not included in existing groundwater quality monitoring programs. Because this group of groundwater users may be affected by groundwater management actions initiated by the GSA in some areas of the Basin, it will be necessary to establish (1) where there are domestic wells that could be affected by groundwater management actions and (2) a water quality sampling program for selected wells to establish a baseline data set for domestic well water quality. Once the baseline has been established, specific need for future water quality sampling will be better understood.

ES-6.1.4 Subsidence Benchmarks

Section 7 describes the planned subsidence monitoring program for the Basin. A combination of InSAR data and measured land surface elevation data at selected benchmarks comprise the monitoring locations. As described in Section 7, the GSA intends to use a set of benchmarks that have previously been used by the County of Los Angeles to monitor land surface elevations in the Basin. The GSA intends to monitor subsidence twice per year at locations where future groundwater level declines could cause subsidence and damage critical infrastructure.

ES-6.1.5 Upland GDE Verification and Assessment

Potential GDEs were identified in upland areas (e.g., Placerita Canyon) outside the main Santa Clara River channel and tributaries. In response to comments from the Stakeholder Advisory Committee, this task includes additional field verification of these areas and assessment of groundwater elevations to assess whether these areas should be included in the ongoing GDE monitoring program.

ES-6.2 Monitoring, Reporting, and Outreach

Monitoring, reporting, and outreach are core functions that the GSA will provide to comply with SGMA regulations. The GSA will direct the monitoring programs outlined in Section 7 to track basin conditions related to the five applicable sustainability indicators. Data from the monitoring programs will be routinely evaluated to ensure progress is being made toward sustainability or to identify whether undesirable results are occurring. Data will be maintained in a data management system (DMS) operated by SCV Water. Data from the monitoring program will be used (1) by the GSA to guide decisions on management actions and to prepare annual reports to basin stakeholders and DWR and (2) by individual entities to guide decision-makers. SGMA regulations require that (1) the reports comply with DWR forms and submittal requirements and (2) all transmittals are signed by an authorized party. Data will be organized and available to the public to document basin conditions relative to the SMCs established for the Basin (see Section 8). In addition to compiling existing monitoring data, this management action includes conducting new monitoring not already being conducted in other programs including the following:

- Domestic water quality monitoring
- GDE monitoring
- Subsidence monitoring
- Receiving extraction data from non-de minimis well owners
- De Minimis Self-Certification Program (for domestic wells pumping less than 2 AFY)

ES-6.3 Promoting Best Water Use Practices

This GSP anticipates that the strong municipal water conservation programs already implemented by municipal agencies are sufficiently conservative so as not to require the GSA to develop separate municipal water conservation programs. However, if the GSA Board of Directors determines that additional conservation from municipal agencies would be appropriate the GSA will encourage additional conservation.

Because municipal agencies do not have specific outreach to private well operators regarding water conservation, the GSA will work with private well operators to facilitate workshops or other programs designed to communicate best water use practices for private wells. This GSP calls for the GSA to encourage private pumpers to implement the most effective water use efficiency methods applicable, often referred to as best management practices (BMPs). Effective BMPs could include the following:

- Efficient irrigation practices in urban and rural areas.
- Implementation of a recycled water program to reduce reliance on groundwater for irrigation.
- Achievement of more optimal irrigation practices by monitoring crop water use with soil and plant monitoring devices and by tying monitoring data to evapotranspiration estimates.

De minimis groundwater users will be encouraged to use BMPs as well. Promoting BMPs will include broad outreach to groundwater pumpers in the Basin to emphasize the importance of using BMPs and help groundwater pumpers understand the positive benefits of BMPs for water conservation to help with sustainability.

ES-6.4 Actions If Minimum Thresholds Are Reached or Undesirable Results Confirmed

The GSA anticipates that, if minimum thresholds are exceeded, the GSA will evaluate the cause. If the evaluation indicates the minimum thresholds were exceeded due to groundwater extraction, and/or if the trend of the data indicates that undesirable results arising from groundwater extraction are imminent, then management actions would be initiated as set forth in Section 9. The planned evaluations and possible management actions are presented below for each sustainability indicator:

ES-6.4.1 Chronic Lowering of Groundwater Levels and/or Chronic Reduction in Storage

The evaluation for these two groundwater sustainability indicators may include the following:

- Evaluate whether the decline is due to pumping, drought, or both.
- Evaluate whether the declining water levels are likely to continue.
- Evaluate whether other sustainability indicators are likely to be affected.

The following summarizes the management actions that will be taken until monitoring data indicate that undesirable results have been eliminated:

1. Redistribute pumping away from the affected area.
2. Reduce pumping in nearby wells.
3. Conduct additional releases from Castaic Lake if there is a benefit of doing so.
4. Bring in additional State Water Project water or other imported banked water to make up for reduced groundwater supply.
5. Implement tiered water conservation measures for the Basin.
6. Reduce pumping in the most affected aquifer.

ES-6.4.2 Degraded Water Quality

The evaluation for this groundwater sustainability indicator may include the following:

- Reviewing local land use information and activities (e.g., state records of groundwater contamination).
- Evaluating groundwater extraction information to understand whether it may cause migration of poor-quality groundwater associated with a contaminant plume or poor-quality groundwater residing in

geologic formations toward other wells. This does not pertain to SCV Water pumping for water supply and SCV Water efforts to contain and treat identified contaminants in the aquifer.

- Reviewing the effects of drought and lower water elevations on water quality constituents.
- Reviewing groundwater quality monitoring information, and/or conducting additional groundwater quality analysis.
- Considering the role of implementation of a recycled water program upon groundwater quality.
- Considering other water management actions not associated with the GSA (e.g., groundwater recharge projects developed by SCV Water, or others, that would have the potential to mobilize degraded groundwater).

The following summarizes the management actions that will be taken until monitoring data indicate that undesirable results have been eliminated:

1. Review alternatives for improving groundwater quality in the affected area.
2. Work with affected groundwater users to deploy well head treatment systems.
3. Arrange for an alternative water supply.
4. Shift pumping to other locations.
5. Reduce or stop pumping near the affected area.

ES-6.4.3 Subsidence

If it is determined that groundwater pumping is the likely cause of observed subsidence or exceedance of the minimum threshold and there is likely to be an undesirable result (e.g., damage to critical infrastructure or land uses), then the evaluation steps and management actions listed for chronic lowering of water levels will be implemented until the rate of subsidence is reduced. These management actions may be directed to certain regions of the Basin that are most affected.

ES-6.4.4 Depletion of Interconnected Surface Water and Impacts to GDEs

Questions that will be addressed as part of this evaluation process include, but are not limited to, the following:

1. Is the affected river segment supported by surface flow from WRP discharges? (Surface water may support habitats during temporary periods of lower-than-normal groundwater levels.)

2. Is the historically low groundwater level already below the tree/shrub root depths? (If so, further declines in the same year may not affect GDEs.)

3. Will the GDEs survive the temporary loss of access to groundwater? (Depending on the season, groundwater levels may be expected to rise above historically low levels within a month or two, avoiding permanent loss of habitat. When groundwater levels are restored sufficiently quickly in the winter months, effects to GDEs may not be significant.)

4. Has the trigger been reached often in recent years? Droughts that lower groundwater levels are a natural occurrence, but do not occur every year. To sustain GDEs over the long term, groundwater levels affected by drought conditions must recover sufficiently quickly and remain higher during most years to support healthy, sustainable habitats over the long term.

5. Are the declines in groundwater levels resulting from pumping?

6. Has new information been obtained that can be used to refine the trigger levels presented in Section 8 of the GSP?

If after performing evaluations there is potential for an undesirable result if water levels decline below minimum thresholds or GDE triggers, then one or more of the following management actions will be taken, following consultation with applicable landowners, until monitoring data indicate water levels have recovered so that undesirable results have been eliminated:

1. Pumping and water importation modifications.
   - Shift pumping to another location to reduce impact on GDEs, and/or
   - Stop pumping in wells near the GDEs, and/or
   - Increase the quantity of imported water or banked water into the Basin
   - Should any of the above be a consideration, the groundwater flow model may also be used to determine optimum pumping locations most likely to avoid undesirable results.
2. The GSA may coordinate with SCV Water to consider implementing a mandatory water conservation program so that overall pumping in the Basin can be reduced.
3. If the evaluation shows that non-municipal production wells are contributing to the problem, then the GSA will conduct outreach up to and including meeting with private well owners and stakeholders to discuss how to best respond to the concern. Ideally, this would occur prior to the time when significant and unreasonable impacts to GDEs are observed.
4. If monitoring data and weather predictions indicate that undesirable results are likely to persist into the following year and the above actions are not likely to mitigate the impacts, then it may be necessary to develop additional projects designed to increase the amount of water in the river system, as described in Section 9.6.3.

ES-6.5 Other Groundwater Management Actions and Projects

Although not specifically funded or managed as part of implementing this GSP, several associated actions will be encouraged by the GSA as part of good groundwater management practices.

ES-6.5.1 Agency Coordination

To effectively manage the groundwater resources within the Basin, there will be an ongoing need to coordinate with various state and local agencies that have authority over land use, water supply, and water quality in the watershed, including California Department of Fish and Wildlife, the RWQCB, DWR, California Department of Transportation (Caltrans), the State Water Resources Control Board, LA County, Sanitation Districts, and the City (refer to Section 3.3 for more details).

ES-6.5.2 Removal of Invasive Species

Invasive plant species, consisting primarily of *Arundo,* have become established within the riparian area along the Santa Clara River and some of its tributaries. While not required, the GSA will continue to support efforts by others to raise money for invasive species removal projects.

ES-6.5.3 Optional Managed Aquifer Recharge Projects

Managed groundwater recharge can utilize water sources such as stormwater, excess imported water, and/or recycled water to meet multiple goals within the watershed including reducing stormwater runoff, increasing the use of recycled water, and augmenting groundwater supplies for drought. Efforts to characterize additional groundwater recharge opportunities in the Basin have been underway for many years and, in recent years, some field studies have been implemented to test areas for recharge capability. Because undesirable results from over pumping have not been identified, implementation of these kinds of projects is not required and are considered optional. A description of these optional projects is presented in Section 9.6.

- Old Castaic School Site Recharge and/or Potential Eastern Recharge
- Recharge Using Potable Water in the Vicinity of the Placerita Nature Center
- Off Stream Recharge Using Recycled Water

ES-7 Groundwater Sustainability Plan Implementation (GSP Section 10)

Section 10 provides a conceptual road map for efforts to implement the GSP during the first 5 years and discusses implementation effects in accordance with SGMA regulations. A general schedule showing the major tasks and estimated timeline is provided as Figure 10-1. Section 9 presents a number of management actions to implement 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. New projects are not proposed at this time, suggested as optional only, because (1) the Basin is in balance and (2) no undesirable results have been observed and are not expected during the future planning horizon.

ES-8 Notice and Communications (GSP Section 11)

This section describes the methods and tactics used to involve individuals and organizations that have a direct interest in the development of this GSP and sustainable management of the Basin. A critical part of the GSP development is communication with, and the involvement of, the public and stakeholders, including private citizens, well owners, community organizations, environmental groups, tribal communities, and anyone with an interest in the prudent management of groundwater resources. Participation from a variety of stakeholders helps the SCV-GSA make decisions that consider varying needs and interests in the Basin. Section 11 and Appendix N describe the opportunities for engagement, including the formation of the Stakeholder Advisory Committee and the decision-making process, key messages, and schedule for accomplishing communication outreach tasks related to this GSP.

1 Introduction to the Santa Clara River Valley East Subbasin Groundwater Sustainability Plan

1.1 Purpose of the Groundwater Sustainability Plan

In September 2015, California Governor Jerry Brown signed into law a package of three bills that, together, constitute the Sustainable Groundwater Management Act (SGMA), codified in Section 10720 et seq. of the California Water Code. This framework for sustainable groundwater management requires governments and water agencies in medium- and high-priority basins to halt the overdraft of groundwater resources and balance groundwater pumping and rechange rates to achieve sustainability. This legislation created the statutory framework for planning and implementing groundwater management that can be sustained without causing undesirable results. Under SGMA, medium- and high-priority basins should reach sustainability within 20 years of implementing their Groundwater Sustainability Plans (GSPs), which is 2042 for the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin).

SGMA has set deadlines for reaching sustainability (in this basin, our focus is on maintaining sustainability) and empowered local agencies to form Groundwater Sustainability Agencies (GSAs) to manage groundwater basins and develop GSPs, such as this document. In his signing statement, Governor Brown emphasized that "groundwater management in California is best accomplished locally." To that end, Santa Clarita Valley Water Agency (SCV Water); the City of Santa Clarita (City); the County of Los Angeles (LA County); and the Los Angeles County Waterworks District No. 36, Val Verde (LACWD) are collaborating under a Joint Exercise of Powers Agreement (JPA) as the Santa Clarita Valley Groundwater Sustainability Agency (SCV-GSA).

This Santa Clara River Valley East Groundwater Subbasin GSP provides information about the area affected by this plan, the basin setting, the sustainable management criteria (SMCs), the monitoring networks, projects and management actions to achieve sustainability, plan implementation, the list of references and technical studies used in the development of this plan, and the supporting appendices.

This GSP is a broad and comprehensive planning-level document, developed to comply with the statutory and regulatory requirements of California Water Code 10721 and 23 California Code of Regulations (CCR) Section 341, Definitions.[1] As such, the language of this GSP may differ from terminology used in other contexts, such as past studies, judicial rules, or analyses. Further, information in this GSP is not to be used to determine water rights.

1.2 Description of the Basin

Following the passage of SGMA into law, the California Department of Water Resources (DWR) revised its document titled *California's Groundwater* (Bulletin 118), an inventory and assessment of available information on the occurrence and nature of California's groundwater (DWR, 2018). In addition to the groundwater inventory and assessment of information, Bulletin 118 also does the following:

- Establishes basin boundaries and priority levels
- Determines which basins are subject to critical conditions of overdraft
- Describes the hydrologic characteristics of groundwater basins

[1] The full text of the California Water Code is available at the website of the California Legislature: https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=WAT&division=6.&title=&part=2.74.&chapter=2.&article=

- Provides GSAs with important groundwater-related data

Bulletin 118 designates the Basin (Number 4-4.07) as a high-priority basin that is not critically overdrafted (DWR, 2018). As shown on Figure 1-1, the Basin is the eastern-most and furthest upstream subbasin in the group of six subbasins that together comprise the Santa Clara River Valley Groundwater Subbasin.

Bulletin 118 (DWR, 2018) describes the Basin as:

> [. . .] located in the central-western portion of Los Angeles County. The subbasin is bound on the north by the Piru Mountains and on the east and southeast by the San Gabriel Mountains. The Santa Susana Mountains bound the south side of the subbasin. The subbasin is bound on the west by the Modelo Formation, the Saugus Formation, and a thinning of the alluvium near the adjoining Piru subbasin (DPW, 1933). The area overlying the basin is drained by the Santa Clara River, Bouqet *[sic]* Creek, and Castaic Creek.

For more detail on the Basin, see Section 3.1.

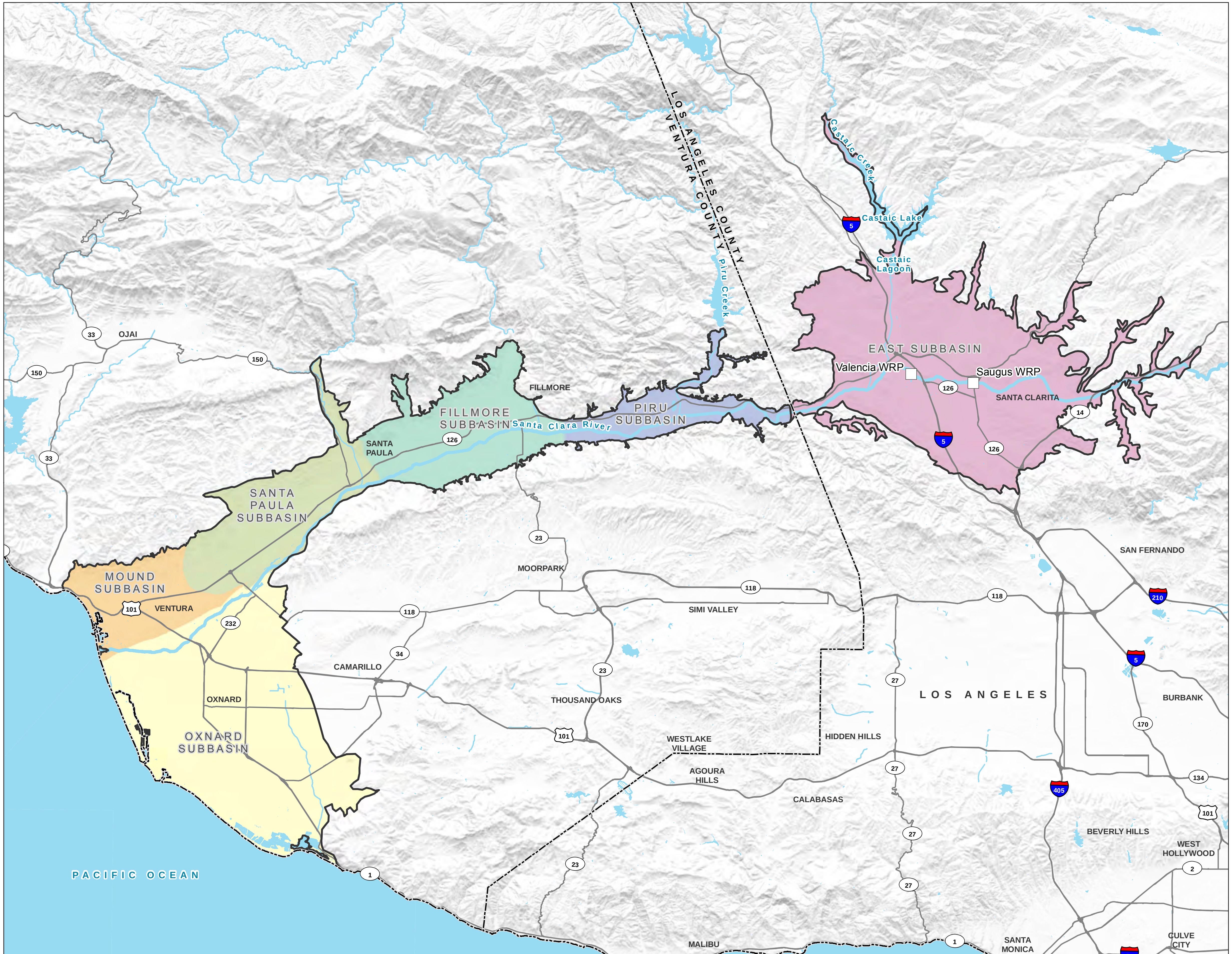


FIGURE 1-1

Santa Clara River Valley Groundwater Basin and Subbasins

Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan

LEGEND

- Water Reclamation Plant (WRP)
- Santa Clara River Valley Groundwater Basin

Santa Clara River Valley Subbasins

- Santa Clara River Valley East
- Piru
- Fillmore
- Santa Paula
- Mound
- Oxnard

All Other Features

- County Boundary
- Major Road
- Watercourse
- Waterbody

N

0 12,500 25,000 37,500 Feet

Date: December 8, 2021
Data Sources: USGS, DWR Bulletin 118

GSI Water Solutions, Inc.

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1.3 How this GSP is Organized

This GSP has been planned and developed collaboratively by the SCV-GSA members. The organization of this plan is as follows:

- **Section 1 – Introduction to the Santa Clara River Valley East Subbasin Groundwater Sustainability Plan:** An introduction to the GSP, including a description of its purpose and a brief description of the Basin.
- **Section 2 – Agencies' Information:** Information on the SCV-GSA as an organization and a brief description of each of the SCV-GSA member organizations, including information on the legal authority of the GSA to plan and coordinate groundwater sustainability for the Basin.
- **Section 3 – Description of Plan Area:** A detailed description of the Basin, land use in the Basin, existing wells and monitoring programs, existing groundwater management plans and regulatory programs, any programs for conjunctive use, and urban land use programs.
- **Section 4 – Hydrogeologic Conceptual Model:** An explanation of the hydrogeologic conceptual model developed for the Basin that includes water sources and uses, a general description of water quality, and a description of the data gaps in the current model.
- **Section 5 – Groundwater Conditions:** A detailed description of the groundwater conditions, including aquifer elevations, changes in storage, any issues related to seawater intrusion or subsidence, locations where surface water and groundwater are interconnected, the identification and distribution of groundwater-dependent ecosystems (GDEs), and a discussion of groundwater quality for drinking water and agricultural irrigation.
- **Section 6 – Water Budgets:** A presentation of the historical, current, and projected future water budgets for the Basin, including quantification of estimated change in storage for historical, current, and the projected future water budget.
- **Section 7 – Monitoring Networks:** A detailed description of the monitoring objectives and monitoring for groundwater levels, storage, water quality, land subsidence, interconnected surface water, as well as representative monitoring sites, and a description of the data management and reporting system.
- **Section 8 – Sustainable Management Criteria:** Defines the sustainability goal for the Basin, describes the process through which SMCs were established; describes and defines SMC regarding chronic lowering of groundwater levels, reduction in groundwater storage, seawater intrusion, degraded water quality, subsidence, and depletion of interconnected surface water; defines management areas for the Basin, and describes how management-area operations will avoid undesirable results.
- **Section 9 – Management Actions and Projects:** A list and description of each project and management action to address data gaps, describe procedures that will be followed if undesirable results are observed, and obtain information needed to manage the Basin. Optional projects intended to improve resiliency to drought are also included.
- **Section 10 – Groundwater Sustainability Plan Implementation:** Presents a planning-level estimate of implementation costs and a schedule for proposed projects and management actions.
- **Section 11 – Notice and Communications:** Presents SCV-GSA's communications and engagement planning and implementation, public feedback and stakeholder comments on the plan, how feedback was incorporated into the plan, and responses to comments received.

1.4 References

DPW. 1933. *Ventura County Investigation.* Division of Water Resources. Bulletin 46. Prepared by the California Department of Public Works (DPW).

DWR. 2018. *California's Groundwater Bulletin 118. Santa Clara River Valley - Santa Clara River Valley East.* Available at: https://water.ca.gov/-/media/DWR-Website/Web- Pages/Programs/Groundwater-Management/Bulletin-118/Files/2003-B118-Basin- Descriptions/B118-Basin-Boundary-Description-2003---4_004_07.pdf. Accessed October 7, 2019. Prepared by the California Department of Water Resources.

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2 Agencies' Information (§ 354.6)

The addresses and telephone numbers for Santa Clarita Valley Water Agency (SCV Water), the City of Santa Clarita (City), the County of Los Angeles (LA County), and Los Angeles County Waterworks District No. 36, Val Verde (LACWD) are listed below:

Santa Clarita Valley Water Agency (SCV Water)
SCV Water – Santa Clarita
27234 Bouquet Canyon Road
Santa Clarita, CA 91350
(661) 297-1600

City of Santa Clarita
23920 Valencia Boulevard #120
Valencia, CA 91355
(661) 259-2489

County of Los Angeles (LA County)
550 South Vermont Avenue
Los Angeles, CA 90020
(213) 738-3700

Los Angeles County Waterworks District No. 36, Val Verde (LACWD)
1000 South Fremont Avenue Building A9-E, 4th Floor
Alhambra, CA 91803
(877) 637-3661

The Santa Clarita Valley Groundwater Sustainability Agency's (SCV-GSA's) mailing address is as follows:

Santa Clarita Valley Groundwater Sustainability Agency
c/o SCV Water – Santa Clarita
27234 Bouquet Canyon Road
Santa Clarita, CA 91350
(661) 297-1600

The SCV-GSA GSP manager is as follows:
Rick Viergutz, Principal Water Resources Planner
SCV Water – Santa Clarita
27234 Bouquet Canyon Road
Santa Clarita, CA 91350
(661) 297-1600
rviergutz@scvwa.org

2.1 Agencies' Organization and Management Structure

2.1.1 Santa Clarita Valley Groundwater Sustainability Agency

SCV-GSA was initially established through the Memorandum of Understanding to Form the Santa Clarita Valley Groundwater Sustainability Agency (MOU) on May 24, 2017, between Castaic Lake Water Agency (CLWA), Newhall County Water District (NCWD), LACWD, the Santa Clarita Water Division (SCWD), the City, and LA County. The members of the SCV-GSA determined that sustainable management of the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) would best be achieved through a Joint Exercise of Powers Agreement (JPA), which, once approved, would supersede and terminate the MOU. On September

18, 2018, SCV Water;[2] the City; LA County; and LACWD filed the JPA in the Office of the County Counsel for LA County. It is included in this Groundwater Sustainability Plan (GSP) as Appendix A.

The JPA authorized the members to create a joint powers authority, which is a public entity separate from the members, the purpose of which is to develop, adopt, and implement the GSP for the Basin. The SCV-GSA is governed by a board of seven directors, constituted from the following:

- Four directors appointed by the Board of Directors for SCV Water
- One director appointed by the City of Santa Clarita City Council
- One director appointed by the LA County Board of Supervisors
- One director appointed by LACWD

Directors serve a term of 2 years and may be removed or reappointed for multiple terms by the Groundwater Sustainability Agency (GSA) member agency. Each director has one vote. A majority of directors constitutes a quorum. All decisions of the Board of Directors require the affirmative vote of at least four directors, except for matters requiring a supermajority vote (of five affirmative votes), which include the adoption of the GSP and amendments.[3]

Each member agency may appoint alternate directors who may vote in lieu of a director if there is an absence or conflict of interest. Unless appearing as an alternate for a director, an alternate director has no vote and may not participate in board deliberations. The GSA officers include a chair, vice chair, secretary, and treasurer. The Board of Directors meet at least quarterly. SCV Water manages the administrative operations of the GSA and development of the GSP.

2.1.2 SCV Water

SCV Water is a special act agency created by the State of California pursuant to California SB 634, Chapter No. 833, 2017, and codified in the California Water Code Appendix (the "Act"). It is the successor agency to CLWA, a wholesale agency, and its three retail purveyors, SCWD, NCWD, and VWC and it came into existence on January 1, 2018. The Agency's functions include the ability to acquire, hold, and utilize water and water rights and to provide, sell, manage, and deliver imported surface water, groundwater, and recycled water for municipal, industrial domestic, and other purposes at retail and wholesale throughout its service area (SCV Water, 2019).

At formation, SCV Water was served by a 15-member board. As per SB 634, through attrition and the election process, SCV Water is currently governed by a 12-member Board of Directors, including one director who is appointed after nomination by member agency LACWD. This appointed seat will sunset in January 2023. Of the remaining 11 members, 6 were elected to a 4-year term in November 2020, and 5 are carried forward from the original agency formation. At the general election in November 2022, two additional seats will be eliminated, resulting in 9 members directly elected from three electoral divisions.

Officers of the board include a president and two vice presidents. The board also appoints a general manager and a treasurer or auditor, and employs a secretary and general counsel, who serves as the assistant secretary. Seven or more directors constitute a quorum of the board. Adoption of any ordinance, resolution, or motion requires an affirmative vote by a majority.

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[2] SCV Water is the successor to CLWA, SCWD, Valencia Water Company (VWC), and NCWD, which were dissolved pursuant to Senate Bill (SB) 634, Chapter 833 (see Appendix A).
[3] See Article 9 of the JPA for more information on the other matters requiring a supermajority vote (see Appendix A).

2.1.3 City of Santa Clarita

The City is a municipal government that provides open-space and land-use planning as well as stormwater capture and treatment, and creek restoration within the city borders. The City has a city manager form of government and a five-member City Council. At the first meeting in December each year, the five-person council designates one member to serve as mayor during the year. According to the Santa Clarita Municipal Code, the Santa Clarita City Council members adopt a legislative platform for the coming year and vote on ordinances and resolutions (1.01.003 Contents of Code).[4] The City Council appoints a city manager with the authority to authorize or assign City positions, similar to the authority of the City Council (2.08.010 Office Created—Term). The city manager is the administrative head of the city government (2.08.060 Powers and Duties) and advises and assists on all matters relating to the fiscal affairs of the City (2.12).

2.1.4 LA County

LA County serves multiple functions related to groundwater in the Basin, including flood management, wastewater treatment, infrastructure maintenance and construction, and land-use and environmental review (see Section 3.3.4 for more detail on LA County's responsibilities). The LA County Board of Supervisors serves as the executive and legislative head of county government. The five-member elected board is responsible for setting policies, enacting ordinances, and adopting resolutions. An Executive Office and civil service staff supports the board and LA County departments.

2.2 Authority of Agencies

California Water Code § 10723 et seq. requires that local agencies form GSAs with a joint powers agreement or memorandum of understanding. The legal agreement shall include the following:

> The service area boundaries, the boundaries of the basin or portion of the basin the agency intends to manage pursuant to this part, and the other agencies managing or proposing to manage groundwater within the basin.
> A copy of the resolution forming the new agency.
> A copy of any new bylaws, ordinances, or new authorities adopted by the local agency.
> A list of interested parties developed pursuant to Section 10723.2 and an explanation of how their interests will be considered in the development and operation of the groundwater sustainability agency and the development and implementation of the agency's sustainability plan.

2.2.1 Santa Clarita Valley Groundwater Sustainability Agency

The SCV-GSA was formed in accordance with the requirements of California Water Code § 10723 et seq. The process by which the SCV-GSA was formed and the key provisions of the JPA to form the GSA are described in the sections below.

2.2.2 Memorandum of Understanding

On May 24, 2017, CLWA, NCWD, LACWD, the SCWD, the City, and LA County signed the MOU to form the SCV-GSA (CLWA et al., 2017). In the fall of 2017, the California Legislature passed SB 634 that reorganized

[4] The Santa Clarita Municipal Code is available at https://www.codepublishing.com/CA/SantaClarita./ (Accessed June 3, 2021.)

the CLWA, NCWD, VWC, and the SCWD into SCV Water.[5] As successor, SCV Water was the party that signed the JPA to form the SCV-GSA.

2.2.3 Joint Exercise of Powers Agreement

On September 18, 2018, SCV Water,[6] the City, LA County, and LACWD filed the JPA in the County of Los Angeles County Counsel's office.[7] In broadest terms, the JPA gives the SCV-GSA the power to sustainably manage groundwater in the Basin. Specifically, the JPA authorizes the members to do the following:

- 4.1 To exercise all powers afforded to the SCV-GSA under SGMA, including without limitation:
  - 4.1.1 To adopt rules, regulations, policies, bylaws, and procedures governing the operation of the SCV-GSA.
  - 4.1.2 To develop, adopt, and implement a GSP for the Basin, and to exercise jointly the common powers of the Members in doing so.
  - 4.1.3 To obtain rights, permits, and other authorizations for, or pertaining to, implementation of a GSP for the Basin.
  - 4.1.4 To collect and monitor data on the extraction of groundwater from, and the quality of groundwater in, the Basin.
  - 4.1.5 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 SCV-GSA's powers.
  - 4.1.6 To establish and administer a conjunctive use program for the purposes of maintaining sustainable yield in the Basin consistent with the requirements of SGMA.
  - 4.1.7 To exchange and distribute water.
  - 4.1.8 To regulate groundwater extractions as permitted by SGMA.
  - 4.1.9 To spread, sink, and inject water into the basin to recharge the groundwater Basin.
  - 4.1.10 To store, transport, recapture, recycle, purify, treat, or otherwise manage and control water for beneficial use.
  - 4.1.11 To develop and facilitate market-based solutions for the use, sale, or lease, and management of water rights.
  - 4.1.12 To impose assessments, groundwater extraction fees, or other charges, and to undertake other means of financing the SCV-GSA as authorized by Chapter 8 of SGMA, commencing at section 10730 of the Water Code.
  - 4.1.13 To exercise the common powers of its Members to develop, collect, provide, and disseminate information that furthers the purposes of the SCV-GSA, including but not limited to the operation of the SCV-GSA and adoption and implementation of a GSP for the Basin to the Members' legislative, administrative, and judicial bodies, as well as the public generally.

[5] SB 634, Chapter 833. October 15, 2017. Santa Clarita Valley Water Agency
[6] SCV Water is the successor to CLWA, SCWD, VWC, and NCWD, which were dissolved pursuant to SB 634, Chapter 833 (see Appendix A of this GSP).
[7] See Appendix A, Groundwater Sustainability Agency Member Resolutions, Memorandum of Understanding, and Joint Exercise of Powers Agreement, for relevant documents.

4.1.14 To perform other ancillary tasks relating to the operation of the SCV-GSA pursuant to SOMA, including without limitation, environmental review, engineering, and design.

- 4.2 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 SCV-GSA's- purposes.
- 4.3 To make and enter contracts necessary to the full exercise of the SCV-GSA's power.
- 4.4 To employ, designate, or otherwise contract for the· services of agents, officers, employees, attorneys, engineers, planners, financial consultants, technical specialists, advisors, and independent contractors.
- 4.5 To incur debts, liabilities, or obligations, to issue bonds, notes, certificates of participation, guarantees, equipment leases, reimbursement obligations, and other indebtedness, as authorized by the Act.
- 4.6 To cooperate, act in conjunction, and contract with the United States, the State of California, or any agency thereof, counties, municipalities, public and private corporations 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 SCV-GSA.
- 4.7 To sue and be sued in the SCV-GSA's own name. Third parties must comply with the requirements of the Government Claims Act prior to filing any action for money or damages against the SCV-GSA.
- 4.8 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, have an interest and employ counsel and other expert assistance for these purposes.
- 4.9 To accumulate operating and reserve funds for the purposes herein stated.
- 4.10 To invest money that is not required for the immediate necessities of the SCV-GSA, as the SCV-GSA determines is advisable, in the same manner and upon the same conditions as Members, pursuant to Government Code section 53601, as that section now exists or may hereafter be amended.
- 4.11 To undertake any investigations, studies, and matters of general administration.
- 4.12 To perform all other acts necessary or proper to carry out fully the purposes of this Agreement.

2.2.4 Coordination Agreements

A coordination agreement is not required for the Santa Clara River Valley East Groundwater Subbasin because the SCV-GSA is the single GSA that manages the Basin.

2.2.5 Legal Authority to Implement Sustainable Groundwater Management Act Throughout the Plan Area

The SCV-GSA was formed in accordance with the requirements of California Water Code § 10723 et seq. The JPA for the formation of the GSA is provided as Appendix A of this GSP.

2.3 References

CLWA et al. 2017. *Memorandum of Understanding to Form the Santa Clarita Valley Groundwater Sustainability Agency.* Signed by Castaic Lake Water Agency (CLWA), Newhall County Water District, Los Angeles County Waterworks District No. 36, the Santa Clarita Water Division, the City of Santa Clarity, and the County of Los Angeles.

SCV Water. 2019. *Policies and Procedures for the Board of Directors of the Santa Clarita Valley Water Agency (SCV Water).* April 2, 2019: Santa Clarita Valley Water Agency.

3 Description of Plan Area (§ 354.8)

3.1 Santa Clara River Valley East Subbasin Introduction

The Santa Clara River Valley East Subbasin is located in the central-western portion of the County of Los Angeles (LA County), bounded on the north by the Piru Mountains, on the east and southeast by the San Gabriel Mountains, and on the south by the Santa Susana Mountains. The surface area of the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) is approximately 66,200 acres (approximately 103 square miles). The City of Santa Clarita is an urban area near the eastern boundary of the Basin. Major highways that intersect the Basin include Interstate 5 (I-5) and California State Routes 14 and 126 (DWR, 2018).

The area overlying the basin is drained by the Santa Clara River, Bouquet Creek, San Francisquito Creek, and Castaic Creek (DWR, 2018). Groundwater is found in alluvium, terrace deposits, and Saugus Formation. Groundwater in the subbasin is generally unconfined in the alluvium, but may be confined, semi-confined, or unconfined in the Saugus Formation (RCS, 2002). Developable quantities of groundwater are present in the alluvium (Alluvial Aquifer) and in portions of the Saugus Formation. These units are underlain and laterally bounded by non-water-bearing bedrock units that are Miocene, Oligocene, and pre-Tertiary in geologic age and which do not contain significant quantities of water that can be developed for municipal purposes (SCV Water, 2020). Figure 3-1 shows the location of the groundwater basin within the local watershed, and Figure 3-2 identifies the tributaries and subwatersheds that extend upstream of the groundwater basin boundary and contribute surface flow into the groundwater basin area (GSI, 2021).

Average annual precipitation in the Basin ranges from 14 inches to 16 inches (DWR, 2018). Rain falling in the upper elevations of the watershed infiltrates into the soil, where some of the water evaporates or is transpired by vegetation and the remainder becomes stormwater that can also infiltrate to groundwater. A portion of the rainfall runs off the land surface and flows into side canyons and tributaries to the river. In the urban areas, precipitation falling on impervious surfaces is directed to storm drains that flow to the river or the stormwater is directed to swales and allowed to percolate in some locations (GSI, 2021).

A detailed description of the Basin, including topography, boundaries, soil characteristics, geology, and aquifers and aquitards, is available in Sections 4.1 through 4.4 of this Groundwater Sustainability Plan (GSP).

3.2 Adjudicated Areas, Other GSAs, and Alternatives

The Santa Clara River Valley East Subbasin has not been adjudicated. In the larger Santa Clara River Valley Groundwater Basin, the westernmost Santa Paula Subbasin has been adjudicated. No other Groundwater Sustainability Agency (GSAs) have jurisdiction in the Santa Clara River Valley East Subbasin. Other GSAs with jurisdiction over subbasins within the Santa Clara River Valley Groundwater Basin include, from east to west, the Fillmore Piru GSA, the Santa Paula Adjudicated Groundwater Basin, and the Mound Basin GSA.

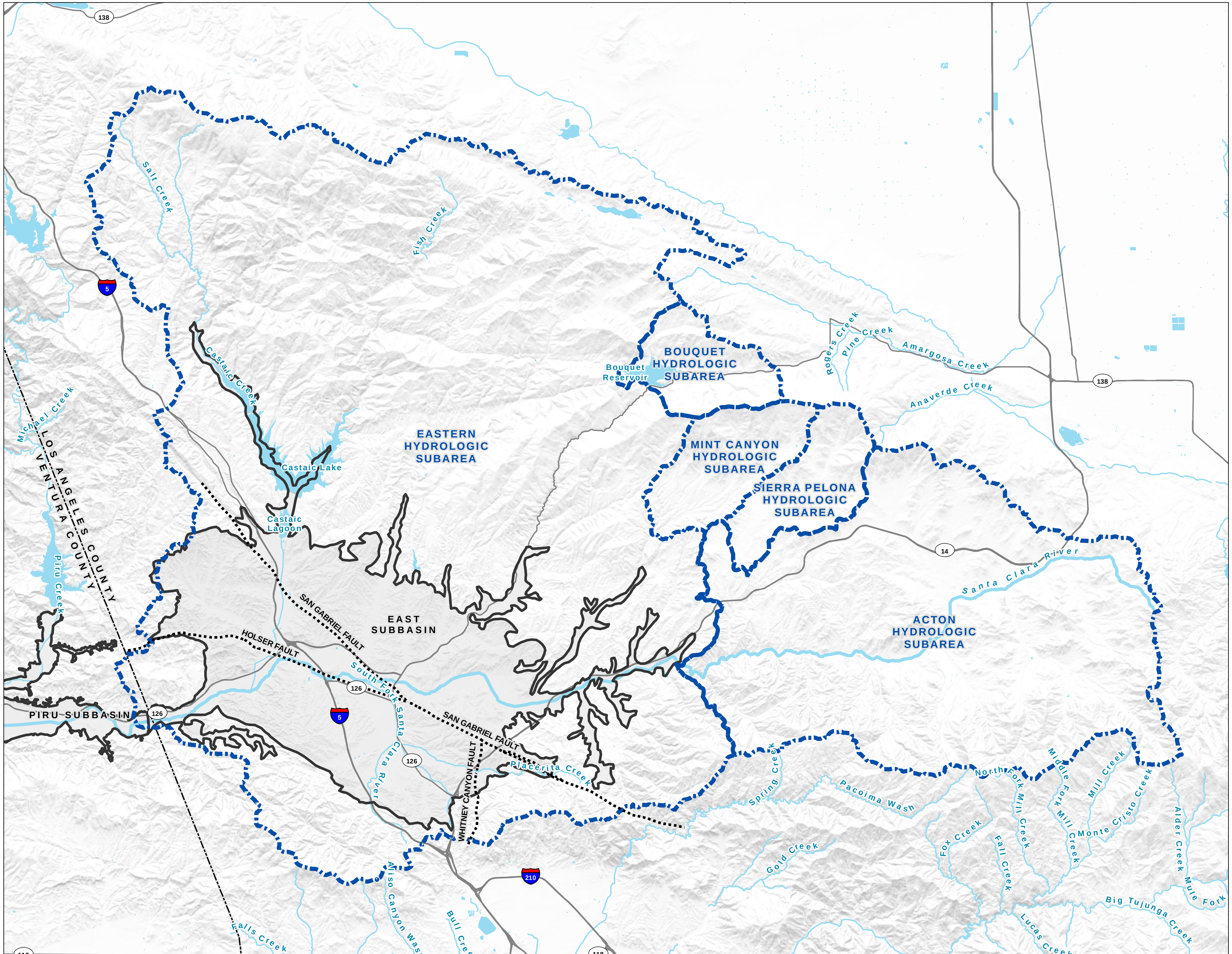
3.3 Other Jurisdictional Areas

Several agencies have jurisdictional authority that affects water management in the Basin. Each agency is discussed in Sections 3.3.1 through 3.3.5. Figure 3-3 shows areas of federal, state, and county jurisdictions and Figure 3-4 shows City of Santa Clarita jurisdiction and the service area for SCV Water.

FIGURE 3-1

Watershed Boundaries for Upper Santa Clara River Hydrologic Area and Subareas

Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan



LEGEND

- Fault
- Santa Clara River Valley Groundwater Basin
- Upper Santa Clara River Hydrologic Subbarea

All Other Features

- Major Road
- Watercourse
- Waterbody

N

0 9,000 18,000 27,000
Feet

Date: December 9, 2021
Data Sources: USGS, DWR Bulletin 118

GSI Water Solutions, Inc.

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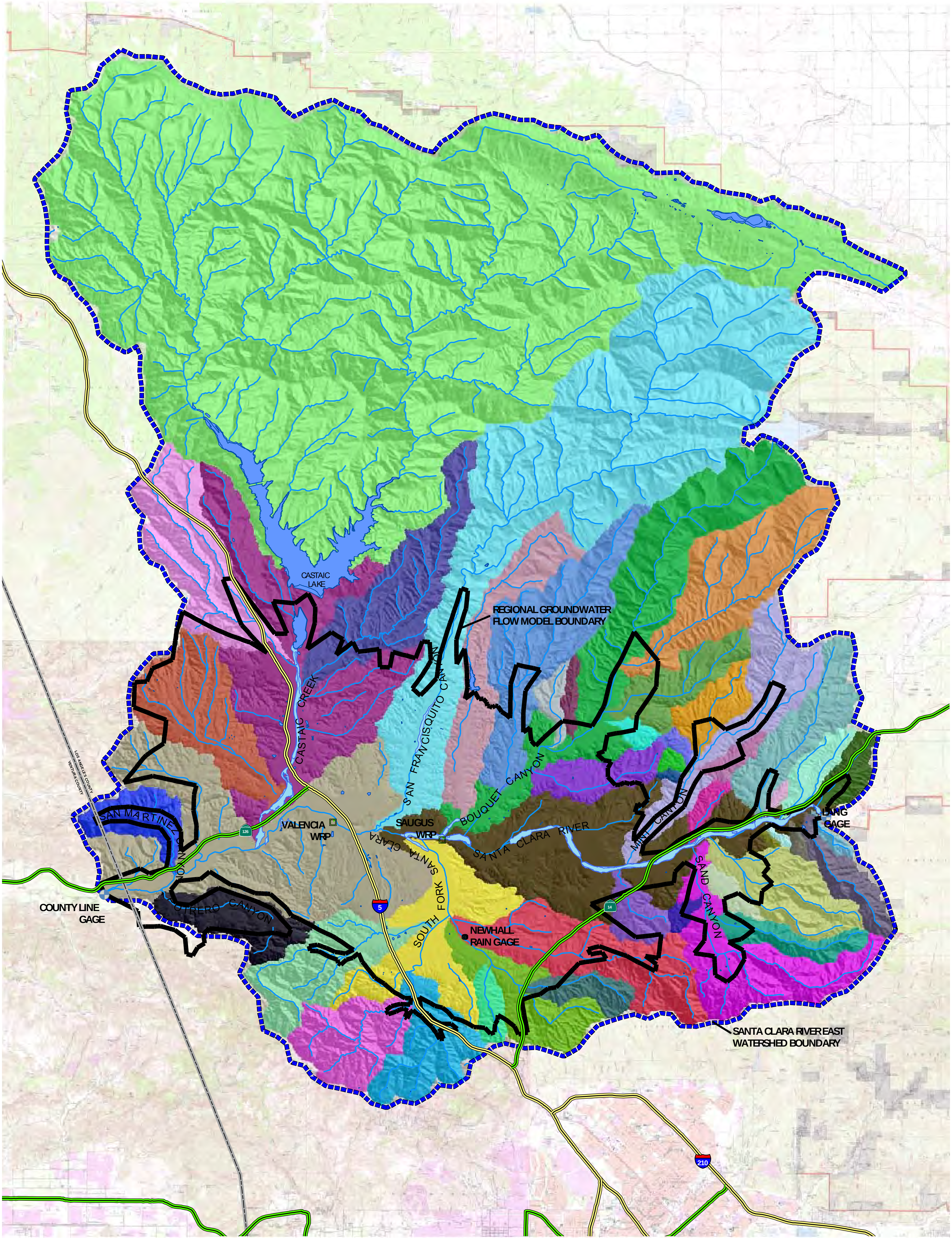

LEGEND

Hydrography

- Lake
- Stream
- Stream Gage
- Water Reclamation Plant (WRP)

Major Road

- Interstate
- State Highway

Data Sources: CH2MHILL, 2004

FIGURE 3-2

Contributing Watersheds to the Santa Clara River Valley East Groundwater Subbasin

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

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0 2.5 5
Miles

GSI Water Solutions, Inc.

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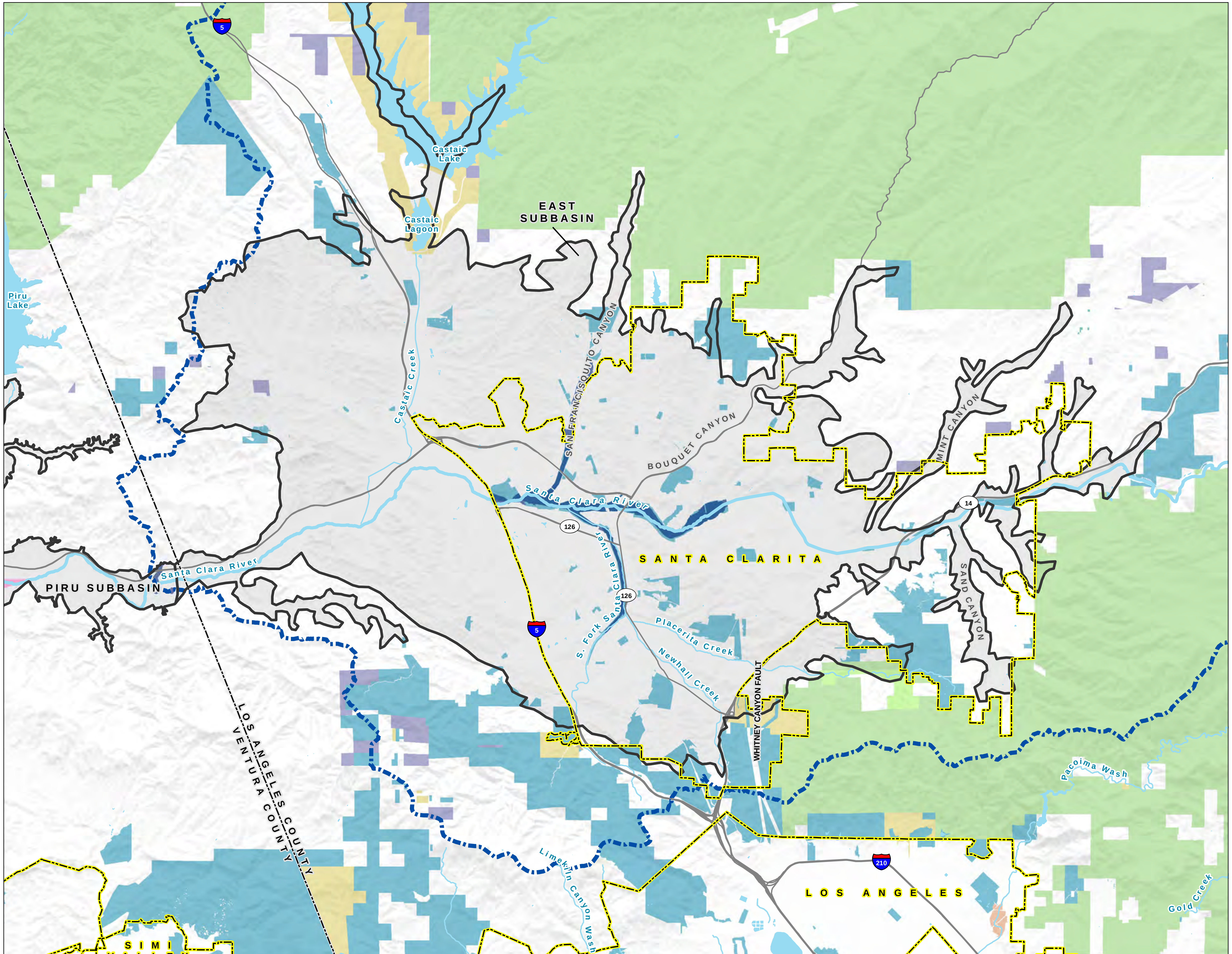

FIGURE 3-3

Federal, State, and County Jurisdictions in the Subbasin

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

LEGEND

Land Ownership

- Bureau of Land Management
- CA Dept. of Parks and Recreation
- Department of Defense
- Local Government
- Non-Profit Conservancies and Trusts
- Other Federal Lands
- Other State Lands
- USDA Forest Service
- CDFW Conservation Easement

All Other Features

- City Boundary
- Santa Clara River Valley Groundwater Basin
- Watershed Boundary
- Major Road
- Watercourse
- Waterbody

NOTE

CDFW: California Department of Fish and Wildlife

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0 5,000 10,000 15,000
Feet

GSI Water Solutions, Inc.

Date: December 9, 2021
Data Sources: USGS, DWR Bulletin 118, CA.gov

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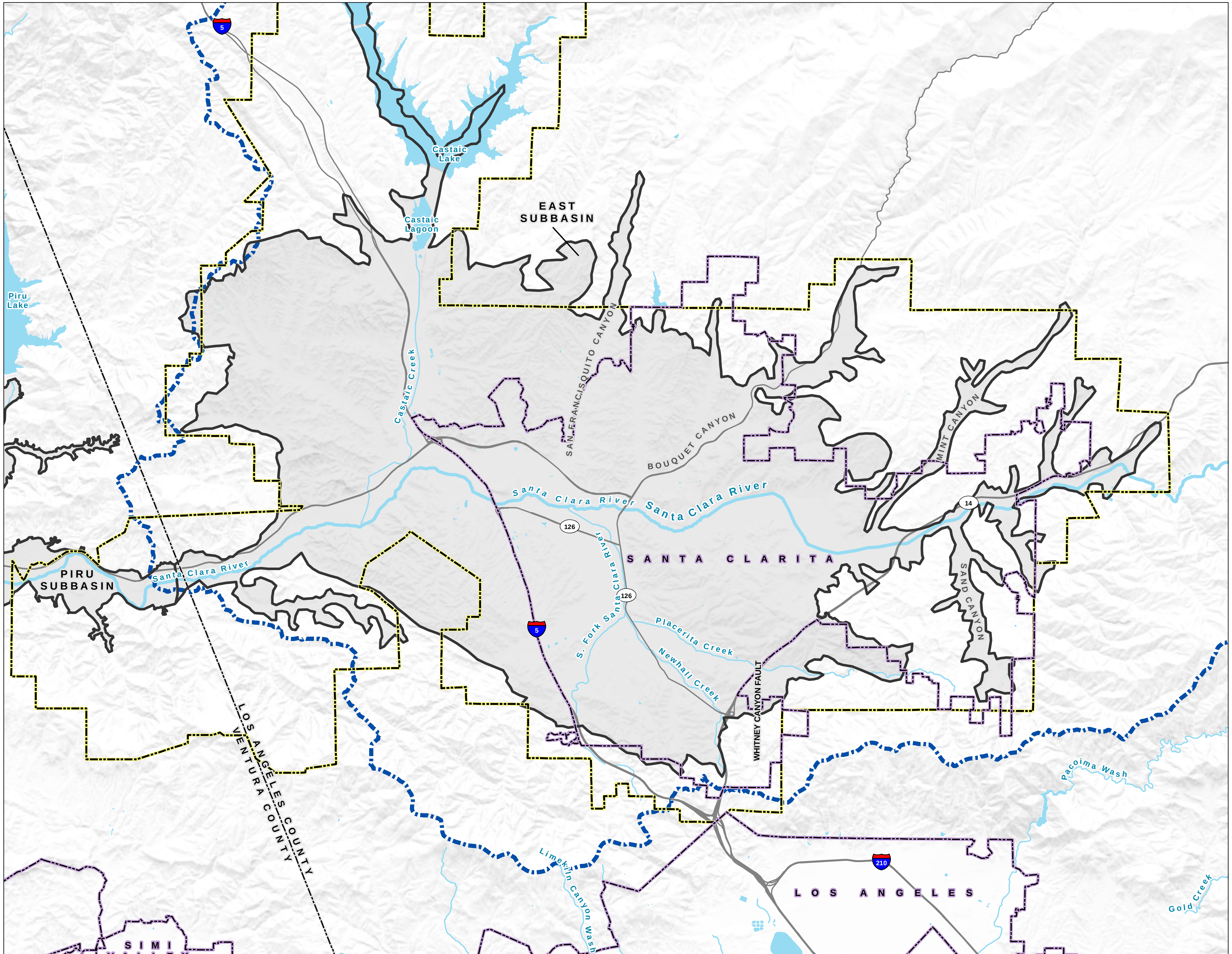

FIGURE 3-4

City of Santa Clarita Jurisdictions in the Subbasin

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

LEGEND

- City Boundary
- Service Area Boundary for SCV Water
- Santa Clara River Valley Groundwater Basin
- Watershed Boundary

All Other Features

- Major Road
- Watercourse
- Waterbody

NOTE

SCV Water: Santa Clarita Valley Water Agency

N

0 5,000 10,000 15,000
Feet

Date: December 9, 2021
Data Sources: USGS, DWR Bulletin 118

GSI Water Solutions, Inc.

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3.3.1 Federal Jurisdictions

U.S. Department of Agriculture Forest Service (Forest Service) Angeles National Forest, U.S. Fish and Wildlife Service (USFWS), and U.S. Army Corps of Engineers (USACE) have jurisdiction in the Basin, as follows:

- **The Forest Service** administers land in the Angeles National Forest.
- **USFWS** provides for the conservation and protection of terrestrial and aquatic species and their habitats.
- **USACE** conducts projects and programs for flood risk management and ecosystem restoration in the Basin.

3.3.2 Tribal Jurisdictions

The Santa Clarita Valley is part of the region that the Fernandeño Tataviam Band of Mission Indians designates as its homeland. The Fernandeño Tataviam Band of Mission Indians are not federally recognized as an American Indian Tribe and therefore do not have tribal jurisdiction in the Basin (Dudek, 2019).

3.3.3 State Jurisdictions

Five state agencies have authority over land use and water resources in the Basin, as follows:

- **California Department of Fish and Wildlife** manages fish, wildlife, and plant resources and their habitats.
- **California Department of Water Resources (DWR)** manages water resources, systems, and infrastructure, including the State Water Project, and regulates the use of groundwater.
- **California Department of Transportation** manages highway and freeway rights of way.
- **State Water Resources Control Board** and the **California Regional Water Quality Control Board – Los Angeles Region** ensure the protection of water quality in stormwater, drinking water, wastewater treatment; oversee all beneficial uses of water and water rights, and ensures proper water resource allocation and efficient use. The State Water Resources Control Board Division of Drinking Water regulates public drinking water systems and is the lead agency for issuing the permits that allow perchlorate-treated groundwater from three SCV production wells to be used for municipal supply. The Los Angeles Regional Water Quality Control Board (LARWQCB) provided guidance for the Salt and Nutrient Management Plan for the Santa Clara River Valley East Subbasin (GSSI, 2016).

3.3.4 County Jurisdiction

LA County has jurisdiction over multiple water-related functions in the Basin:

- **Los Angeles County Department of Public Works (LACDPW)** is responsible for the design, construction, and maintenance of regional infrastructure related to water resources, environmental services transportation infrastructure, public buildings, development services, and emergency management.
- **Los Angeles County Waterworks District 36, Val Verde (LACWD)** is a special district operated by LACDPW to provide drinking water for urban use in Val Verde. This local water system is owned and operated by LACWD and obtains its water supplies from SCV Water and from a Saugus Formation production well that it owns and operates inside its service area.
- **Los Angeles County Flood Control District (LACFCD)** provides flood management services within District boundaries and has permitting authority for construction activities within the floodway.
- **Los Angeles County Department of Regional Planning (LACDRP)** performs all land-use planning and environmental review for unincorporated areas of LA County. LACDRP collaborated with the City of Santa

Clarita in a regional planning effort titled the Santa Clarita Valley Area Plan – One Valley One Vision to plan for concurrent growth and protection of natural resources.

3.3.5 City and Local Jurisdictions

The City of Santa Clarita is responsible for land-use planning, as articulated in the Santa Clarita Municipal Code and the City of Santa Clarita General Plan (General Plan), and implementation and funding plan elements through the passage of ordinances and resolutions.[8] The General Plan is an outcome of a joint collaborative planning effort between the City and LA County that is called One Valley One Vision. The purpose of this effort is to plan growth in the Santa Clarita Valley while preserving natural resources. The Conservation and Open Space element of the City's plan establishes a policy framework that provides for "water recharge and watershed protection" in the plan area (City of Santa Clarita, 2011).

The Santa Clarita Valley Sanitation District of Los Angeles County (SCVSD) is one of 24 sanitation districts that are public agencies that together make up the Los Angeles County Sanitation Districts. SCVSD provides wastewater treatment at the Valencia and Saugus Water Reclamation Plants (WRPs) for the City and adjoining unincorporated communities in the Los Angeles County Sanitation District's Santa Clarita/Newhall Ranch Service Area.

3.4 Land Use

Prior to the 1960s, the Santa Clarita Valley was primarily agricultural, and much of the valley was undeveloped. Urbanization began gradually in the 1960s, with a rapid increase beginning in the late 1970s and early 1980s and continuing to the present. Accompanying the rapid population increase has been a gradual change from largely agricultural land use to urban and suburban developments. Nevertheless, a considerable portion of the hills and low mountains bordering the main river valley remain in a natural, undeveloped condition, as shown on the accompanying land use map (see Figure 3-5) (GSI, 2020).

By 2019, the population of the Santa Clarita Valley was approximately 286,000, with the majority of the total water demand (more than 80 percent) from municipal users (GSI, 2020). LA County and the City of Santa Clarita collaborated on the Santa Clarita Valley Area Plan, in an effort called One Valley One Vision. The plan sets out standards for growth. The majority of the land within the planning area is undeveloped. The plan designates 21 land uses (Los Angeles County Department of Regional Planning and City of Santa Clarita, 2012).

The current water budget (Section 6) incorporates land uses from 2014.[9] The projected water budget uses future demands for water under full build-out land use conditions, which are expected to occur by the year 2050 (KJ, 2021). Land use mapping for recent periods and for the future full build-out of the Santa Clarita Valley are from information published in the Southern California Association of Governments (SCAG) 2008 land use survey[10] and the One Valley One Vision land use planning process (Los Angeles County Department of Regional Planning and City of Santa Clarita, 2012).

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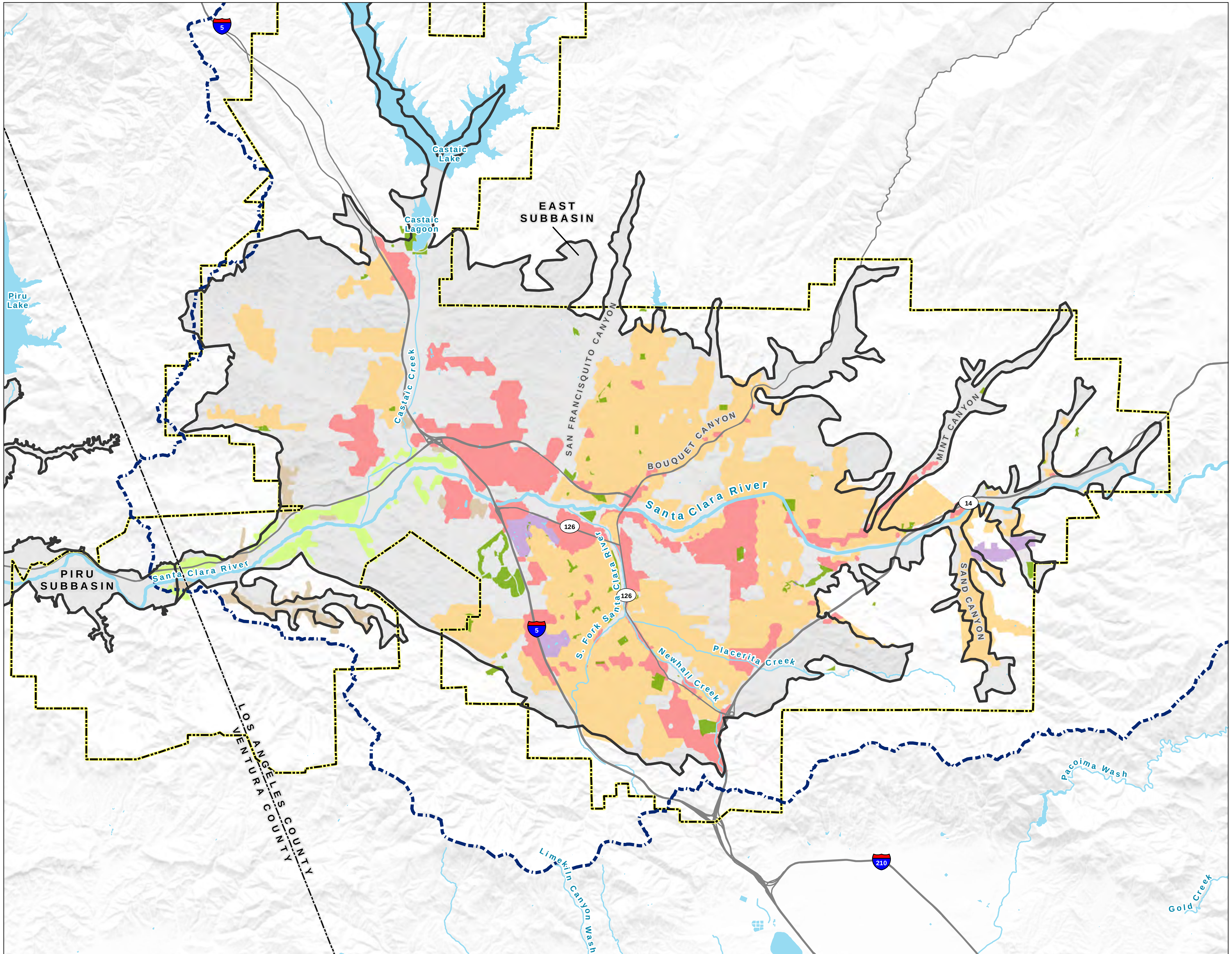
[8] The City of Santa Clarita Municipal Code and Genera Plan are both available at https://www.santa-clarita.com/ (Accessed October 2, 2020.)
[9] The 2014 land uses are believed to be within 1 percent of those found in 2019, based on the number of water accounts served by SCV Water. The depicted land uses are based on land uses published in the One Valley One Vision plan (Los Angeles County Department of Regional Planning and City of Santa Clarita, 2012) and the SCAG (2008) land use survey (available at https://scag.ca.gov/data-tools-geographic-information-systems).
[10] Available at https://scag.ca.gov/data-tools-geographic-information-systems. (Accessed June 3, 2021.)

FIGURE 3-5

2014 Land Use

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan



LEGEND

- Santa Clara River Valley Groundwater Basin
- Watershed Boundary
- Service Boundary Area for SCV Water

Land Use

- Agriculture (Dryland)
- Agriculture (Irrigated)
- Park
- Golf Course
- Commercial/Industrial
- Residential

All Other Features

- Major Road
- Watercourse
- Waterbody

NOTE

SCV Water: Santa Clarita Valley Water Agency

N

0 5,000 10,000 15,000
Feet

Date: December 9, 2021
Data Sources: USGS, Southern California Association of Governments (2008), LA County and City of Santa Clarita (2012), DWR Bulletin 118

GSI Water Solutions, Inc.

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As mentioned in Sections 3.3.4 and 3.3.5, the City/LA County collaborative One Valley One Vision planning effort encompassed the City of Santa Clarita General Plan (2011) and the Los Angeles County General Plan 2035 (Los Angeles County, 2015). The 2011 One Valley, One Vision Plan (City of Santa Clarita, 2011) categorizes land use in the basin in six major areas:

- **Residential** – Including a mix of housing developed at varying densities and types.
- **Commercial** – Including retail and commercial businesses.
- **Mixed Use** – Includes retail, office, and service uses with higher-density residential uses.
- **Industrial** – Including heavy manufacturing and light industrial uses, including resource extraction and businesses that use or generate hazardous materials.
- **Public and Institutional** – Including government buildings, hospitals, libraries, schools, other public institutions, correctional facilities and transportation and communication uses such as freeways and major roads, railroads, park and ride lots, truck terminals, airports, communication facilities, electrical power and natural gas facilities, solid waste and liquid waste disposal, transfer facilities, and maintenance yards.
- **Open Space and Recreation** – Including land used for agriculture, private and public recreational open spaces, local and regional parks, golf courses, the Angeles National Forest, water bodies and water storage, and some agricultural use in unincorporated Los Angeles County areas.

The 2016 Salt and Nutrient Management Plan (SNMP) (GSSI, 2016) categorizes land uses in designated Groundwater Management Zones to evaluate historical and current salt and nutrient loads. For this reason, the land use categories differ slightly from those used in the SCV General Plan Background Report; however, they provide acreages for each type of land use (see Table 3-1).

Table 3-1. Land Uses in Groundwater Management Zones, Santa Clara River Valley East Subbasin

Land Use	Acreage	Percentage of Total
Residential	14,140	7.00%
Commercial/Industrial	14,437	7.00%
Impervious Surfaces	208	0.10%
Agricultural/Parks/Golf Courses	2,653	1.00%
Water Bodies	663	0.33%
Open Space	167,377	84.00%

Source: *Final Salt and Nutrient Management Plan Santa Clara River Valley East Subbasin* (GSSI, 2016)

The SCV-GSA is not aware of any information regarding the implementation of land use plans outside the Basin that could affect the GSA's ability to achieve sustainable groundwater management.

3.4.1 Water Source Types

The Final Santa Clarita Valley 2020 Urban Water Management Plan (UWMP) (KJ, 2021) outlines regional water supplies and demands over the 2025 to 2050 planning horizon. Water sources include local groundwater, imported water, and recycled water. The following sections describe these water supplies in more detail.

3.4.1.1 Local Groundwater

The sole source of local groundwater for urban water supply in the Santa Clarita Valley is the groundwater basin identified in Bulletin 118, 2003 Update, as the Santa Clara River Valley Groundwater Basin, East

Subbasin (Basin No. 4-4.07). The Basin comprises two aquifer systems, the Alluvial Aquifer and the Saugus Formation. The UWMP includes a summary of the existing Groundwater Management Plan (GWMP)[11] that describes pumping from each of the two aquifers (KJ, 2021), as follows:

- Pumping from the Alluvial Aquifer in a given year is governed by local hydrologic conditions in the eastern Santa Clara River watershed. Pumping for municipal, agricultural, and private purposes ranges between 30,000 and 40,000 acre-feet per year (AFY) during normal and above-normal rainfall years. However, due to hydrogeologic constraints in the eastern part of the Basin, pumping is reduced to between 30,000 and 35,000 AFY during locally dry years.
- Pumping from the Saugus Formation in a given year is tied directly to the availability of other water supplies, particularly from the California State Water Project (SWP). During average year conditions within the SWP system, Saugus pumping ranges between 7,500 and 15,000 AFY. Planned dry-year pumping from the Saugus Formation ranges between 15,000 and 25,000 AFY during a drought year and can increase to between 21,000 and 25,000 AFY if SWP deliveries are reduced for two consecutive years and between 21,000 and 35,000 AFY if SWP deliveries are reduced for three consecutive years. Such high pumping would be followed by periods of reduced (average-year) pumping, at rates between 7,500 and 15,000 AFY, to further enhance the effectiveness of natural recharge processes that would recover water levels and groundwater storage volumes after the higher pumping during dry years.

3.4.1.2 Imported Water

SCV Water's imported water supply comprises SWP water as well as additional sources from the Buena Vista Water Storage District (BVWSD) and Rosedale-Rio Bravo Water Storage District (RRBWSD) in Kern County, and other sources outside of the Santa Clarita Valley (LCSE, 2020).

SCV Water's contractual amount of Table A SWP water is 95,200 acre-feet (AF). SCV Water receives 11,000 AFY under the 2007 Water Acquisition Agreement with BVWSD and the RRBWSD. SCV Water has entered into long-term groundwater banking and water exchange programs and, in aggregate, had more than 164,000 AF of recoverable water outside the local groundwater basin at the end of 2019. The first component of SCV Water's overall groundwater banking program is with Semitropic Water Storage District (SWSD). SCV Water participates in the Stored Water Recovery Unit (SWRU) banking program at SWSD, whereby SCV Water can withdraw up to 5,000 AFY from the water that was stored in the SWRU to meet Valley demands when needed in dry years (January 2020 storage balance of 45,279 AF). The second component, the Rosedale-Rio Bravo Water Banking Program in Kern County, had approximately 100,000 AF in storage as of January 2020 with a withdrawal capacity of 10,000 AFY after completion of the Rosedale-Rio Bravo Drought Relief Project in 2019. The other components are the Two-For-One Water Exchange Programs that SCV Water initiated with RRBWSD, West Kern Water District, Antelope Valley-East Kern Water Agency, and United Water Conservation District that had a combined amount of almost 19,200 AF of recoverable water at the end of 2019 (LCSE, 2020) and approximately 2,850 AF at the end of 2020.

In 2019, SCV Water's final allocation of SWP water was 75 percent of its Table A amount, or 71,400 AF. The total imported water supply in 2019 was 86,758 AF which consisted of 71,400 AF of delivered Table A supply, 11,000 AF purchased from BVWSD and RRBWSD, 750 AF returned from the Central Coast Water Authority Exchange, and 3,608 AF of 2018 SWP carryover water available in 2019. SCV Water deliveries of imported water to service connections and Los Angeles County Waterworks District No. 36, Val Verde (LACWD) were 42,072 AF with the remaining imported water banked (5,002 AF), exchanged in Two-For-One Water Exchange Programs (19,500 AF), sold (9,900 AF), delivered to Devil's Den (382 AF), carried over to

[11] According to Sustainable Groundwater Management Act (SGMA), the GWMP will be in place until this GSP is implemented in 2022.

2020 (9,013 AF), and some loss (889 AF) through meter reading differences and use through operations (LCSE, 2020).

In 2020, SCV Water's final allocation of SWP water was 20 percent of its Table A amount, or 19,040 AF. As identified in the 2020 UWMP (KJ, 2021), the total imported water supply in 2020 was 48,828 AF, which consisted of 14,587 AF of delivered Table A supply, 11,000 AF purchased from BVWSD and RRBWSD, and 284 AF of Yuba Accord water. SCV Water deliveries of imported water to its service connections and to LACWD totaled 48,196 AF, with the remaining imported water consisting of system losses (632 AF) arising from meter reading differences and use through operations.

3.4.1.3 Recycled Water

SCV receives recycled water from two sources: the Saugus WRP and the Valencia WRP. The Valencia WRP has a current treatment capacity of 21.6 million gallons per day (MGD), equivalent to 24,190 AFY, developed over time in stages. The Valencia WRP produces an average of 15,500 AFY of tertiary recycled water. The Saugus WRP has a current treatment capacity of 6.5 MGD (7,280 AFY). No future expansions of treatment capacity are possible at the Saugus WRP because of space limitations at the site. Use of recycled water from these two facilities is permitted under LARWQCB Order Nos. 87-49 and 97-072 (KJ, 2016b). In 2019 and 2020, SCV used approximately 458 AF and 468 AF of recycled water, respectively (LCSE, 2020; KJ, 2021).

An additional treated wastewater stream consists of groundwater that is pumped from extraction wells on the Whittaker-Bermite property and then discharged (after treatment) into the Santa Clara River about 1 mile upstream of the Saugus WRP. This system began operating in August 2017 and since that time has discharged approximately 500 AFY to the river.

3.4.2 Water Use Sectors

By far, the largest water use sector in the Basin is municipal use by SCV Water and LACWD, which together provided water to approximately 73,200 service connections as of 2019 (LCSE, 2020). Agricultural and small private wells[12] constitute the other users of groundwater in the Basin. As shown in Table 3-2, during 2019 municipal use accounted for 60,077 AF (83 percent) of total water use in the Basin, and agricultural and private well use accounted for 12,510 AF (17 percent of total water use in the Basin) (LCSE, 2020; KJ, 2021). In 2020, municipal use accounted for 65,996 AF (84 percent) of total water use in the Basin, and agricultural and private well use accounted for 12,300 AF (16 percent of total water use in the Basin) (KJ, 2021).

Table 3-2. Beneficial Uses and Water Sources

Beneficial Use Type	Imported	Groundwater	Recycled Water	Total
2019 Municipal Use	42,072	17,547	458	60,077
2019 Agriculture/Miscellaneous	NA	12,510	NA	12,510
2019 Total	**42,072**	**30,057**	**458**	**72,587**
2020 Municipal Use	48,196	17,332	468	65,996
2020 Agriculture/Miscellaneous	NA	12,300	NA	12,300
2020 Total	**48,196**	**29,632**	**468**	**78,296**

Notes
All values in acre-feet and are the amounts of water use that occurred during calendar years 2019 and 2020.
NA = not applicable

[12] The information on the locations, construction details, annual pumping, and other details for the small fraction of Santa Clarita Valley residents reliant on private wells for water supply approximately are not collected by any agency.

Beneficial uses and users of groundwater in the Basin include disadvantaged communities (DACs) (see Figure 3-6). Most DAC areas identified from the online mapping tool lie completely within the basin boundaries, but some include areas inside and outside of the basin boundary. The DACs lying within the Basin boundary reside primarily in neighborhoods that are served by municipal water supplies from either SCV Water or LACWD. The majority of the DAC area lying outside the basin boundary and the municipal water service areas consist of open range and pastureland.

The GSA also knows of two unmapped DACs in Bouquet Canyon that are not listed on the DWR mapping tool website: the LARC Ranch and Lily of the Valley Mobile Home Park, both of which are located along Bouquet Canyon Road. Both of these DACs presently utilize private wells or trucked water. SCV Water is currently working with the State and others to replace the private well water supply at these locations with an alternate municipal supply from SCV Water. Once these projects are completed, it is anticipated that all DAC areas within the subbasin will be serviced by SCV Water's municipal supply and that no DAC will rely on groundwater.

3.5 Existing Well Types, Numbers, and Density

A total of 78 production wells are listed as providing data for calibrating the regional model that provides information for the water budget in this GSP. The wells have been developed in the Alluvial Aquifer and the Saugus Formation. Section 7 provides detailed information on well development, status, and location data. Figure 3-7 shows the density of domestic wells in the Basin and average domestic well depth based on data obtained from the DWR Well Completion Report Database. Figure 3-8 shows the locations and density of production wells.

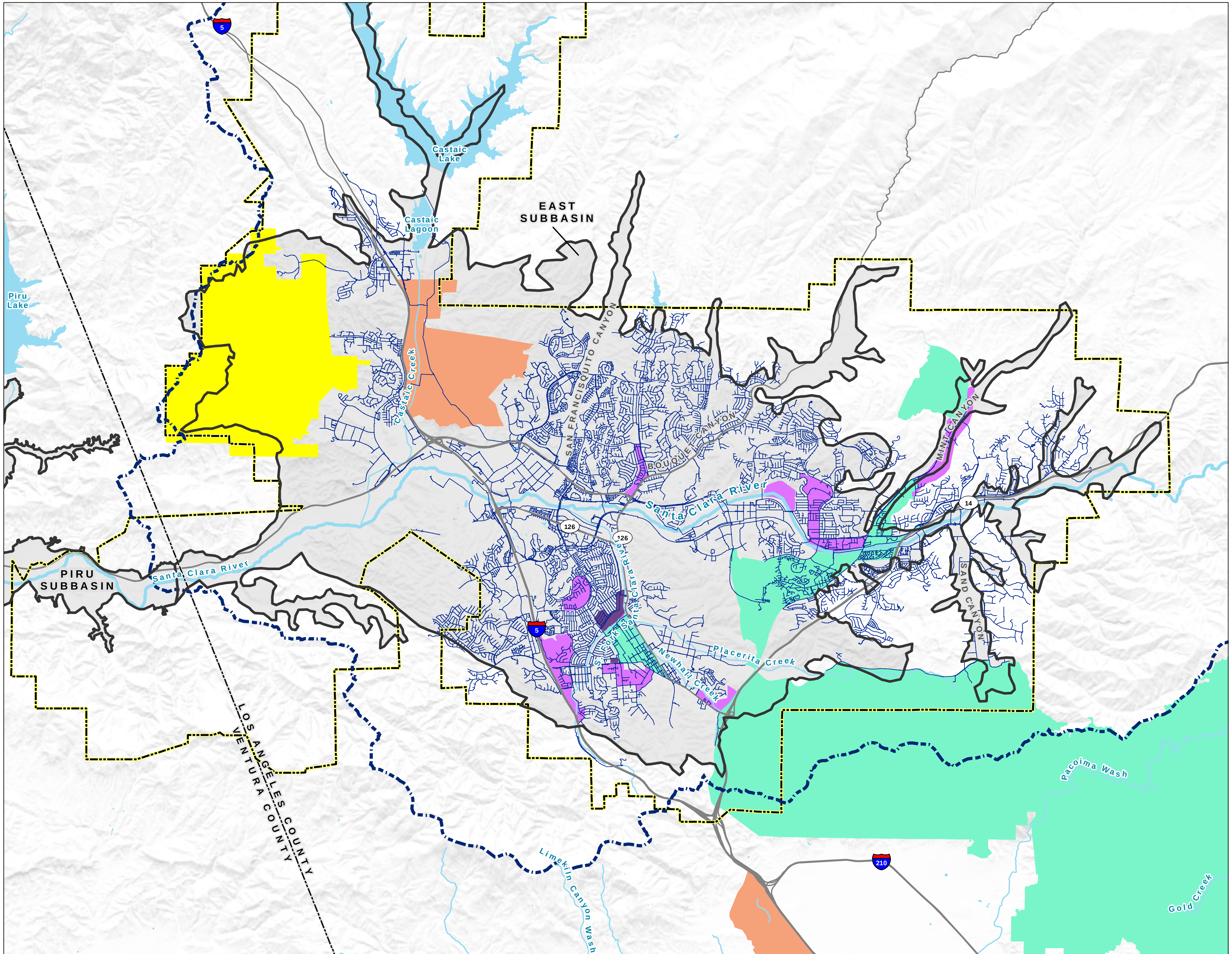


FIGURE 3-6

Disadvantaged Community Census Block Groups and Municipal Water Supply Area

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

LEGEND

SCV Watermain

LACWWD36

Disadvantaged Communities Block Groups

Severely Disadvantaged Communities (MHI < $42,737)

Severely Disadvantaged Communities (MHI <= $56,982)

Disadvantaged Communities Tract

Data Not Available

Severely Disadvantaged Communities ($42,737 <= MHI < $56,982)

All Other Features

Santa Clara River Valley Groundwater Basin

Watershed Boundary

Service Boundary Area for SCV Water

Major Road

Watercourse

Waterbody

NOTES

MHI: median household income
SCV Water: Santa Clara Valley Water Agency

N

0 5,000 10,000 15,000
Feet

Date: December 9, 2021
Data Sources: USGS, Southern California Association of Governments (2008), LA County and City of Santa Clarita (2012), DWR Bulletin 118, SCV Water (2021)

GSI Water Solutions, Inc.

Document Path: Y:\0420_CLWA\Source_Figures\019_EastSubbasinGSP\GSP\Section3\Figure3_6_DAC_2018.mxd, abarry

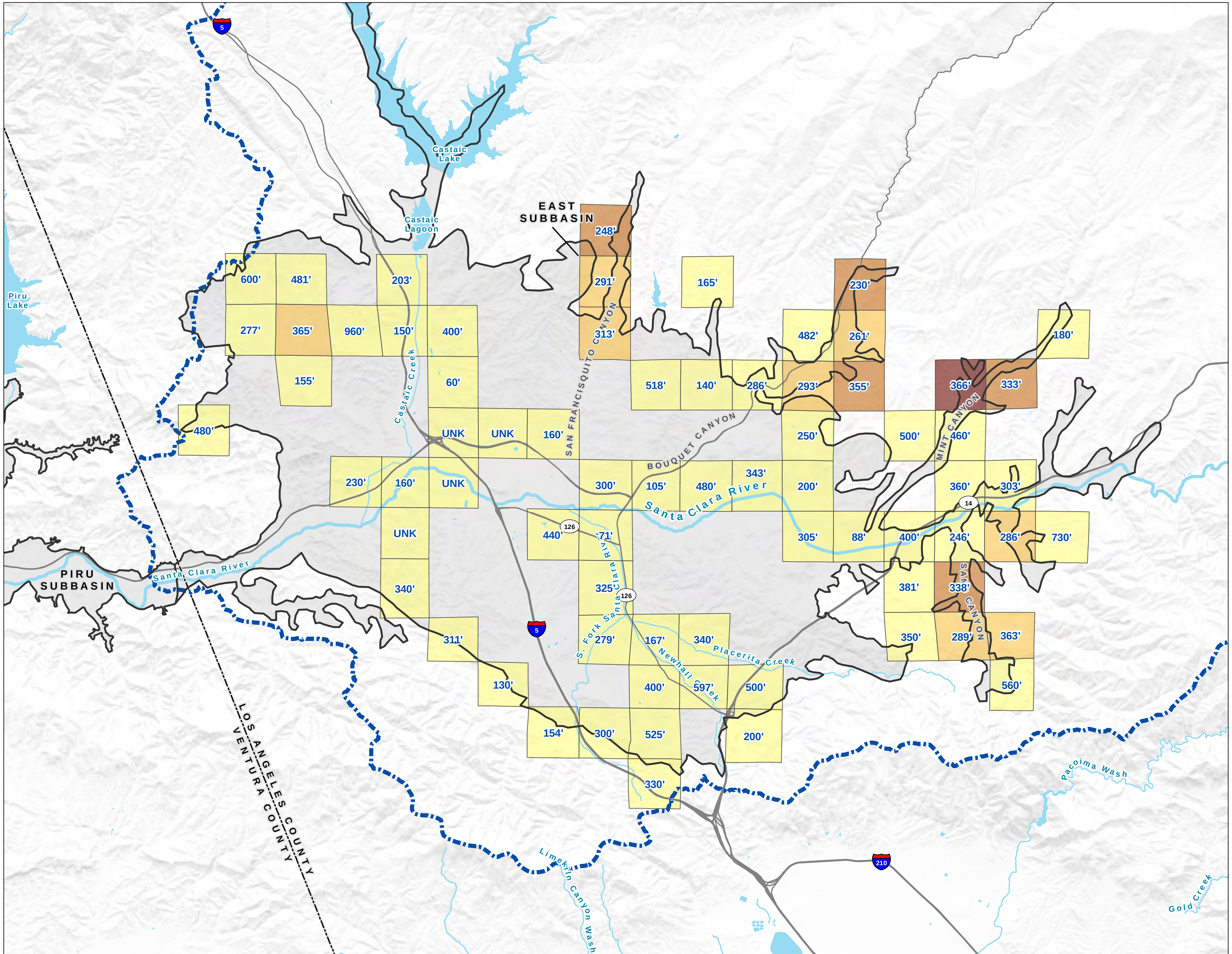


FIGURE 3-7

Density and Average Well Depth of Domestic Wells per Square Mile

Groundwater Sustainability Plan
Santa Clara River Valley East
Groundwater Subbasin

LEGEND

481' Average Well Depth (feet)

Domestic Well Count

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 24

All Other Features

- Santa Clara River Valley Groundwater Basin
- Watershed Boundary
- Major Road
- Watercourse
- Waterbody

NOTE

UNK: unknown

N

0 5,000 10,000 15,000
Feet

Date: December 9, 2021
Data Sources: USGS, DWR Bulletin 118, Luhdorff & Scalmanini (2021)

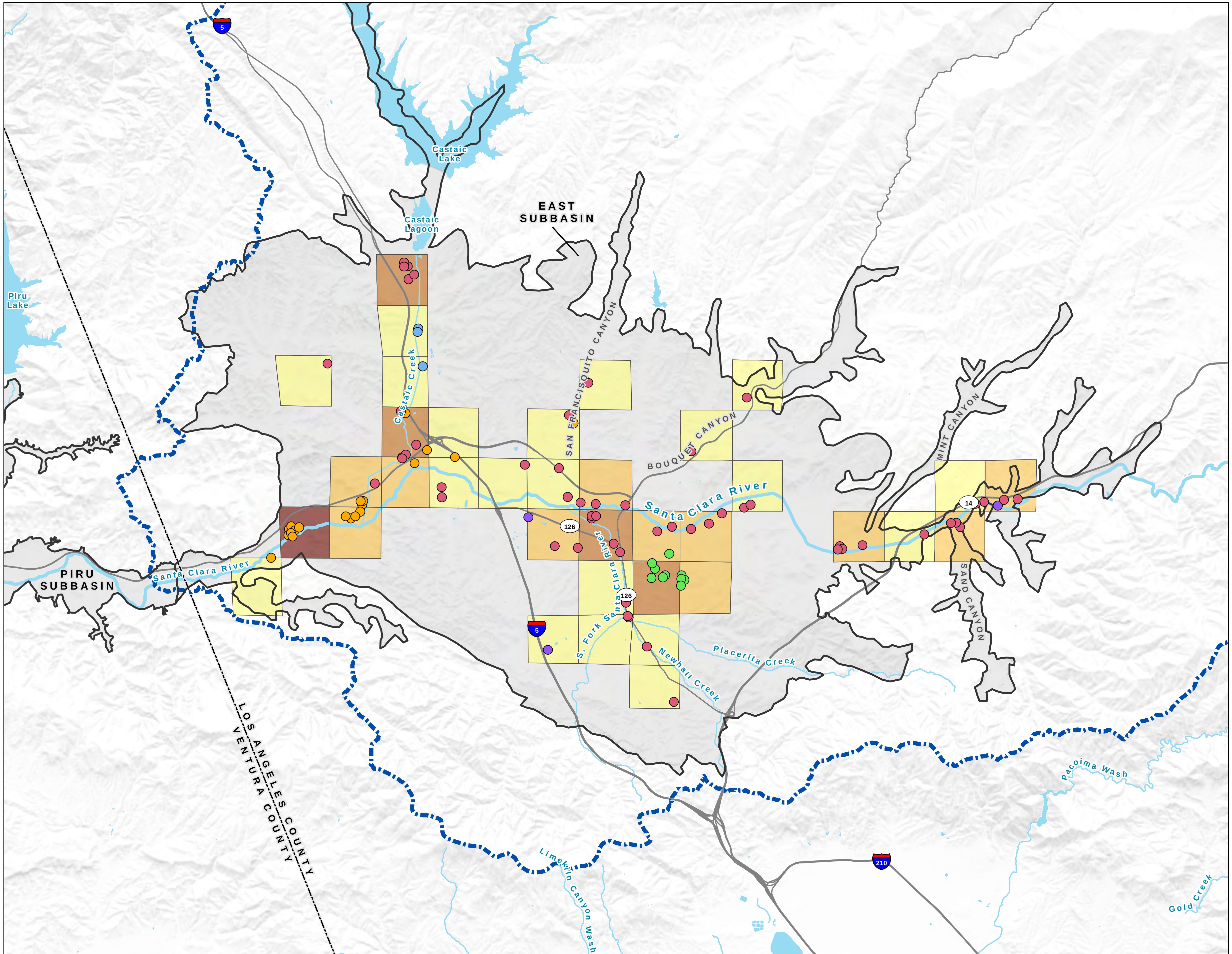
GSI Water Solutions, Inc.

Document Path: Y:\0420_CLWA\Source_Figures\019_EastSubbasinGSP\GSP\Section3\Figure3_7_Density_Domestic_Wells.mxd, abarry

FIGURE 3-8

Density of Production Wells per Square Mile

Groundwater Sustainability Plan
Santa Clara River Valley East
Groundwater Subbasin



LEGEND

Operating Production Wells

Water Use Sector

- Agricultural
- Golf Course
- Municipal
- Small Public Water System
- Whittaker-Bermite Contaminant Treatment/Extraction

Production Well Count

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

All Other Features

- Santa Clara River Valley Groundwater Basin
- Watershed Boundary
- Major Road
- Watercourse
- Waterbody

N

0 5,000 10,000 15,000
Feet

Date: December 9, 2021
Data Sources: USGS, DWR Bulletin 118

GSI Water Solutions, Inc.

Document Path: Y:\0420_CLWA\Source_Figures\019_EastSubbasinGSP\GSP\Section3\Figure3_8_Density_Production_Wells.mxd, abarry

3.6 Existing Monitoring Programs

Monitoring of groundwater levels and quality have been conducted by various agencies in the Basin; a detailed discussion of these monitoring programs is discussed in Section 7. A summary of existing monitoring programs is presented in the following subsections.

3.6.1 Groundwater Level Monitoring

The local water purveyors have collected groundwater levels at their production wells in the Saugus Formation and Alluvial Aquifer on a generally monthly basis from 1980 to present. Groundwater level records have been analyzed and shown in hydrographs of representative wells that are provided in annual reports, the latest of which is the 2019 Santa Clarita Valley Water Report (LCSE, 2020).[13]

3.6.2 Groundwater Quality Monitoring

SCV Water monitors water quality for its customers and reports on water quality in detail in the annual Water Quality Report that is provided to all Santa Clarita Valley residents who receive water from SCV Water or LACWD[14] and more broadly in the annual Santa Clarita Valley Water Report (LCSE, 2020). The latter report also provides information on the actions taken to address sources of contamination that are regulated by the California Department of Toxic Substances Control and the California State Water Resources Control Board.

Groundwater quality has not been reported for agricultural and domestic wells in the Basin. This is a data gap that is discussed further in Section 9.

3.6.3 Surface Water Monitoring

Historical annual streamflow in the Santa Clara River watershed has been monitored by the U.S. Geological Survey (USGS) and the LACDPW. Currently active and former gages for the Basin include an upstream gage in the Santa Clara River above Lang Railroad Station at the Capra Road Railroad Crossing (LACDPW station F93B-R), the Old Road Bridge gage just west of I-5 (LACDPW station F93C-R), and two downstream gages (the former County Line gage [USGS station 11108500], which was located 0.75 miles west of the western boundary of the Basin, and the current Piru gage [USGS station 11109000], which is located 3.5 miles west of the western boundary of the Basin). Stream gaging also occurs in Mint Canyon (LACDPW station F328B-R) and Bouquet Canyon (LACDPW station F377B-R).

The California Surface Water Ambient Monitoring Program (SWAMP) monitors, assesses, and reports on the conditions of surface waters throughout the state of California. Data from SWAMP are used to improve the state’s water quality assessment and add or remove water bodies from the impaired water bodies list as required under Sections 305(b) and 303(d) of the Clean Water Act. The Central Coast Regional Water Quality Control Board is the regional agency that implements SWAMP in the Basin.

Water quality in the upper Santa Clara River is affected by natural and urban runoff, WRP discharges, reservoir releases (Castaic and Bouquet), and potentially groundwater inflow. Annually, during the dry summer season, the composition of the streamflow in the Santa Clara River in the Upper Santa Clara River is predominantly composed of WRP discharges, and the total dissolved solids (TDS) concentrations are generally higher compared to the wet winter/spring periods. During the wet season, streamflow in the river is composed of runoff from the watershed and urban areas, along with WRP discharges resulting in relatively

[13] Available at https://yourscvwater.com/wp-content/uploads/2020/08/2019-Santa-Clarita-Valley-Water-Report.pdf . (Accessed April 16, 2021.)
[14] Available at https://yourscvwater.com/water-quality/#waterqualityreports. (Accessed April 16, 2021.)

lower TDS concentrations. Water quality data from surface flows in the central part of the Santa Clarita Valley are available as part of surface water monitoring by the Upper Santa Clara River Watershed Management Group as required for the region's municipal stormwater permit. These monitoring efforts are described in the Coordinated Integrated Monitoring Program plan (LCSE, 2020) (Upper Santa Clara River Watershed Management Group, 2015).

3.6.4 Climate Monitoring

Precipitation and weather monitoring in the Basin have been performed at two locations in the Town of Newhall since the late 1800s. Precipitation gauges are currently located at Newhall Fire Station #73 (maintained by LACDPW) and at the SCV Water-owned Pine Street gage. One of the dominant uncertainties in water resource planning in California is climate change. Hydrology in California is highly variable, and forecasts of the effects of climate change suggest even greater variability in the coming years. Moreover, climate models suggest a general warming trend, which is likely to reduce SWP water deliveries and have other profound implications for management of water supplies in the state (GSI, 2020).

The Los Angeles Region Framework for Climate Change Adaptation and Mitigation, published by LARWQCB, states that "Climate change will likely impact both water demand and water supply through various pathways. Drought periods and a lower snowpack could trigger a drop in groundwater levels and a decrease in the amount of imported water available to the region, which would have major impacts on the water supply that require increased reliance on local groundwater supplies. In addition, higher temperatures will likely increase water demand. In order to cope with these added stresses on water supply and water demand, augmented pumping of local aquifers would exacerbate the decrease in groundwater levels" (LARWQCB, 2015).

When evaluating sustainable management of the Basin 50 years into the future, it is prudent to consider the potential impacts that climate change could have on the state's future management of water supplies and the change in hydrology within the local groundwater system. SGMA issues guidance to local GSAs for consideration of how to factor these forecasts and uncertainties into planning for local sustainability. Sustainable groundwater management provides a buffer against drought and climate change and contributes to reliable water supplies regardless of weather patterns. The Santa Clarita Valley depends on groundwater for a portion of its annual water supply, and sustainable groundwater management is essential to a reliable and resilient water system.

SCV Water has updated its UWMP, which includes reviewing and (as needed) revising the future water supply and demand values, including incorporating DWR's most current estimates of future SWP delivery reliability (DWR, 2020). The future water budgets presented in Section 6 of this GSP make use of DWR's most current estimates of future SWP delivery reliability and also evaluate three local climate-change conditions in the Basin (i.e., no climate change, 2030 climate change, and 2070 climate change), using local-scale climate-change factors provided by DWR on its SGMA web portal that are applied to the historical climate record for the Basin. Future updates of this GSP may need to adjust climate change factors and the amount of imported water that is assumed to be available for supply, particularly if severe drought conditions continue.

3.6.5 Incorporating Existing Monitoring Programs into the GSP

Section 7 provides a detailed discussion of all the existing monitoring programs in the Basin and describes how those monitoring programs are integrated into the GSP.

3.6.6 Limits to Operational Flexibility

DWR provides GSAs with one climate scenario for 2030 and three climate scenarios for 2070. The climate scenario for 2030 provides the best estimate of the variability in local hydrology (precipitation and evapotranspiration) that the Basin might experience during the next 20 years as the GSA works to obtain and/or maintain sustainability of local groundwater resources. The three climate scenarios for 2070 demonstrate the uncertainty of climate when considering a 50-year planning horizon under SGMA. The forecasts result in a fairly minor change in local hydrology compared with the effects of climate uncertainty and future climate change on future statewide policymaking and water resource management. When considering sustainability 50 years out, SCV Water anticipates there will be a need to consider and adjust to the influences of climate change in its water demand and supply management programs. Thus, it is prudent to focus on the 2030 climate scenario for addressing sustainability within the 20-year time frame required by SGMA, while also using the results of the 2070 water budget analysis to inform water managers about conditions that may be possible afterward (GSI, 2020).

3.7 Existing Management Plans, Studies, and Reports

Water providers in the Basin have prepared numerous plans and conducted numerous studies over many years to enhance water supply reliability and resilience to drought and to sustainably manage water resources in the Basin. These plans, studies, and reports include the following:

- *Analysis of Groundwater Supplies and Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin* (LCSE and GSI, 2009)
- *Castaic Lake Water Agency Water Resources Reconnaissance Study* (Carollo Engineers, 2015)
- *Upper Santa Clara River Integrated Regional Water Management Plan, 2018 Amendments* (KJ, 2018)
- *2021 Water Supply Reliability Plan Update* (Geosyntec, 2021)
- *Groundwater Management Plan, Santa Clara River Valley Groundwater Basin, East Subbasin* (LCSE, 2003)
- *State Water Project Delivery Capability Report 2019* (DWR, 2020)
- *2015 Urban Water Management Plan for Santa Clarita Valley* (KJ, 2016a)
- *Castaic Lake Water Agency 2016 Recycled Water Master Plan* (KJ, 2016b)
- *Santa Clarita Valley Family of Water Suppliers Water Use Efficiency Strategic Plan* (Maddaus, 2021a)
- *2019 Santa Clarita Valley Water Report* (LCSE, 2020)
- *Santa Clarita Valley Water Agency Groundwater Treatment Implementation Plan* (Rajagopalan and Bracewell, 2021)
- *Draft 2021 SCV Demand Study: Land-Use-Based Demand Forecast Analysis* (Maddaus, 2021b)
- *2020 Urban Water Management Plan for Santa Clarita Valley Water Agency* (KJ, 2021)
- *Final Salt and Nutrient Management Plan, Santa Clara River Valley East Subbasin* (GSSI, 2016)

3.7.1 Analysis of Groundwater Supplies and Groundwater Basin Yield, Upper Santa Clara River Groundwater Basin, East Subbasin

This analysis of groundwater supplies and groundwater basin yield provides an update to prior assessments; provides consideration of increased utilization of groundwater for wet/normal and dry-year water supply;

evaluates augmentation of basin yield using artificial groundwater recharge from stormwater runoff in selected areas; and describes the general impacts of climate change on the groundwater basin and yield. The findings from this report were incorporated into subsequent UWMPs.

3.7.2 Castaic Lake Water Agency Water Resources Reconnaissance Study

The study evaluates water supply augmentation alternatives, including modeling of some alternatives to evaluate potential benefits and impacts to the local groundwater supply, and recommends (1) groundwater recharge of the Alluvial Aquifer with recycled water and delivery to nonpotable customers and (2) aquifer storage and recovery for further development, analysis, and planning (Carollo Engineers, 2015).

3.7.3 Upper Santa Clara River Integrated Regional Water Management Plan

The Integrated Regional Water Management Plan (IRWMP) for the Upper Santa Clara River covers the upper Basin (bounded by the San Gabriel Mountains to the south and southeast, the Santa Susana Mountains to the southwest, the Transverse Ranges to the northeast, the Sierra Pelona Mountains to the east, and the Ventura County Line to the west) and encompasses the City of Santa Clarita and unincorporated surrounding communities. The Upper Santa Clara River Watershed is a logical region for integrated regional water management due to its history of cooperative water management, the topography and geography of the Region and the similarity of water issues facing agencies in the region. The IRWMP integrates planning and implementation efforts[15] and facilitates regional cooperation to help reduce potable water demands, increase water supply, improve water quality, promote resource stewardship over the long term, reduce negative effects from flooding and hydromodification, and adapt to and mitigate climate change (KJ, 2016a). The IRWMP was most recently updated in 2018 to be consistent with DWR's Proposition 1 Integrated Regional Water Management Guidelines (DWR, 2019) (KJ, 2018).

3.7.4 2017 Water Supply Reliability Plan Update

The Water Supply Reliability Plan identifies current and future storage capacity and emergency storage needs and options for managing water supplies for SCV Water. The plan evaluates four supply scenarios from the 2015 UWMP, evaluating supplies under varying assumptions regarding projected SWP and local supply availability and reliability. Each supply scenario is evaluated against the 2015 UWMP projected demands with conservation scenario (Clemm and KJC, 2017). The plan has been recently updated (2021). The supply planning documented in this plan, combined with the operating plans in the GWMP and UWMP, form the basis for current and future water planning in the Santa Clarita Valley.

3.7.5 Groundwater Management Plan, Santa Clara River Valley Groundwater Basin, East Subbasin

In 2001, as part of legislation authorizing Castaic Lake Water Agency (CLWA) to provide retail water service in addition to its ongoing wholesale supply, California Assembly Bill (AB) 134 included a requirement for the preparation of groundwater management plan, which was enacted by AB 3030. Adopted in 2003, the GWMP complements and formalizes a number of existing water supply and water resource planning and management activities in the now-SCV Water service area, which effectively encompasses the basin of the Santa Clara River Valley Groundwater Basin. The four management objectives outlined in the GWMP include the following:

[15] Development of the IRWMP was informed by prior regional water management and planning efforts; agency facilities and master planning; and city, county, and federal land use planning efforts. See IRWMP Section 10.1.1. for a description of each of the referenced plans.

1. Development of an integrated surface water, groundwater, and recycled water supply to meet existing and projected demands for municipal, agricultural, and other water uses
2. Assessment of groundwater basin conditions to determine a range of operational yield values that use local groundwater conjunctively with supplemental SWP supplies and recycled water to avoid groundwater overdraft
3. Preservation of groundwater quality, including active characterization and resolution of any groundwater contamination problems
4. Preservation of interrelated surface water resources, which includes managing groundwater to not adversely impact surface and groundwater discharges or quality to downstream basin(s)

To accomplish these objectives, the GWMP includes multiple elements, such as monitoring groundwater; monitoring and management of surface water; development of emergency water supplies; continuation of conjunctive use; management of salinity; integration of recycled water; identification and mitigation of contamination in soil and groundwater; development of stakeholder relationships; reporting, public education, and conservation programs; identification and management of recharge and wellhead protection areas; identification of policies for well construction, abandonment, and destruction; and updates to the GWMP (KJ, 2018). The operating plans in the GWMP, combined with the supply planning documented in the Water Supply Reliability Plan and UWMP, form the basis for current and future water planning in the Santa Clarita Valley.

3.7.6 State Water Project Delivery Capability Report 2019

The State Water Project Delivery Capability Report 2019 updates the estimate of current (2019) and future (2040) SWP delivery capability and incorporates current regulatory requirements for SWP and Central Valley Project operations (DWR, 2020).

3.7.7 Santa Clarita Valley Urban Water Management Plans (2015 and 2020)

The UWMP is a collaboration of the Santa Clarita Valley agencies that were water providers in 2015.[16] The purpose of the UWMP is to provide a broad overview for decision-making on water supply issues, such as opportunities for exchanges or water transfers. The UWMP provides information on potential sources of supply and amounts available; projected area demand, given assumed growth and water management; and the relationship between supply and demand. The purpose of the UWMP is to provide cost-effective options and opportunities to develop supplies and meet demands (KJ, 2016a and 2021). SCV Water completed the 2020 UWMP in June 2021, with its Board adopting this plan on June 16, 2021, upon which the 2020 UWMP was submitted to DWR in compliance with the due date of July 1, 2021.

3.7.8 Castaic Lake Water Agency 2016 Recycled Water Master Plan

The Recycled Water Master Plan explores opportunities to maximize the utilization of recycled water in the Santa Clarita Valley (KJ, 2016). The 2016 plan analyzed the costs and benefits of several alternatives to use recycled water to augment the region's water supply. The analysis recommends implementation of Alternative 1 - Non-Potable Reuse Expansion Projects - Phase 2. Four projects planned to expand recycled water use within Santa Clarita Valley, collectively known as Phase 2, are currently in various stages of design. Phases 2A, 2C, and 2D would use recycled water from the Valencia WRP and Phase 2B would use

[16] At the time, the area water providers were CLWA service area, which included four retail water purveyors: SCWD, NCWD, Valencia Water Company (VWC), and LACWD. As discussed in Section 2.2.2, SB 634 consolidated the four retail providers into SCV Water, leaving SCV Water and LACWD as the two regional water providers.

recycled water produced at the Vista Canyon Water Factory, which is being constructed to treat flows from the planned Vista Canyon Development. SCV Water intends to update this plan within the next couple of years.

3.7.9 Santa Clarita Valley Family of Water Suppliers Water Use Efficiency Strategic Plan

An essential theme of the Water Use Efficiency Strategic Plan (WUE SP) is to maximize the use of existing water and fiscal resources and maintain the flexibility to adjust planning to meet changing conditions. The WUE SP provides a comprehensive approach supported by a thorough economic analysis of water conservation efforts in the coming years. The WUE SP also quantifies the benefits of meeting a significant portion of future water demands through water conservation measures compared with the economic benefit of adding recycled water infrastructure. The WUE SP will be updated during SCV Water's 2021/2022 fiscal year to reflect water efficiency goals established by the state legislature (AB 1668 and Senate Bill 606).

3.7.10 2019 Santa Clarita Valley Water Report

Each year, SCV Water and LACWD prepare an annual water report. The report provides information about local groundwater resources, SWP and other imported water supplies, treated and recycled water, and water conservation. It also includes discussion about the Santa Clarita Valley's Groundwater Operating Plan, the 2015 UWMP, and the development of this GSP. The 2019 report (LSCE, 2020) reviews the sufficiency and reliability of supplies in the context of existing water demand with focus on actual conditions in 2019, and it provides a short-term outlook of water supply and demand for 2020. The 2020 report is anticipated to be completed during the summer of 2021.

3.7.11 Santa Clarita Valley Water Agency Groundwater Treatment Implementation Plan

The Santa Clarita Valley Water Agency Water Groundwater Treatment Implementation Plan includes a feasibility evaluation of compliance alternatives for SCV Water wells impacted by perchlorate and per- and polyfluoroalkyl substances (PFAS), develops planning-level treatment costs, updates tables in the 2015 UWMP, and informs the upcoming 2020 UWMP. The plan recommends single-use ion exchange treatment for perchlorate and PFAS and provides a planning-level conceptual process and site diagrams as well as recommendations for prioritizing wells for compliance (Rajagopalan and Bracewell, 2021).

3.7.12 Draft 2021 SCV Demand Study: Land-Use-Based Demand Forecast Analysis

This 2021 analysis of current and projected demand for SCV Water includes the most recently obtainable data, climate change factors that rely on assumptions that are similar to those used in this GSP (see Section 6 and Appendix G), an inclusion of water savings from passive measures and demand reduction due to active conservation programs, demand due to increased work from home as a result of the COVID-19 pandemic, and estimated overwater or irrigation inefficiencies. The study presents the demand forecast for SCV Water since formation[17] and projects water demand to 2050, the year by which full buildout is expected to occur. The study scope includes SCV Water service areas and anticipated annexations and the service area for LACWD. This study is an input to the 2020 UWMP (due to be published in July 2021) and the full buildout demand projections from this study have been incorporated into the water budgets for this GSP.

[17] Since the formation of SCV Water in 2018 from the merger of CLWA, SCWD, NCWD, and VWC.

3.8 Process for Permitting New or Replacement Wells

The California Division of Drinking Water regulates municipal water companies (those with service connections greater than 200) under the provisions of the Safe Drinking Water Act and California Code of Regulations (CCR) Titles 17 and 22.[18] The LA County Department of Public Health Drinking Water Program is responsible for reviewing the plans and approving private residential water wells in designated cities and unincorporated areas of the county.

Under DWR, a public water system must submit an application for a permit or amended permit to install a water supply well pursuant to the California Health and Safety Code Division 104, (12)(4) § 116525 or § 116550, respectively. For proposed water system improvements, new water systems, or a "project" (as defined in CCR Title 14 § 15378, for which environmental documentation is required), a copy of the documentation must be included in the application.[19]

The LA County Department of Public Health Drinking Water Program requires the following for permitting new or replacement private residential water wells in the Basin:

- Submittal of an Application for Well/Exploration Hole Permit, which includes details about construction materials, contractor licenses, local geology, and nearby environmental remediation sites.
- A written narrative with work plan details
- A well diagram detailing depth, size, thickness, and materials of the following:
  - The casing
  - The annular space
  - Sanitary seal
  - The screen or slots in the casing
  - Any pertinent geological features
- A scaled drawing to include the following:
  - Roads
  - Property lines
  - Private sewage disposal systems
  - Surface water features
  - Any other possible sources of contamination within 200 feet of the well site
- A county inspector visits the well site and witnesses the placement of the sanitary seal.

Upon completion of the work, the applicant must submit a well completion report to the DWR using the Online System for Well Completion Reports.

[18] Drinking water regulations under CCR Titles 17 and 22 are available here: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/dw_regulations_2019_04_16.pdf. (Accessed June 4, 2021.)
[19] Information on California Environmental Quality Act requirements is available here https://resources.ca.gov/CNRALegacyFiles/ceqa/docs/2010_CEQA_Statutes_and_Guidelines.pdf. (Accessed June 4, 2021.)

3.9 Existing Groundwater Regulatory Programs

3.9.1 Salt and Nutrient Management Plan for the Santa Clara River Valley East Subbasin

In 2014, a SNMP was prepared for the Santa Clara River Valley East Subbasin in accordance with the State Water Resources Control Board's (SWRCB's) Recycled Water Policy (SWRCB, 2019). This SNMP is intended to provide the framework for water management practices to ensure protection of beneficial uses and allow for the sustainability of groundwater resources consistent with the Water Quality Control Plan: Los Angeles Region Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties (Basin Plan) (LARWQCB, 1994).

The SNMP for the Basin determined current water quality conditions to ensure that all water management practices (including the use of recycled water) are consistent with site-specific water quality objectives (WQOs) set by the LARWQCB for the Basin (GSSI, 2016). WQOs have been set by the LARWQCB for the Alluvial Aquifer but not for the Saugus Formation. The SNMP identifies WQOs for TDS, chloride, and nitrate, but state that further analysis is necessary in order to establish meaningful WQOs. As part of the SNMP, a monitoring plan has been developed for the Basin that identifies key monitoring locations within each subunit for both surface water and groundwater (GSSI, 2016).

The Santa Clara River, the predominant surface waterbody in the Basin, also influences groundwater quality in the losing reaches of the river (where river water infiltrates to groundwater). The Santa Clara River has been identified as an impaired water body and listed in the Clean Water Act Section 303(d) list published by the U.S. Environmental Protection Agency (EPA). The Upper Santa Clara River has been listed for the following contaminants: coliform bacteria, boron, and sulfates (GSSI, 2016).

The Basin consists of six groundwater management zones: five shallow alluvial groundwater basins and the Saugus Formation (see Figure 8-6). Water use associated with land uses and the form of the water that enters the groundwater system (i.e., irrigation runoff, septic seeps, precipitation percolation, underflow from upgradient zones, and other forms) determine the salt and nutrient load carried into each management Basin Plan.

Responsibility for the protection of surface water and groundwater quality in California rests with the SWRCB and nine Regional Water Quality Control Boards (RWQCBs). The SWRCB establishes statewide water quality control policy and regulation and coordinates with and reviews RWQCB efforts to provide reasonable protection and enhancement of the quality of both surface waters and groundwaters in the region. Region-specific water quality regulations are outlined in water quality control plans that recognize regional beneficial uses, water quality characteristics, and water quality problems.

The LARWQCB has jurisdiction over the coastal drainages between Rincon Point (on the coast of western Ventura County) and eastern LA County, which includes Santa Clarita Valley. LARWQCB prepared the Basin Plan (LARWQCB, 1994).

The Basin Plan is designed to preserve and enhance water quality and protect the beneficial uses of all regional waters. Specifically, the Basin Plan (1) identifies beneficial uses for surface and ground waters, (2) includes the narrative and numerical water quality objectives that must be attained or maintained to protect the designated beneficial uses and conform to the State's anti-degradation policy, and (3) describes implementation programs and other actions that are necessary to achieve the water quality objectives established in the Basin Plan. In combination, beneficial uses and their corresponding water quality objectives are called water quality standards. Table 8-2 lists the water quality standards for private drinking water wells.

3.10 Monitoring and Management Programs with GSP

3.10.1 Incorporation into GSP

Information in these plans have been incorporated into this GSP and used during the preparation of sustainability goals when setting minimum thresholds and measurable objectives, and also were considered during development of the projects and management actions. This GSP specifically incorporates the plans and programs, described above, into the following sections:

Section 6 – Water Budgets

- Groundwater Management Plan, Santa Clara River Valley Groundwater Basin, East Subbasin
- 2015 and 2020 Urban Water Management Plans for Santa Clarita Valley[20]
- 2021 Water Supply Reliability Plan Update (Geosyntec, 2021)
- State Water Project Delivery Capability Report 2019
- 2019 Santa Clarita Valley Water Report (LCSE, 2020)
- Draft 2021 SCV Demand Study: Land-Use-Based Demand Forecast Analysis (Maddaus, 2021b)

Section 8 – Sustainable Management Criteria

- Salt and Nutrient Management Plan—Santa Clara River Valley East Subbasin
- 2015 and 2020 Urban Water Management Plans for Santa Clarita Valley
- Water Quality Control Plan: Los Angeles Region Basin Plan for the Coastal Watershed of Los Angeles and Ventura Counties

3.10.2 Limits to Operational Flexibility

SCV Water has developed an integrated plan and related infrastructure to meet water demands under a wide range of conditions including supplies from local groundwater sources, imported water sources, and banked water sources from outside of the Basin. These various sources, associated infrastructure, and operational aspects are described in detail in Section 6. Groundwater contamination, including perchlorate, volatile organic compounds (VOCs) and PFAS, has been identified in the Basin (refer to Section 7) and has necessitated construction of wellhead treatment facilities at some wells. During planning and construction of these treatment facilities, affected wells have been shut down and SCV Water (and its predecessor agencies) have relied on other wells and/or imported water to make up for the temporary reduction in supply. These temporary reductions in supply from some wells have not impacted the ability of SCV Water to continue to provide high quality groundwater to its customers. These responses to contamination have been conducted under the oversight of the Division of Drinking Water.

The SNMP has not limited operational flexibility thus far; however, the assimilative capacity of the aquifers to additional salt loadings may be an issue in the future in some parts of the Basin as recycled water projects are planned and implemented.

[20] The UWMP is one of the primary sources for the Water Budget (Section 6) of this GSP. The UWMP incorporates the planning described in *Upper Santa Clara River Integrated Regional Water Management Plan, 2018 Amendments*; *Castaic Lake Water Agency 2015 Recycled Water Master Plan*; and the *Santa Clarita Valley Family of Water Suppliers Water Use Efficiency Strategic Plan*.

3.10.3 Conjunctive Use Programs

Conjunctive use is the coordinated operation of surface water storage and use, groundwater storage and use, and the necessary conveyance facilities. In 2017 SCV Water updated its Water Supply Reliability Plan (Reliability Plan). While the plan focuses on increasing imported water reliability, water banking, groundwater storage, and the groundwater operating plan are key elements that SCV Water uses to conjunctively use and manage groundwater (Clemm and KJC, 2017). The Reliability Plan includes the following:

- An implementation schedule that allows for gradually increasing banked storage and pumping capacity through to 2050. Target capacities include an additional 10,000 AF by 2025 and an additional 10,000 AF by 2035.
- A Groundwater Operating Plan with flexibility to vary pumping from year to year to allow for increased groundwater use during dry periods and increased recharge during wet periods.

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4. Hydrogeologic Conceptual Model

This section is a description of the hydrogeologic conceptual model of the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin). This section describes the physical characteristics of the Basin as they relate to groundwater occurrence in the aquifers. Data and interpretations compiled herein are based on the long-term experience of Richard C. Slade & Associates LLC (RCS) performing hydrogeologic services for various water agencies and private parties in the Basin, coupled with information from a number of publicly available resources.

Note that, as part of ongoing GSP development, an updated groundwater flow model will be utilized to further quantify ranges of key terms listed below.

4.1 Basin Setting

4.1.1 Topography and Boundaries

Figure 4.1-1 shows the boundary of the local groundwater basin superimposed on a topographic map of the area, and the locations of select wells that are known to exist or to have existed in the region. Topographically, the area surrounding the groundwater basin is defined by higher elevations on the north, south, and east, and lower elevations on the west. This topography defines the watershed of the Santa Clara River, which has its headwaters in Soledad Canyon and a drainage area of several hundred square miles. The Santa Clara River provides regional drainage in an east-to-west direction across the groundwater basin and it continues westerly across Ventura County and into the Pacific Ocean. In general, the local groundwater basin is oriented along the Santa Clara River.

Principal tributaries draining the northern side of the groundwater basin include, from east to west, Mint Canyon, Bouquet Canyon, San Francisquito Canyon, and Castaic Creek Canyon. Principal tributaries draining the southern side of the Basin include, from east to west, Oak Spring Canyon, Sand Canyon, and Potrero Canyon. The South Fork of the Santa Clara River, which drains in a northerly direction toward its confluence with the main reach of the Santa Clara River (located just west of Bouquet Junction), has Placerita Creek Canyon, Newhall Creek Canyon, and Pico Canyon as its main tributaries.

The boundaries of the groundwater basin as defined by the California Department of Water Resources (DWR) are based on ground surface exposures of the two main aquifers that comprise the local groundwater basin: the Alluvial Aquifer, and the Saugus Formation (RCS, 1988, 2001). Depending on the location of the boundary, the boundary of the Basin is either defined as the geologic contact of the Saugus Formation with other geologically older, non-water-bearing formations, or the contact of the alluvium of the Santa Clara River and its tributaries with geologically older, non-water-bearing formations. The same is true for the “bottom” of the Basin in the subsurface: in some instances, the Alluvial Aquifer is in contact with non-water bearing sediments where no Saugus Formation is present (as in the western portion of the groundwater basin), and in areas where the Saugus Formation is relatively thick, the Basin is defined as its contact with the underlying Pico Formation, or even other older, non-water-bearing formations. Additional discussions of the nature of these geologic contacts are discussed below.

LEGEND

Santa Clara River Valley Groundwater Basin, East Subbasin

Santa Clara River

Wells (Type / Status)

- Destroyed
- Municipal
- Monitoring
- Monitoring (?)
- Groundwater Extraction
- Public
- Irrigation
- Domestic
- Oil /Gas Well

RCS

FIGURE 4.1-1
LOCATION MAP

RCS Job No. 693-LAS01

May 2021

4.1.2 Soil Infiltration Potential

Soil infiltration is defined as the ability of a soil to allow water movement through the soil profile. The infiltration rate of a soil is the velocity or speed at which water enters and flows into the soil under gravity. Publicly available databases of soil types and estimated infiltration rates of these soils were reviewed and are summarized below.

4.1.2.1 Soil Types in the Basin

Soils in the region have been mapped and described by the Natural Resources Conservation Service (NRCS, 1999), a division of the United States Department of Agriculture (USDA). Figure 4.1-2 shows the locations of soil groups within the boundaries of the Basin and the surrounding region. Four groups of soil types are shown to exist within the boundaries of the Basin on Figure 4.1-2. Below is a description of these four soil groups as adapted from the NRCS (1999), shown in order of relative abundance within the Basin:

- **Entisols** are the most prevalent soil group within the Basin, and are exposed throughout the Basin. Entisols are made up of mineral soils that have not yet developed distinct soil horizons. Because entisols have no diagnostic horizons, these soils appear unaltered from their parent material, which can be unconsolidated sediment or rock. Entisols are the most abundant soil order on earth, occupying about 16 percent of the global ice-free land area.
- **Inceptisols** are the second most prevalent soil group and are exposed primarily in the western portion of the Basin. These soils are made up of freely draining soils in which the formation of distinct horizons is not far advanced. By definition, Inceptisols are more developed than Entisols, but have no accumulation of clays or organic matter. Inceptisols develop more rapidly from parent material than do Entisols,
- **Alfisols** are similar in abundance to inceptisols, but occur primarily in the eastern portion of the Basin. Alfisols consist of a group of leached basic or slightly acidic soils, exhibiting clay-enriched subsoils. These subsoils are considered mineral soils and contain higher concentrations of aluminum (Al) and iron (Fe) than other soils. Alfisols typically are found to have formed on late-Pleistocene aged geologic deposits.
- **Mollisols** are the least abundant soil type within the Basin, generally found along the Santa Clara River. These soils are commonly very dark colored, base-rich, mineral soils and contain high concentrations of calcium and magnesium. These soils typically develop under grassland cover.

4.1.2.2 Soil Infiltration Rates

To help provide a general understanding of estimated infiltration capacity of the soils within the boundaries of the Basin, infiltration rates for these soils were compiled from the Los Angeles County Department of Public Works (LACDPW) *Hydrology Manual* (LACDPW, 2006). Infiltration rates throughout the County of Los Angeles (LA County) were obtained by LACDPW by performing double-ring infiltrometer tests of various soil types (LACDPW, 2006). Results of these infiltration tests were reportedly used by LACDPW to produce runoff coefficient curves of the tested soil type, from which infiltration rates were interpreted. Compiled results from the LACDPW infiltration tests are presented in Figure 4.1-3. Reported infiltration rates ranged from 0.1 to 1.0 inch per hour (in/hr). Lower infiltration rates of 0.1 in/hr were observed in individual areas located in the southern portion of the Basin. Spatially, an infiltration of 0.3 in/hr was more prevalent than others.

LEGEND

Santa Clara River Valley Groundwater Basin, East Subbasin
Santa Clara River

USDA Taxonomic Soil Order
- Alfisols
- Entisols
- Inceptisols
- Mollisols
- Vertisols
- No Soil
- Data Not Available

RCS

FIGURE 4.1-2
NRCS SOIL CLASSIFICATIONS

RCS Job No. 693-LAS01

May 2021

LEGEND

Santa Clara River Valley Groundwater Basin, East Subbasin

Santa Clara River

Infiltration Rates

inches per hour

- ≤0.10
- ≤0.20
- ≤0.30
- ≤0.60
- ≤1.00

RCS

FIGURE 4.1-3
INFILTRATION RATES
LA COUNTY

RCS Job No. 693-LAS01

May 2021

4.1.3 Regional Geology

The regional geologic conditions in and around the Basin consist predominantly of continental to marine deposits of clay, silt, sand, and gravel divided among several formations ranging in geologic age from late-Tertiary (approximately 25 million years old) through the present. The oldest of these formations lies unconformably (a separation of two or more units by a geologic time gap) upon basement complex rock, which consist of undifferentiated crystalline granitic rocks and metamorphic-type rocks of late Mesozoic age (greater than 66 million years old). Figure 4.1-4 shows the locations and lateral extents of these various earth materials as mapped at ground surface by others. This map, which provides the basis for the following discussion of the geologic conditions of the region, has been adapted from geologic maps published by RCS (RCS, 1986, 1988), created by updating interpretation on various geologic mapping efforts by others combined with subsurface interpretation of geologic materials derived over time during the drilling of deep boreholes. Among the geologic references used by RCS (1986, 1988) were those by Oakeshott (1958), Dibblee (1991), and others. For Figure 4.1-4, various crystalline rocks have been simplified and grouped into a single unit named basement complex, and no distinction is provided between the various rock types that comprise the crystalline rocks. Also, alluvial deposits are shown as one unit, although efforts to map Quaternary deposits by others in the past have separated those into more discrete units based on slight differences in age or location. The legend to the map provides information on the names and basic earth materials of each formation shown on that map. The locations of several geologic faults are also shown on the Figure 4.1-4 map; these faults are discussed later in this section. It should be noted that the locations of the faults have been somewhat simplified for this study. In some cases, faults actually exist as en echelon faults within a fault zone, with a number of approximately parallel, similarly trending smaller faults. For this study, however faults are represented by a single line-trace on Figure 4.1-4. For the geologic cross sections (discussed in Section 4.1.5), where data support the interpretation, multiple fault line traces may be shown for a single named fault. Also shown on Figure 4.1-4 are the alignments of several geologic cross sections which are discussed later in this text.

4.1.3.1 Geologic Formations within the Basin

There are three relatively young geologic formations that comprise the local Basin, namely: alluvium, terrace deposits and the Saugus Formation. These formations, except for the terrace deposits, are generally utilized by high-capacity water production wells for municipal-supply purposes by Santa Clarita Valley Water Agency (SCV Water) and the Los Angeles County Waterworks District No. 36, Val Verde (LACWD), and, thus, provide a major portion of the water supply to valley residents. Privately owned wells that utilize these formations (primarily the Alluvial Aquifer) are owned by FivePoint Holdings, LLC (FivePoint, formerly Newhall Land and Farming Company), the Disney Company, multiple golf courses, and others for agricultural irrigation, turf irrigation or local domestic purposes. The spatial distribution of the extraction, and general rates of those extractions are described in Section 6.

LEGEND

Santa Clara River Valley Groundwater Basin, East Subbasin
Santa Clara River

Cross Section Trace
- By RCS
- By Geosyntec

Well Type
- Destroyed Well
- Municipal Well
- Irrigation Well
- Domestic Well
- Oil/Gas Well

Formations
- Undifferentiated Alluvium (Qa)
- Terrace Deposits (Qt)
- Saugus Formation (QTs [undifferentiated])
- Pico Formation (Tp)
- Towsley Formation (Tt)
- Castaic Formation (Tc)
- Modelo Formation (Tms)
- Violin Breccia (Tvb)
- Mint Canyon Formation (Tmc)
- Tick Canyon Formation (Ttc)
- Vasquez Formation (Tv)
- Basement Complex (bc)

Faults
- Fault Trace (Simplified)
- Bedding Plane Orientation with Dip

RCS

FIGURE 4.1-4
GEOLOGIC MAP SHOWING CROSS-SECTIONS

RCS Job No. 693-LAS01

May 2021

Alluvium

The Quaternary Alluvium (Qa) is of Holocene (Recent) geologic age, ranging from 10,000 years in age to the present. These recent alluvial deposits consist primarily of stream channel and floodplain materials along the course of the Santa Clara River and its tributaries. The alluvial sediments are composed of complexly interlayered and interfingered beds of unconsolidated gravel, sand, silt, and clay containing variable concentrations of cobbles and boulders. The source material for this alluvium is from weathering and erosion of the surrounding hills and mountains bordering the Santa Clarita Valley. In general, alluvium along the main reach of the Santa Clara River ranges from medium-grained sand in the west, to cobbly- or gravelly-sand in the east. The maximum thickness of the alluvium varies along the course of the Santa Clara River, but can attain a maximum thickness of ± 200 feet (ft). Typically, the alluvium tends to be thickest near the central portion of the river channel and thins or pinches out as the base of the adjoining hills is approached.

The alluvium in the tributary canyons is generally thinner than that along the main river valley. Larger watershed areas such as Castaic Creek and Bouquet Canyon are typically underlain by more extensive and thicker accumulations of alluvium than what exists within the smaller tributaries, such as the Oak Spring or Pico canyons. In these latter canyons, the maximum alluvial thickness occurs near the confluence with the main river valley, where it may be from 75 to 125 ft in thickness.

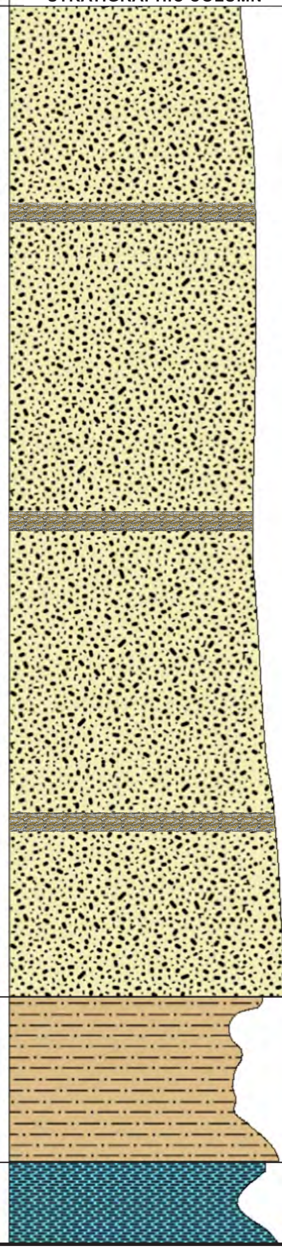
Terrace Deposits

Terrace deposits (Qt) are isolated remnants of what was, during the late Pleistocene (129,000 years or less in age), a continuous blanket of alluvial material covering the entire floor of the Santa Clara River Valley (Winterer and Durham, 1962). Tectonic uplift of the valley floor led to downcutting and incision of this somewhat geologically older alluvial material by the Santa Clara River, leaving the terrace deposits restricted to platforms or benches that are topographically higher than the Santa Clara River, and hence above the regional water table. Sediments comprising the terrace deposits include crudely stratified, poorly consolidated reddish-brown gravel, sand and silt (Winterer and Durham, 1962). Terrace deposits are sometimes weakly cemented by iron oxides, clay minerals, or calcium carbonate.

Terrace deposits may be up to 200 ft thick in some areas, but, because of the limited areal extent of these deposits and because they are generally above the regional water table, they are not a viable source for the development of groundwater resources. However, limited zones of perched groundwater may be locally present in some areas on a seasonal basis within these Terrace Deposits.

Saugus Formation

The Saugus Formation (QTs), of late-Pliocene to early-Pleistocene geologic age (ranging from approximately 3.6 to 1.8 million years in age), has traditionally been divided into two stratigraphic units: a lower, geologically older Sunshine Ranch Member (QTsr) of mixed marine to terrestrial origin; and an overlying, upper portion of the formation (QTsu), which is entirely terrestrial (non-marine) in origin (Winterer and Durham, 1962). Figure 4.1-5 graphically illustrates these two stratigraphic units and the overall characteristics of each. Ground surface exposures of the Saugus Formation shown on Figure 4.1-4 are labeled as undifferentiated Saugus Formation (QTs) because data necessary to distinguish the upper portion (QTsu) from the Sunshine Ranch Member (QTsr) are not available for all areas of the Basin. For the cross sections (discussed in Section 4.1.5), the upper portion of the Saugus Formation (QTsu) and the Sunshine Ranch Member (QTsr) are labeled discretely where data allow for interpretation of the contact between the members; otherwise, the same undifferentiated Saugus Formation (QTs) label is used.

GEOLOGIC AGE	FORMATION/DEPTH	STRATIGRAPHIC COLUMN	GENERAL LITHOLOGIC DESCRIPTION	ORIGIN
Quaternary /Tertiary	Upper Saugus Formation (QTsu) to ±5,300 ft bgs		Coarse-grained conglomerates and sandstones interbedded with clays/mudstones.	Terrestrial Depositional Environment (Fluvial & Floodplain)
Quaternary /Tertiary	Sunshine Ranch Member Saugus Formation (QTsr) to ±7,700 ft bgs		Predominantly Claystones, Siltstones & Sandstones, thinly interbedded	Transitional Terrestrial to Marine Depositional Environment
Tertiary	Pico Formation (Tp)		Bluish gray to gray Claystones	Deep Marine Depositional Environment

Note: Information above based on RCS correlation of the electric log for oil well Badger Oil Co. Magic Mountain No. 1 - 04N/16W-17Ka. Interpreted depths differ in other portions of the Basin.

RCS

FIGURE 4.1-5
GENERALIZED SAUGUS FORMATION STRATIGRAPHY

May 2021

The upper stratigraphic unit of the Saugus Formation consists of terrestrial fluvial and floodplain deposits that are composed of slightly cemented, interfingered and interbedded conglomerate, sandstone, and clay/mudstone layers. These deposits generally extend to a maximum depth of 5,300 ft in the local groundwater basin, based on an electric log (E-log) for a deep oil well [21] located in the approximate center of the Basin; these depths vary in other parts of the Basin. This deep wildcat (exploratory) oil well was drilled near the east end of a prominent topographic high (called Round Mountain), which is an isolated outcrop of the Saugus Formation, just southeast of Rye Canyon Rd and Avenue Stanford, within the course of the Santa Clara River.

Strata within the Saugus Formation tend to become coarser-grained and generally more permeable in an upward direction, which is from the older and less permeable beds within the Sunshine Ranch Member, to the coarser and somewhat younger beds within the main part of the formation. The formation consists mainly of lenticular beds of light-gray and brown sandstone and conglomerate intercalated with lesser amounts of reddish-brown sandy mudstone. These terrestrial sediments were deposited in stream channels, floodplains, and alluvial fans of an ancestral drainage system in the Santa Clarita Valley. The coarser-grained sand and gravel beds of the Saugus Formation were deposited in the main channels of the ancient drainage system, and these more permeable beds constitute the principal, potential water-bearing materials within the present-day Saugus Formation. As the locations of the ancestral drainage channels changed during the approximately 3 million-year period of deposition of the Saugus Formation strata, the distribution of the coarse-grained channel deposits also changed, both laterally and vertically (in space and time, respectively).

In contrast, the underlying and older Sunshine Ranch Member of the formation is comprised of interfingered, fine-grained, shallow marine, brackish-water to non-marine deposits of generally thinly interbedded gray to greenish-gray sandstone and siltstone. The base of this member occurs at a depth of approximately 7,700 ft bgs and attains a maximum thickness of approximately 2,400 ft in the central part of the local groundwater basin.

Because of the marine origin and the fine-grained nature and relatively low-permeability of the Sunshine Ranch Member, it is not considered to be a target for groundwater exploration or production. Wells drilled near the periphery of the Saugus Formation surface exposures in the Santa Clarita River Valley (i.e., in those areas where the Sunshine Ranch Member is at or very near to ground surface) have typically produced groundwater at rates too low for municipal supply purposes but may provide sufficient water for small-capacity domestic supply wells or irrigation wells, depending on water quality. Evidence from oil field E-logs suggests that the groundwater in much of the Sunshine Ranch Member may be brackish and hence not useful for municipal supply purposes.

4.1.3.2 Geologic Formations Surrounding the Basin

There are a number of geologically older formations that underlie the alluvium and the Saugus Formation and that occur outside of the Basin; refer to Figure 4.1-4 for DWR-derived boundaries of this local groundwater basin. Each of these older formations is considered to be non-water bearing for large-scale water supply purposes (i.e., high-volume production wells), though groundwater in these formations could possibly be utilized for small-scale residential or landscape purposes (depending on water quality). Because they are not a significant source of groundwater for municipal water-supply purposes, these essentially non-water bearing formations will be discussed only briefly in this section. As noted above, none of these older geological formations lie within the local groundwater basin as defined by DWR Bulletin 118, update 2016 (DWR, 2016).

[21] Badger Oil Company, Magic Mountain No. 1 - 04N/16W-17Ka

The formations that are present differ slightly on the north and south sides of the San Gabriel Fault, as defined in Figures 2 and 3 of the report by Oakeshott (1958). Many of the named formations in those figures are not exposed at ground surface in the Basin and some of their names have been reassigned to other formations or have been renamed by others over time. Thus, the formations discussed below are in accordance with, and confined to, only those depicted on the surface geology shown on Figure 4.1-4 within the Basin.

South of the San Gabriel Fault

South of the San Gabriel Fault, the Saugus Formation lies conformably and gradationally upon the Pico Formation of late-Pliocene to Pleistocene geologic age (ranging approximately from 3 to 1.8 million years old). The Pico Formation is of marine origin and consists of gray clay, siltstone, fine-grained sandstone, and light-colored sandstone and conglomerate. The Pico Formation is present at or near ground surface on the west end of the Basin where the Saugus Formation ceases to exist (or pinches out). Local residents sometimes refer to an area called blue cut, which is a location where the Santa Clara River has incised into the Pico Formation; sediments in the Pico Formation often exhibit a blue hue.

Conformably underlying the Pico Formation (Tp) is the Towsley Formation (Tt) of late-Miocene to early-Pliocene geologic age, approximately 6 to 3(?) million years in age. This unit is composed of terrestrial fluvial deposits consisting of well-consolidated to cemented and interbedded shales, siltstones, sandstones, and conglomerates. The Towsley Formation is, in turn, unconformably underlain by sedimentary rocks of the Modelo Formation (Tms) of middle- to late-Miocene age, ranging from approximately 16 to 7 million years ago, and consisting chiefly of cemented sandstone and siliceous, diatomaceous shales.

The above-described bedrock units unconformably overlie pre-Tertiary basement complex rocks (bc) of the San Gabriel Mountains. These geologically old materials consist of the crystalline rocks of quartz diorite, hornblende diorite, gabbro, and gneiss; they were likely emplaced during the Cretaceous period; i.e., approximately 145 to 90 million years before the present.

North of the San Gabriel Fault

North of the San Gabriel Fault, the formations below the Saugus Formation are not the same as those on the south side of the fault. Movement along the fault during and following formation of the Basin-area sediments caused the Saugus Formation to be deposited on top of different, geologically older formations. On the north side of the fault, the Saugus Formation unconformably overlies Miocene-aged (ranging from 23 to 5.2 million years ago) terrestrial sediments of the Castaic (Tc), Tick Canyon (Tt), Mint Canyon (Tm), Vasquez (Tv) formations and the Violin Breccia (Tvb, northwest of Castaic Lake); refer to Figure 4.1-4. These older formations that underlie the water-bearing alluvium and Saugus Formation (within the local groundwater basin) tend to be well-consolidated and cemented and have relatively low porosity and permeability. The Violin Breccia, in particular, of late Miocene age, is considered to be a facies (unit within the rock formation with unique chemical or physical characteristics) of the Ridge Basin Group and is an assemblage of hard sand, gravel, and breccia derived from basement rocks southwest of the San Gabriel Fault (Dibblee, 1997a). These rocks were deposited as debris flows, talus, and alluvial fans accumulating along the San Gabriel Fault scarp (Link and Osborne, 1978; Link, 2003), during development of the San Gabriel Fault at that time.

These older rocks essentially form the local bedrock and are not considered water-bearing in terms of their ability to supply groundwater in useable quantities and of acceptable quality for municipal or agricultural supply purposes. Wells and test holes drilled into these bedrock materials have typically encountered low groundwater production rates and sometimes less than favorable water quality.

The assemblage of bedrock units, discussed above, also unconformably overlie all pre-Tertiary basement complex rocks of the San Gabriel Mountains. The rocks in this area of the mountains consist of crystalline, intrusive igneous rock granite, and metamorphic rocks of the Pelona Schist, both of late Mesozoic age (approximately 80 to 66 million years in geologic age), and augen gneiss, of Pre-Cambrian geologic age (approximately 1.65 billion years old).

4.1.3.3 Regional Geologic Structures

The Quaternary alluvium along the Santa Clara River and its tributaries generally overlies the older terrace deposits and the Saugus Formation in the area. As such, a significant unconformity (a separation of two or more units by a geologic time gap) occurs between those two older formations and the alluvium. The alluvium appears to be undeformed by any recent tectonic activity (occurring since the beginning of the Holocene period), such as folding or faulting. To some extent this is also the case for the terrace deposits, although they have been tectonically uplifted in some areas and are slightly folded. One such fold has been mapped in an area where the terrace deposits crop out in the hills east of San Fernando Road and the South Fork of the Santa Clara River.

However, the alluvium generally exhibits sedimentary structures associated with deposition by the typical mode of meandering rivers and streams. Examples of such sedimentary structures are cross-bedding (where one set of sediments have been laid at an angle to previously deposited sediments) and cut and fill structures (where one stream bed has cut into underlying previously deposited sediments and then subsequently filled in by more recent material).

The general overall structure of the slightly geologically older Saugus Formation is one of an isolated bowl that has been cut (at least in part) by two major faults, namely the San Gabriel Fault and the Holser Fault, and also folded along a number of generally east-west trending folds. The sedimentary layering in the Saugus Formation and in the underlying bedrock dips (i.e., the beds are inclined) generally toward the center of the bowl from all locations along the outer (perimeter) contact of the Saugus Formation. However, there is some degree of localized folding of the layers along the San Gabriel Fault, resulting in small and large anticlinal and synclinal structures with axes trending from the northwest to the southeast (Dibblee, 1996a).

The San Gabriel Fault system and the Holser Fault generally cut across the Saugus Formation and all older formations in the region. The San Gabriel Fault system has a relative right-lateral movement (where land on one side or the other moves to the right, relative to the other side); whereas the Holser Fault is considered to have left lateral movement However, these two faults also show some vertical component of movement. The San Gabriel fault is theorized to have a horizontal displacement on the order of 20 miles and vertical displacement of 1,400 ft (Crowell, 1954). Displacement on the Holser Fault has been estimated to be roughly 4 miles horizontally, and perhaps 3,000 to 5,000 ft vertically (RCS, 1988). Further, these two faults divide the Saugus Formation into three distinct fault-bounded blocks, sometimes referred to as the South, Central, and Northern blocks.

4.1.4 Principal Aquifer Systems

4.1.4.1 Alluvial Aquifer System

The Alluvial Aquifer system overlies the Saugus Formation and serves as one major source of groundwater to groundwater users in the region. Data from the numerous shallow wells in the valley show that the maximum thickness of alluvium varies along the Santa Clara River and it appears to reach a maximum depth to 200 ft bgs in several wells in the approximate center of the valley. The alluvial sediments generally thin and pinch out traversing from the valley center and progressing outward towards the surrounding hills. The Alluvial Aquifer is replenished/recharged chiefly by rainfall and infiltration of surface water runoff in the Santa Clara River and its tributaries, as evidenced by static water level changes shown on hydrographs from the numerous wells in the valley that obtain groundwater solely from this aquifer. Those hydrographs (presented in Section 6) show that static water levels exhibit rapid responses and large fluctuations during rainfall events and intervening drought periods. The Alluvial Aquifer along the main stem of the river is also replenished from discharge of treated wastewater from the Saugus and Valencia water reclamation plants (WRPs).

Exclusion of Portrero Canyon from GSP Management

Potrero Canyon lies in an unincorporated portion of LA County west, of Interstate 5 and south of the Santa Clara, and just west of the LA/Ventura County line (county line) (see Figure 4.1-1). The canyon is nearly 4 miles long, extends westward from its headwaters near Stevenson Ranch to its outlet just south of the Santa Clara River, about 1 mile upstream of the county line and the western terminus of the groundwater basin. Because the floor of the canyon is shallowly underlain by alluvium, it is included as part of the DWR-defined groundwater basin shown on Figure 4.1-1. However, for the reasons described below, Potrero Canyon will not be included as an area that is subject to management under this GSP.

Available geologic and water quality data indicate that groundwater in the alluvium of Potrero Canyon and the underlying Pico Formation bedrock is saline. Furthermore, those earth materials do not readily transmit groundwater to wells. As shown on Figure 4.1-4, the principal geologic units in the canyon are shallow alluvium (Qa) and the underlying Pico Formation (Tp). As noted in Section 4.1.3.2, the Pico Formation is considered to be non-water bearing for large-scale water supply purposes. Within Portrero Canyon, the alluvium is also fine-grained and contains saline groundwater (RCS, 2002). No water supply wells are currently present in the Potrero Canyon area. Available water quality data in Potrero Canyon indicate that alluvial groundwater and surface water are saline, likely because the alluvium is derived from the weathering, transport, and redeposition in the Potrero Canyon watershed of Pico Formation strata, which are of marine origin (RCS, 2002).

Potrero Canyon is largely undeveloped and is owned by FivePoint. A cattle ranching operation was formerly present in the canyon, but is not currently in operation. No agricultural or other irrigation-dependent activities are present or are known to have existed in the past, except for domestic outdoor use at the existing ranch (now owned by FivePoint). The limited water use in the canyon has been mainly for domestic purposes and has been supplied by a pipeline that imports water from a water well located outside of Potrero Canyon.

Three sensitive plant communities have been identified by others in Potrero Canyon: the community in the riparian strip along the main stream channel in the canyon, the Salt Grass community, and the Mesic Meadow. Shallow saline groundwater is supporting each of the sensitive plant communities in the canyon. Because the local groundwater has high concentrations of total dissolved solids, the predominant plant species living in the Salt Grass and Mesic Meadow areas (e.g., those that are characteristic of a cismontane alkali marsh) are salt tolerant. Evapotranspiration processes occurring in and around these plant communities also tend to concentrate salts in the upper soil profile, and as a result, salt is visible at the ground surface in some locations.

4.1.4.2 Saugus Formation

Depending on location within the local basin groundwater basin, the Saugus Formation may exist under confined, semi-confined or even unconfined conditions. This formation serves as the other major source of groundwater in the region. In the center of the valley, the sedimentary layering of the formation is nearly horizontal and some confining layers of low permeability (fine-grained silts and clays) may limit groundwater movement in an upward or downward direction. Consequently, groundwater occurs under pressure within the intervening sand and gravel units, and water levels in Saugus Formation water wells tend to be above the top of the perforated casing intervals that intersect these coarse-grained aquifer units, thereby providing evidence that groundwater is under confined or semi-confined conditions.

In contrast, near the outer perimeter of the Saugus Formation, near the boundaries of the groundwater basin, the sedimentary layering is tilted downward toward the center of the bowl and the permeable sand and gravel beds of the formation are in direct contact with either the ground surface or with highly permeable alluvial or Terrace Deposit materials. In these areas, the Saugus Formation aquifer may be essentially under unconfined, water-table conditions.

Virtually all known existing and historical Saugus Formation water wells have been drilled south of the San Gabriel Fault. Only one known attempt has been made to drill and construct a Saugus Formation water well into the lower and geologically older Sunshine Ranch Member of the Saugus Formation, which predominates in the area north of the San Gabriel Fault. That well did not produce groundwater in sufficient quantities or acceptable quality for municipal supply purposes, and was subsequently destroyed.

As discussed above, the San Gabriel and Holser faults divide the Saugus Formation into three distinct blocks: the South, Central, and North blocks. These fault blocks control the geographic distribution of potential sand and gravel aquifers within the Saugus formation; wherein the Central block contains the thickest accumulation of potentially water-bearing sediments, the South block has the second-greatest accumulation of such sediments, and the North block has the thinnest accumulation of sediments. Details regarding the sediment thickness of the Saugus Formation within each block are described below in the subsection Depth to the Base of Freshwater and Santa Clarita Zone.

RCS (2002) identified an important stratigraphic zone of coarse-grained sediments near the base of the Upper Saugus Formation through the correlation of E-logs of several existing oil wells and water wells. This correlated stratigraphic zone was informally termed the Santa Clarita Aquifer Zone by RCS (2002). This zone in the subsurface can be identified on E-logs of wells over a wide area of the Basin and generally occurs at depths ranging from 800 to 1,500 ft bgs. Existing Saugus Formation water wells with the highest pumping rates generally tend to produce groundwater from within and stratigraphically above this Santa Clarita Aquifer Zone.

4.1.4.3 Aquifer Properties

Alluvial Aquifer

The Alluvial Aquifer generally consists of unconsolidated and intercalated (i.e., interfingering lenticular beds) deposits of clay, silt, sand and gravel. Groundwater within the Alluvial Aquifer in the Basin occurs under unconfined (i.e., water table conditions) and groundwater within this aquifer is generally contained within the interstitial pore spaces (known as porosity). Moreover, the degree of interconnectedness of these pore spaces is a measure of its permeability, which is the ability of the material to transmit water. Permeability values are generally used in groundwater flow and transport modeling studies.

Groundwater in the Alluvial Aquifer system, because it is under the direct influence of atmospheric conditions of pressure (water table conditions), moves (flows) from higher to lower elevations via the force of gravity. Thus, the slope of the water table surface is known as the hydraulic gradient and is governed by both elevation and the amount of groundwater moving through the alluvium. In addition, because of the unconsolidated nature of the aquifer materials, the permeability (hydraulic conductivity) of the Alluvial Aquifer is relatively higher than that of the underlying Saugus Formation. As such, wells perforated in the Alluvial Aquifer system tend to be relatively efficient, compared to that in the less permeable aquifer systems in the underlying Saugus Formation.

Porosity and Specific Yield

The porosity of the Alluvial Aquifer system may range from 10 percent to 30 percent, or slightly greater, depending on the grain size distribution in the type of earth materials present; an average value of 20 percent is often assumed for the purposes of evaluating aquifer characteristics. The porosity of the alluvial sediments is governed by the type of earth materials present in the aquifer system. Generally, clays tend to have the highest porosities whereas sands and gravels tend to have lower porosity values. However, porosity values for the alluvial sediments of the Santa Clarita Valley were estimated based on a review of over 300 drillers' logs for historical alluvial water-supply wells throughout the Basin. These porosities were estimated by RCS (1986) to range from 9 percent to 16 percent.

Specific yield is a measure of the amount of groundwater that can flow to a well under gravity drainage only. For unconsolidated alluvial sediments, the porosity is approximately equal to the specific yield. Thus, the specific yield for the alluvium is estimated to be in that aforementioned range of 9 percent to 16 percent.

Hydraulic Conductivity, Transmissivity, and Storativity Values

As noted above, hydraulic conductivity is a measure of the ability of geologic media to transport water through the pore spaces in the sediments of an aquifer system. Generally, clays have the lowest hydraulic conductivities whereas gravels tend to display the highest values. This character is usually determined through aquifer testing of wells, although values can be estimated using empirical relationships. Based on the results of aquifer testing, calculation of the aquifer coefficients of transmissivity (T) and storativity (S) can be made. The parameter T is a measure of the transmitting property of an aquifer and can expressed in units of square ft per day (ft^2/day). The parameter S is a measure of the volume of water that can be released from an aquifer per unit area of the aquifer and per unit reduction in hydraulic head (water level change). This value is usually expressed in cubic ft per square foot per foot (ft^3/ft^3) and thus is a dimensionless quantity. In alluvial aquifer systems, S can be considered to be equal to the specific yield. Hydraulic conductivity, which is a measure of the velocity at which groundwater moves through a formation, is expressed as k, in units of ft per day (ft/day). This parameter can be calculated directly from T values, by dividing T by the saturated thickness of the aquifer section perforated in a well. As such, calculated k values reflect the intrinsic property of the aquifer and do not change, whereas T values could change, based on the differences in the saturated thickness of the aquifer system.

For the Alluvial Aquifer system, RCS (1986, Plate 7 and updated with results of constant rate pumping test data from numerous alluvial wells constructed between 1986 and 2009) provided values for T and k values. These values tend to vary spatially in the Alluvial Aquifer system. The following table summarizes the ranges of those T and k values for the Alluvial Aquifer system along the Santa Clara River and its tributary watersheds, from the west (near the county line) to the east (near Lang):

Table 4-1. Estimates of T and k Values for the Alluvial Aquifer along the Santa Clara River and Its Tributaries

River Section	k Values (ft/day)	T Values (ft^2/day)
Dell Valle to Castaic Junction	40 to 735	2,850 to 67,300
Castaic Valley Tributary	25 to 710	1,778 to 60,600
San Francisquito Canyon Tributary	11 to 285	1,000 to 22,000
Castaic Junction to Bouquet Junction	3 to 460	3,000 to 29,400
Bouquet Canyon Tributary	10 to 440	700 to 55,200
Bouquet Junction to Newhall (South Fork of Santa Clara River)	2 to 47	1,400 to 19,300
Saugus to Solemint	<7 to 935	<670 to 84,600
Solemint to Lang	<7 to 930	<670 to 67,600

Notes

ft^2 = square feet

ft = feet

Table 4-1 shows that both T and k values in the alluvium tend to show a great degree of variability. Such variability is likely due to local lithologic differences in the alluvial sediments between different well locations, methods of well construction, depth interval of the perforated section(s) of the well, degree of plugging of the casing perforations, and/or differences between the efficiency of the well, or a combination of some or all of these factors.

Historical Groundwater in Storage Calculations

The amount (i.e., the total volume) of groundwater contained within pore spaces within the alluvial sediments that is present at any one particular time is known as the groundwater in storage. The amount of groundwater in storage in an alluvial aquifer system depends on the following:

- The total volume of the alluvial sediments in the defined alluvial aquifer system of the local groundwater basin
- The specific yield of those sediments
- The proportion of those sediments that is saturated with groundwater at a specific water level monitoring date

Because the volume of sediments and specific yield of an aquifer do not generally change over time, the amount of groundwater in storage in the Alluvial Aquifer is directly related to its saturated thickness (i.e., to a specific water level monitoring date for wells in the alluvium). This is indicated by measured groundwater levels at a specific date in water wells within the alluvial sediments. A rising water table increases the thickness of the saturated water-bearing section, thereby increasing the volume of groundwater in storage; the converse is true for a declining water table.

Groundwater levels in the Alluvial Aquifer are highly influenced by local rainfall and recharge (a highly variable factor in southern California). The amount of groundwater in storage in the Alluvial Aquifer has varied considerably over the past 50 to 60 years as the local climate has experienced periods of both higher than average rainfall (wet years) and lower than average rainfall (dry years). RCS (1986 and 2002) estimated the volume of groundwater in storage (in units of acre ft, AF) for the years 1945, 1965, 1985, and 2000; those volumes ranged from 100,000 AF to 200,000 AF. As part of the GSP development, current groundwater storage estimates will be calculated using a groundwater flow model, and reported in Section 6, Water Budgets.

Saugus Formation

Groundwater moves slowly through the Saugus Formation because it is slightly more consolidated in comparison to that in the overlying alluvial sediments, and groundwater must travel through more restricted pore spaces within the individual sand and gravel aquifer units in the Saugus Formation. The groundwater velocity at any location within this formation depends on (1) the hydraulic conductivity (permeability) of the aquifer materials, which differs from one individual sand and gravel unit to the next, and (2) the hydraulic gradient that drives the groundwater movement. The hydraulic gradient is defined as the slope of the water level surface (or more correctly, the slope of the piezometric surface where the formation is under confined conditions), and this slope will vary on both seasonal and longer-term cycles over time.

Hydraulic Conductivity, Transmissivity, and Storativity Values

Transmissivity (T) and hydraulic conductivity (k) values of the Saugus Formation sediments also show some degree of variation across the local groundwater basin. T values determined from aquifer (pumping) tests in several Saugus Formation wells located in different parts of the local groundwater basin have generally ranged from 400 ft^2/day to as high as 24,300 ft^2/day (RCS, 1988, 1989, 2001). Calculated k values for wells exhibiting these T values ranged from 1 ft/day to 34 ft/day. Only a few additional Saugus Formation wells have been constructed since 1988. Testing of these more recently constructed deep wells have yielded T values of 3,300 ft^2/day and 8,300 ft^2/day (VWD-207 and VWD-206, respectively). Values of k for these two wells were 1 ft/day to 34 ft/day, respectively. The distribution of the T and k values in the wells indicates a general trend from lower transmissivity values near the southeastern edge of where the Saugus Formation is exposed at ground surface to higher transmissivity values near the center of the local groundwater basin.

Storativity, which is a term typically used for confined aquifer systems, is a dimensionless measure of the volume of water that will be discharged from an aquifer per unit area of the aquifer and per unit reduction in hydraulic head. These values for wells in the Saugus Formation are on the order of 1.0×10^{-4}.

Depth to the Base of Freshwater and Santa Clarita Zone

Groundwater in the Saugus Formation is classified into two basic conditions, depending upon salinity. These conditions exist where the groundwater grades from fresh water, considered to be 3,000 parts per million (ppm) or less in salinity, to brackish and saline groundwater, which may display salinity values above 3,000 ppm. Estimation of the maximum depth to which fresh groundwater occurs within the Saugus Formation, defined as the base of fresh water, had been performed with some degree of accuracy through an evaluation of both water well and oil well E-logs. More than 250 of these E-logs, located throughout the river valley, were utilized in previous studies (RCS 1988, 2002), as a part of the effort to define the base of fresh water within the local groundwater basin. On some E-logs, the vertical transition from the overlying fresh water to the underlying saline water is very abrupt and unambiguous, and thus can be identified at a specific depth. On other E-logs, the transition from fresh water to saline water is gradual and may occur over a vertical distance of hundreds of feet. In such cases, and to be conservative, the base of fresh water was chosen, insofar as possible, at the top of the zone of transition from fresh water to saline water (RCS, 1988, 2002).

The depth and thickness of the water-bearing deposits in each of the fault blocks (areas bounded by faults) in the valley are as follows:

- **North Block.** Northeast of the San Gabriel fault, the maximum depth to the base of fresh water within the Saugus Formation is approximately 1,500 ft. By comparison, the maximum total thickness of the Saugus Formation, based on E-logs, is on the order of 2,000 ft in this area. In this fault block, the Santa Clarita Aquifer Zone does not exist, and instead only deposits of the underlying Sunshine Ranch Member are considered to occur.
- **Central Block.** In the wedge-shaped central fault block between the San Gabriel fault and the Holser fault, the maximum depth to the base of fresh water within the Saugus Formation is approximately 5,500 ft. In this area, the maximum total thickness of the Saugus Formation is approximately 8,500 ft. The top of the Santa Clarita Aquifer Zone in this fault block was determined to occur at a depth ranging from 100 ft in the north-northwestern portion of the block, to 1,500 ft in the southeastern corner of the block adjacent to the San Gabriel fault, and to as great as 2,900 ft bgs in the central (deepest) portion of this block.
- **South Block.** Southwest of the Holser fault, the maximum depth to the base of fresh water within the Saugus Formation is approximately 5,000 ft. The Saugus Formation obtains a maximum total thickness on the order of 7,500 ft in this block. The depth to the top of the Santa Clarita Zone is estimated to be roughly 2, 200 ft bgs.

Confining Beds

The Saugus Formation generally contains disconnected and interbedded layers of clay, silt, sand, and gravel. The interbedded clay layers may act as local aquitards (confining beds), thereby providing at least a partial barrier to the vertical migration of groundwater. Interbedded clay layers range in thickness from 10 ft to as much as 50 ft. However, the depths and thicknesses of these clay layers have not been defined to date in any studies of the groundwater basin, but, depending on the locations of a well in the Basin, there is likely to be several such clay layers dispersed throughout a vertical section of the formation.

4.1.5 Cross Sections

As part of the geologic and hydrostratigraphic characterization of the Basin, five geologic cross sections have been prepared by RCS to further describe and illustrate the vertical and lateral extent of the aforementioned geologic formations and units. Figure 4.1-4 illustrates the ground surface traces and alignments of these cross sections plotted on a geologic map of the Basin. These five cross sections (AA-AA' through EE-EE'), prepared by RCS, are presented in Figures 4.1-6 through 4.1-10, respectively and illustrate the subsurface interpretation based on a comparative review of available geologic data and electric log data.

4.1.5.1 Cross Section Preparation

Preparation of the five RCS cross sections utilized a step-wise multifaceted approach combining previous studies with additional more recent geologic data. Cross section data were obtained from previous basin-wide studies completed by RCS (1986, 1988, 2001, and 2002), as well as from review of published geologic maps and geophysical well logs (E-logs) from the California Geologic Energy Management Division (CalGEM) well database. Some data were reinterpreted, and prior interpretations were updated based on the availability of newer subsurface data that were available in some areas of the local groundwater basin.

RCS

FIGURE 4.1-6
CROSS-SECTION AA-AA'

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FIGURE 4.1-7
CROSS-SECTION BB-BB'

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FIGURE 4.1-8
CROSS-SECTION CC-CC'

RCS Job No. 693-LAS01

May 2021

LEGEND

Formations & Units — **Geologic Age**

		Geologic Age
Qa	Undifferentiated Alluvium	Holocene - Pleistocene
Qt	Terrace Deposits	Holocene - Pleistocene
QTs	Saugus Formation (QTs - Undifferentiated; QTsu - Upper Unit)	Pleistocene - Pliocene
QTsr	Sunshine Ranch Member	Pleistocene - Pliocene
Tp	Pico Formation	Pliocene
Tt	Towsley Formation	Miocene
Tc	Castaic Formation	Miocene
Tmc	Mint Canyon Formation	Miocene
bc	Basement Complex	Pre-Tertiary

Symbols

- Santa Clara River Valley Groundwater Basin, East Subbasin Boundary
- Inferred Contact
- Unknown Contact
- Oil/Gas Well Borehole Trace
- Municipal Well Borehole Trace
- Irrigation Well Borehole Trace
- Destroyed Well Borehole Trace
- Domestic Well Borehole Trace
- Inferred Fault Plane
- Interpreted Fault Motion
- TD — Total depth of borehole

Horizontal Scale

0 — 4,000 ft

Scale 1:15,000

Vertical Exaggeration = 1.275

RCS

FIGURE 4.1-9
CROSS-SECTION DD-DD'

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May 2021

RCS

FIGURE 4.1-10
CROSS-SECTION EE-EE'

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May 2021

4.1.5.2 Cross Section Traces

Cross section traces were selected to illustrate the stratigraphy and general geologic structure of the groundwater basin. Cross section line traces AA-AA', DD-DD', EE-EE' (see Figure 4.1-4) extend past opposite basin boundaries in a semi-orthogonal orientation to provide representative subsurface illustrations of the long and short axes of the Basin. Obliquely oriented cross sections BB-BB' and CC-CC' illustrate subsurface conditions along the Santa Clara River and the southeastern zone of the Basin, respectively. Each of these cross sections is presented at the same vertical scale, but due to the small horizontal scales of the sections, the cross sections are vertically exaggerated, as shown on the figures. Cross section FF-FF', Figure 4.1-11 (the section trace is shown on Figure 4.1-4 for reference), was created by Geosyntec Consultants, Inc. (Geosyntec), using a different methodology than that used by RCS and for a separate purpose and does not use the same horizontal or vertical scale as the five other cross sections discussed herein. Specific discussion of cross section FF-FF' is provided in Section 4.1.5.5.

4.1.5.3 Geologic Structures

Construction of the five cross sections required derivation and correlation of geologic formations in the subsurface using various data and methods. First, shallow formation contacts were interpreted and derived from mapped surface contacts and structural geology features. Surface mapped contacts and bedding orientations were plotted and projected from surface to depth, allowing for an initial starting point to correlate geologic formations.

Additional review of regional geologic structures was conducted with respect to previous studies. Fault traces and contact planes were compared to available geographic information system (GIS) data sets. Similarly, local fold structures, escarpments, and topography GIS data sets were reviewed to provide a summary representation of local fault structures and geologic contacts. As discussed in Section 4.1.3, a majority of the fault traces depicted in the figures created for this document have been simplified to be represented by single-line traces, and not by a series of en echelon faults within various fault zones.

4.1.5.4 Well Log Analysis and Interpretation

After plotting surficial contacts and regional structural features, formation depth intervals were derived from analysis of available groundwater and oil/gas well E-logs. Formation identification and interpretation based on E-logs is a common method and is a practice that is routinely used in the energy and resource sectors. The process involves comparing different geophysical logs such as gamma-ray, spontaneous potential, resistivity, and density-neutron in combination with other geologic data gathered during drilling (core, cuttings, drilling progression, etc.) to help identify formations and changes in subsurface materials. For further detail on well logging see, for example, Asquith and Krygowski (2004).

Due to the nature and availability of E-logs from the CalGEM database, short and long normal resistivity logs were primarily used to identify and correlate the respective formations within the Basin. To demonstrate how the well log and E-log information was correlated, Figure 4.1-12 plots three sequential (west to east) resistivity logs that were used to correlate formation contacts in cross section AA-AA'. Higher resistivity values (ohm meters per meter) plotted in Figure 4.1-12 infer higher porosity within the local subsurface material, which can be inferred to be coarser-grained strata. Thus, the vertical resistivity profile can show a stratigraphic package(s) of geologic units (and may even suggest depositional environments) when coupled with drill hole cuttings and core logs. These geologic or stratigraphic packages or units were correlated with similar geologic units in selected E-logs to infer the subsurface extent and continuity of each respective formation as shown on the cross sections.

GM faulted - Fault System

Holser

Geological Model

Holser Fault

Stream Gauge Location

GM faulted

1. Qa - Undifferentiated Alluvium
3. QTs - Saugus Formation
5. Tp - Pico Formation

FIGURE 4.1-11
CROSS SECTION FF-FF'

Geosyntec consultants

May 2021

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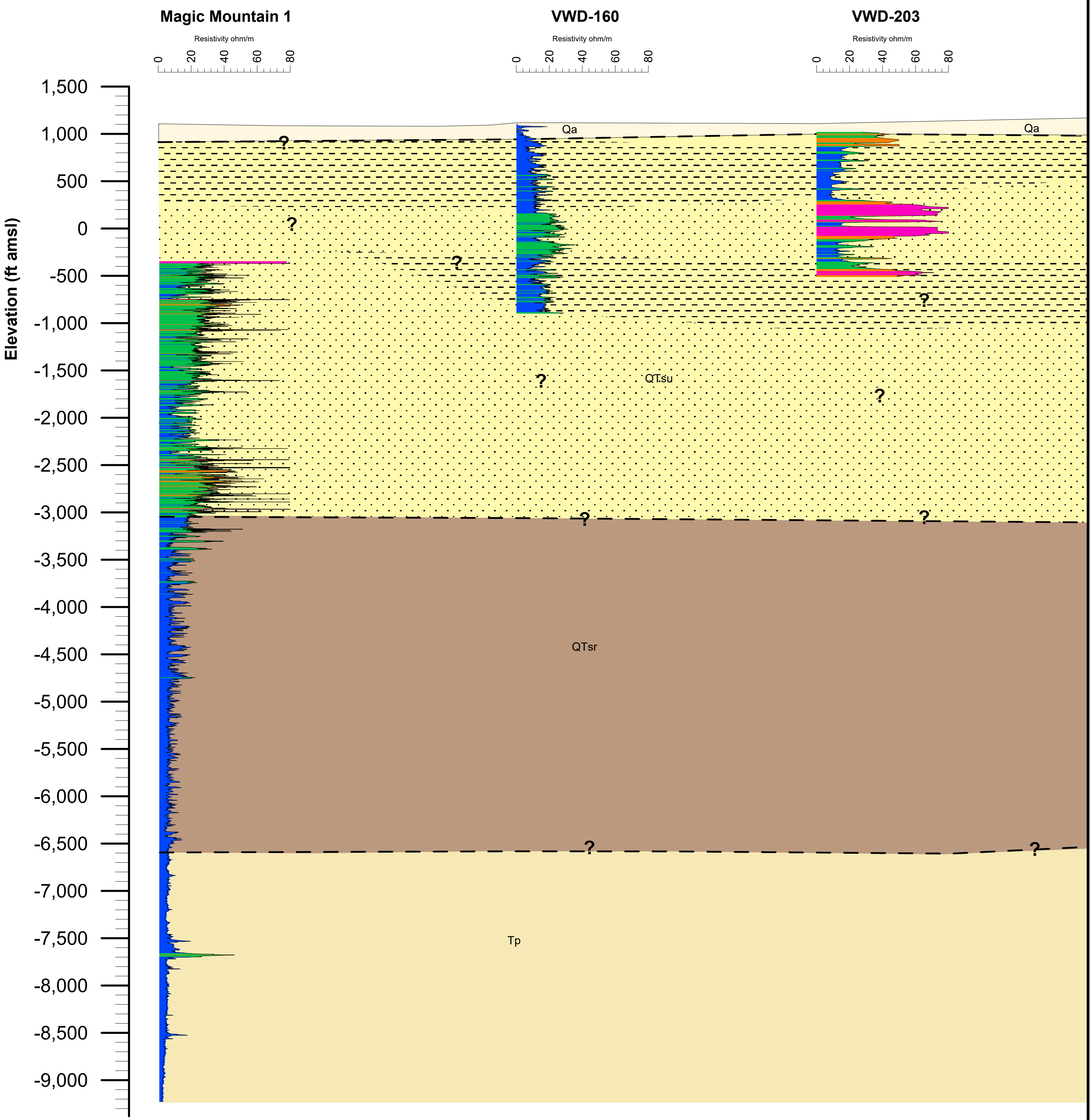

LEGEND

Formations

- Qa — Undifferntiated Alluvium
- QTs — QTsu Saugus Formation (QTs - Undifferentiated / QTsu - Upper zone); QTsr Sunshine Ranch Member
- Tp — Pico Formation

Lithology

- Silty / Clay
- Clayey Sand / Silty Sand
- Sand with Silt / Sand
- Gravel / Cobbles

Units

- Fine Grained
- Coarse Grained
- Inferred Contact
- Unknown Contact

RCS

FIGURE 4.1-12 DETAILED STRATIGRAPHIC INTERPRETATION

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May 2021

Additionally, lithologic interpretation of the resistivity logs shown in Figure 4.1-12 was also conducted to show sedimentary variance within the Saugus Formation. Interpretation of lithology based on resistivity is provided in a color sequence in Figure 4.1-12. Lithologic comparison between resistivity logs of wells VWD-160 and VWD-203 show correlative units of coarser-grained sediments but with varying intensity of resistivity. The lithology logs show finer-grained (lower resistivity) units are interbedded with coarser-grained units within both well logs, as documented in previous studies (Winterer and Durham, 1962). Moreover, resistivity signatures in the well log for the wildcat oil well Magic Mountain 1 indicate coarser-grained sediments at the same elevation where finer-grained sediments are correlated in well VWD-160, further indicating lateral formation variation within the Saugus Formation.

4.1.5.5 Cross Section FF-FF'

As discussed above, cross section FF-FF' (Figure 4.1-11) was created by Geosyntec using different methodology than that used by RCS to create the other five cross sections shown on Figure 4.1-4 and therefore does not use the same horizontal or vertical scale as the other five cross sections presented on Figures 4.1-6 through 4.1-10. Further, cross section FF-FF' was created by Geosyntec to help evaluate the interaction of groundwater between the shallow alluvium of the Santa Clara River, the Saugus Formation, and the Pico Formation.

Cross section FF-FF' is aligned along the approximate center of the Santa Clara River channel, traversing approximately east to west, beginning in the vicinity of an outcrop of the Saugus Formation known as Round Mountain. From there, this cross section continues westerly to a point outside of the western boundary of the groundwater basin (see Figure 4.1-4) that coincides with the edge of the existing MODFLOW model boundary; the MODFLOW model is discussed in *Development of a Numerical Groundwater Flow Model for the Santa Clara River Valley East Groundwater Subbasin* (model development report) (GSI, 2020).

To create cross section FF-FF', Geosyntec incorporated the five RCS-prepared cross sections (AA-AA' through EE-EE') into the Leapfrog Geological Modeling software package. Geologic contacts on those sections were digitized and interpolated across the model domain by Geosyntec. Cross sections AA-AA', DD-DD', and EE-EE' (Figures 4.1-6, 4.1-9, and 4.1-10, respectively) reportedly provided the most influence on lithologic interpretations by Geosyntec along the central and eastern portions of cross section FF-FF'. The depth of alluvium on those three cross sections serve as the primary drivers for depth of alluvium in the central and eastern potions of cross section FF-FF'. Cross section A-A' from the RCS (1988) report was also used to support the interpreted depth of alluvium in the eastern portion of cross section FF-FF' by Geosyntec.

Because the ground-surface profile of cross section FF-FF' is relatively shallow compared to the other five cross sections, Geosyntec used a high-resolution Light Direction and Ranging (LiDAR) survey to supplement the existing 1/3-arcsecond digital elevation model (DEM) from the U.S. Geological Survey that was used to create the ground surface profiles for cross sections AA-AA' through EE-EE'. The high-resolution LiDAR survey was conducted by others along the Santa Clara River in the vicinity of cross section FF-FF' and provided for a more accurate ground surface profile of cross section FF-FF'. LiDAR survey data were downsampled to 0.5-meter resolution to maintain a manageable file size and were converted from their native coordinate system (North American Datum of 1983 [NAD 83] 2011 Universal Transverse Mercator [UTM] Zone 11 North) into the Leapfrog model projection (NAD 83 CA State Plane V).

Alluvium depths shown on cross section FF-FF' that were interpreted using the RCS cross sections and the Leapfrog Modeling software were calibrated using a series of surface geophysical transects that were performed by Geosyntec in February and March 2007. Data from four seismic refraction lines were collected in the vicinity of the blue cut perpendicular to Henry Mayo Drive (near the west end of the groundwater basin). Data collected were used to digitize the survey profiles into the Leapfrog model and were calibrated using the existing 0.5-meter resolution DEM (created using the LiDAR data). The depth of alluvium interpreted from each of the four seismic refraction surveys was used to establish control points along each profile and interpolated between adjacent transects. Those data were then used to adjust the alluvial depths shown on cross section FF-FF'.

4.2 Groundwater Recharge and Discharge Areas within the Basin

4.2.1 Groundwater Recharge

4.2.1.1 Alluvial Aquifer System

Groundwater in the Alluvial Aquifer is recharged by both natural and artificial (human-made) sources. The relative volume of each of the recharge sources discussed below is variable depending on a number of factors, including annual variations in precipitation and temperature.

Sources of natural recharge to the sediments of this aquifer include:

- Streamflow infiltration from runoff along the Santa Clara River and its tributaries.
- Deep percolation of direct rainfall.
- Subsurface groundwater inflow from upstream areas along the Santa Clara River or its tributaries.
- Upward groundwater flow from certain portions of the Saugus Formation where it is overlain by alluvium. This interaction between the alluvium and the underlying Saugus Formation is discussed in the 2003 *Groundwater Management Plan, Santa Clara River Valley Groundwater Subbasin, East Subbasin, Los Angeles County, California* (LSCE 2003). In general, groundwater moves from the Saugus Formation aquifers to the Alluvial Aquifer in areas west of Bouquet Canyon (LSCE, 2003).

Sources of anthropogenic (man-made) recharge to the sediments of this aquifer include:

- Recharge to the alluvium also occurs from deep percolation of irrigation water and is obtained from urban irrigation (landscape irrigation) in the developed areas of the groundwater basin and from areas that are farmed. Agricultural irrigation was historically widespread in the valley; current irrigated acreage is on the order of 1250 acres.
- Recharge also occurs indirectly as a result of the infiltration of reclaimed water that is actively treated by and discharged from the Saugus WRP, placed into operation in 1962, and located east of the intersection of Cinema Drive and Bouquet Canyon Road; and the Valencia WRP, in operation since 1967, and located west of the intersection of Rye Canyon Road and the Old Road. Both plants are operated by the Los Angeles County Sanitation District, and together discharge approximately 18 million gallons of treated water per day to the Santa Clara River, with an average annual discharge of approximately 20,000 AF per year. A portion of the treated water from the Saugus WRP is discharged to the Santa Clara River northwest of the intersection of Bouquet Canyon Road and Valencia Boulevard, while the remainder is conveyed to the Valencia WRP for additional treatment and then released to the Santa Clara River west of Interstate 5. Treated water from septic systems in unsewered areas is an additional source of groundwater recharge.
- Artificial recharge of the Alluvial Aquifer system, via spreading basins or injection wells, has not been conducted within the Santa Clarita Valley; however, SCV Water is presently conducting studies to evaluate the feasibility of managed aquifer recharge.

4.2.1.2 Saugus Formation

Direct natural recharge to the Saugus Formation occurs via deep percolation of rainfall within and around the perimeter of the outcrop area where the permeable sand and gravel beds are either exposed at ground surface or lie directly beneath the relatively thin, permeable Alluvial and Terrace Deposits. Natural recharge to the Saugus Formation also takes place in the eastern end of the outcrop area due to leakage from overlying portions of the saturated alluvium, as originally discussed by RCS (1988). Groundwater recharge from the alluvium to the Saugus Formation generally occurs in areas east of Bouquet Junction where the alluvium overlies the Saugus (LSCE, 2003).

Anthropogenic sources of recharge to the Saugus Formation chiefly include deep percolation of landscape irrigation water in existing areas, and areas subject to future development, where the Saugus Formation crops out at the surface. Agricultural returns are not likely to contribute significant amounts of recharge, as agricultural operations have generally been situated over alluvial areas.

To date, artificial recharge of the Saugus Formation via injection wells or highland spreading basins has not been undertaken in the region (RCS, 2001). However, an injection and recovery study carried out in 2000 at Saugus Formation well VWD-205 located in the vicinity of McBean Parkway and Valencia Boulevard (RCS 2001) demonstrated that it is feasible to conduct and operate an aquifer storage and recovery (ASR) program in the Saugus Formation.

4.2.2 Groundwater Discharge

4.2.2.1 Alluvial Aquifer

Discharges from the Alluvial Aquifer occur primarily through pumping extraction for municipal-supply use by the water purveyors and for agricultural-supply use by others. As previously noted, FivePoint farms utilizes irrigation-supply water wells in the western end of the Basin. Other agricultural operations and golf courses extract groundwater and there are also an unknown number of other privately owned wells that utilize groundwater from the Alluvial Aquifer system for private irrigation and/or domestic use.

Evapotranspiration by phreatophyte vegetation is also a significant component of discharge of groundwater from the alluvium. Phreatophytes are plants, such as willows and cottonwoods, as well as invasive species, such as *Arundo* and tamarisk, that root directly into the water table in areas of shallow groundwater.

The westernmost part of the Basin is also an area of groundwater discharge from the alluvium to the Santa Clara River. The amount of flow into the river will depend largely on water levels within the alluvium. Groundwater also flows out of the Basin into Ventura County, but this occurs solely as underflow from groundwater present within relatively thin alluvium at the western basin boundary. The only other water to flow from the valley into Ventura County is via surface water flow along the Santa Clara River, including releases from Castaic Reservoir into Castaic Creek that flows into the Santa Clara River and WRP discharges to the river, and from direct discharge via an agricultural supply line operated by FivePoint, which is supplied via its alluvial wells at the western end of the valley.

4.2.2.2 Saugus Formation

Discharge from the Saugus Formation has historically occurred primarily through natural discharge into the Alluvial Aquifer on the western end of the basin and through pumping of the several municipal-supply water wells in the Saugus Formation that are situated throughout the central portion of the valley. At the time of this study, there are only a limited number of wells that extract groundwater from the Saugus Formation for agricultural-supply or landscape irrigation purposes. Saugus Formation wells currently in operation for irrigation purposes are located at Vista Valencia Golf Course and Valencia Country Club. Agricultural irrigation using groundwater pumped from the Saugus Formation also occurs at the Disney Company property in the southeastern portion of the groundwater basin, east of the Whitney Canyon fault. An additional natural discharge source occurs at the west end of the valley where Saugus Formation groundwater is considered to flow upward into the overlying alluvium in the western portion of the Saugus Formation (LSCE, 2003).

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5. Groundwater Conditions

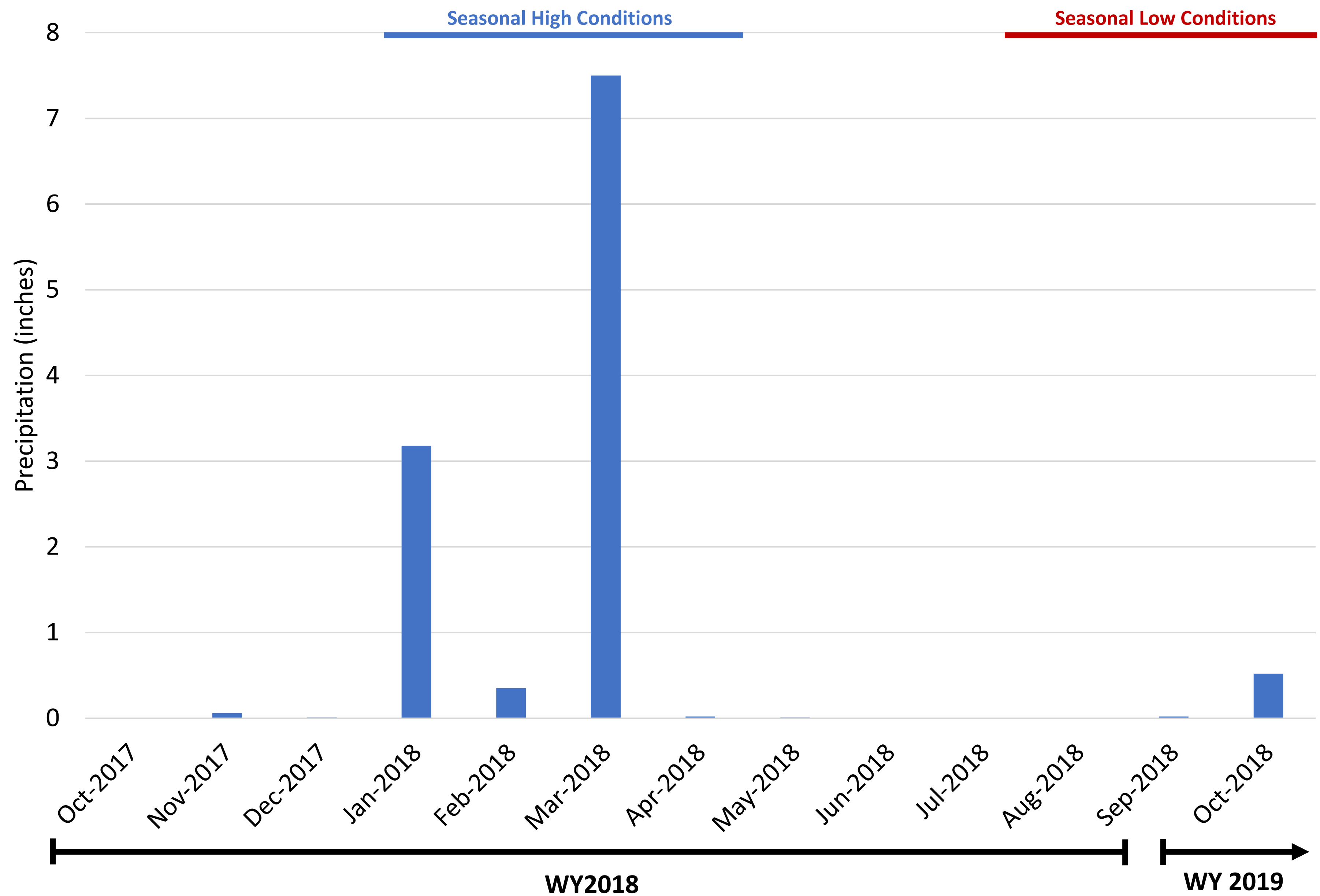
This section presents a description of groundwater conditions present in the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) and describes the hydrogeologic framework of the Basin. It is intended to provide a general understanding of the physical controls that influence the flow of groundwater and groundwater quality conditions and the interactions between groundwater and surface water in the Basin. This section focuses on the groundwater conditions portion of the hydrogeologic conceptual model. Following are the elements discussed:

- Groundwater occurrence, flow direction, horizontal and vertical gradient (Section 5.1)
- Groundwater-surface water interaction (Section 5.2)
- Groundwater dependent ecosystems (GDEs) (Section 5.3)

5.1 Groundwater Occurrence, Flow Direction, Horizontal and Vertical Gradient

The occurrence and movement of groundwater in the Basin are described in this section. Water level contours for seasonal high and seasonal low conditions for water year (WY) 2018 are presented as it is a year that had the most complete data set at the time this document was first drafted in early 2020. The water year refers to the 12-month period from October 1 through September 30 for any given year for which precipitation and surface water supply totals are measured (see Figure 5-1). Under the Sustainable Groundwater Management Act (SGMA), the California Department of Water Resources (DWR) requires that groundwater related data be represented as a WY rather than a calendar year or other year type.

Historically, seasonal high groundwater conditions occur in the winter and early spring between January and April. This time frame is generally associated with the least amount of groundwater pumping and the greatest amount of recharge from rainfall and streamflow. The greatest amount of precipitation in WY 2018 (October 2017 through September 2018) occurred in January (3.18 inches) and March (7.5 inches). Seasonal low conditions occur at the end of the water year following the summer and early fall which are associated with the least amount of recharge from precipitation and the greatest amount of groundwater pumping. Historical groundwater elevation data are presented in hydrographs for wells that are representative of conditions in each principal aquifer (refer to Appendix C, the *Hydrogeologic Conceptual Model: Groundwater Conditions in the Santa Clara River Valley Groundwater Basin, East Subbasin*; hydrographs are included in Appendix A of that report). There are two principal aquifers in the Basin: the Alluvial Aquifer and the Saugus Formation. The areal extent of each of these aquifers are presented in Figure 5-2 and described in the following sections. The areal extent of these aquifers has been generalized to conform to the DWR Bulletin 118 Basin boundary.



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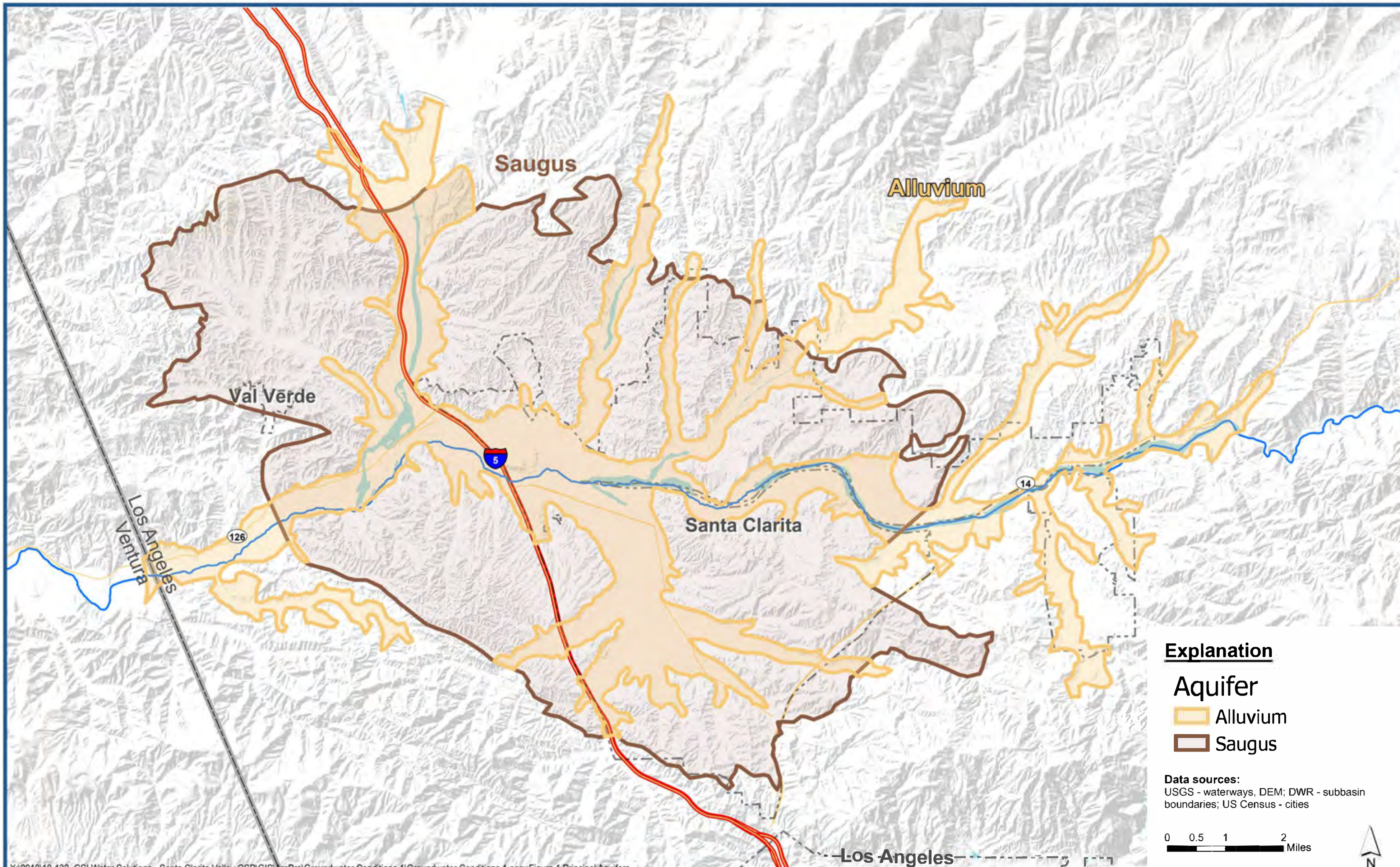
Water Year 2018 Calendar and Precipitation Totals (Newhall Water Division Gage)

Santa Clara River Valley East Subbasin Groundwater Sustainability Plan

Figure 5-1



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Santa Clara East Subbasin
Principal Aquifers

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-2

5.1.1 Alluvial Aquifer

5.1.1.1 Groundwater Occurrence

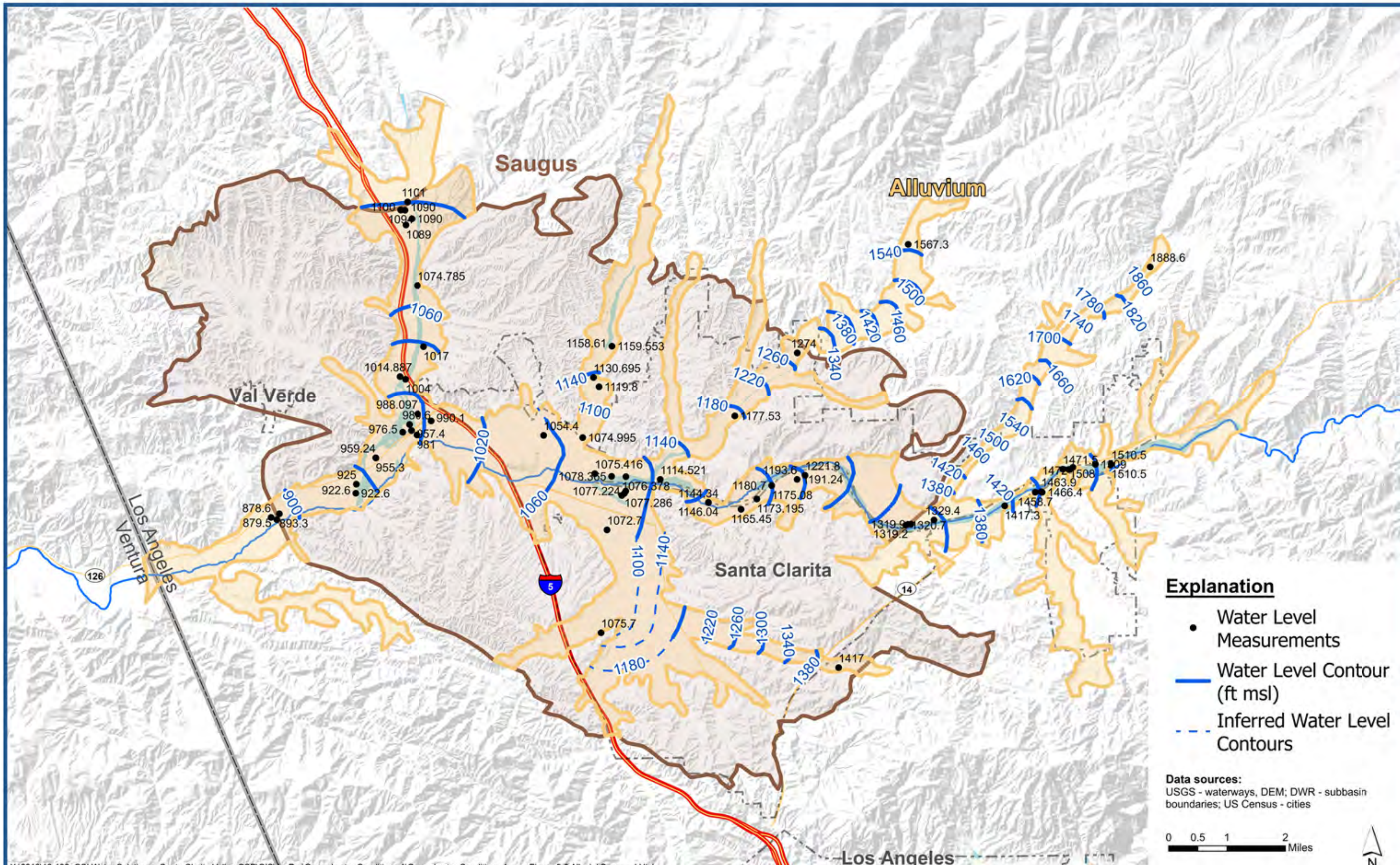
The Alluvial Aquifer is the uppermost principal aquifer in the Basin. Primary sources of recharge include precipitation, recharge from the Santa Clara River, recharge from the Saugus Formation, and mountain front recharge (LSCE, 2003). Sources of manmade recharge include infiltration of irrigation water, infiltration of stormwater runoff from urban areas, infiltration of surface flow and underflow from Castaic Dam, infiltration releases by the Los Angeles County Department of Public Works (LADPW) from its reservoir facilities in the San Francisquito and Bouquet Canyon area, and infiltration associated with discharges from the water reclamation plants (WRPs).

Discharge from the Alluvial Aquifer occurs through pumping of irrigation and municipal supply wells, discharge to the Santa Clara River in the western portion of the Basin, subsurface discharge to the neighboring Piru Basin to the west, and evapotranspiration (ET) by riparian vegetation. Discharge also occurs in the form of seepage to the underlying Saugus Formation.

5.1.1.2 Flow Direction - Water Level Contours

Figures 5-3 and 5-4 present water level contours for seasonal high and seasonal low conditions for 2018. Contours of equal groundwater elevations provide information on the elevation of groundwater in various parts of the Basin where the aquifer exists, and data is collected. Contour maps also provide information on the direction of groundwater flow. Groundwater flow is in the direction from high elevation to lower elevations and are perpendicular to the contour lines. The general pattern and orientation of the contours shown in Figures 5-3 and 5-4 are generally representative of historical conditions in the Basin, although the elevation values on the contour lines may change from year to year.

Under seasonal high conditions, groundwater depths range between 10 feet and 150 feet below ground surface (bgs) with groundwater elevations between 878 and 1,888 feet above mean sea level (msl) using the North American Vertical Datum 1988 (NAVD 88). Groundwater flow is toward the Santa Clara River on the flanks of the Basin and to the west in the lower portions of the valley along the Santa Clara River (see Figure 5-3). Under seasonal low conditions, groundwater depths range between 12 feet and 150 feet bgs with groundwater elevations between 877 and 1,887 feet msl. Contours are not shown where there is a lack of water level data. The groundwater flow directions in the seasonal low conditions are similar to seasonal high directions (see Figure 5-4). During both seasonal high and seasonal low conditions, the highest groundwater elevations occurred in the northeastern part of the Basin and the lowest occurred in the southwest part of the Basin. For WY 2018, there was minimal variation between seasonal high and seasonal low groundwater conditions. Groundwater flow conditions based on 2018 data are consistent with the observation of Richard C. Slade & Associates LLC (RCS 1986) and with water level contours presented in the Salt and Nutrient Management Plan for 2016 (GSSI, 2016).



Water Year 2018 Seasonal High Water Level Contours - Alluvial Aquifer

Figure 5-3

Santa Clara River Valley East Subbasin Groundwater Sustainability Plan

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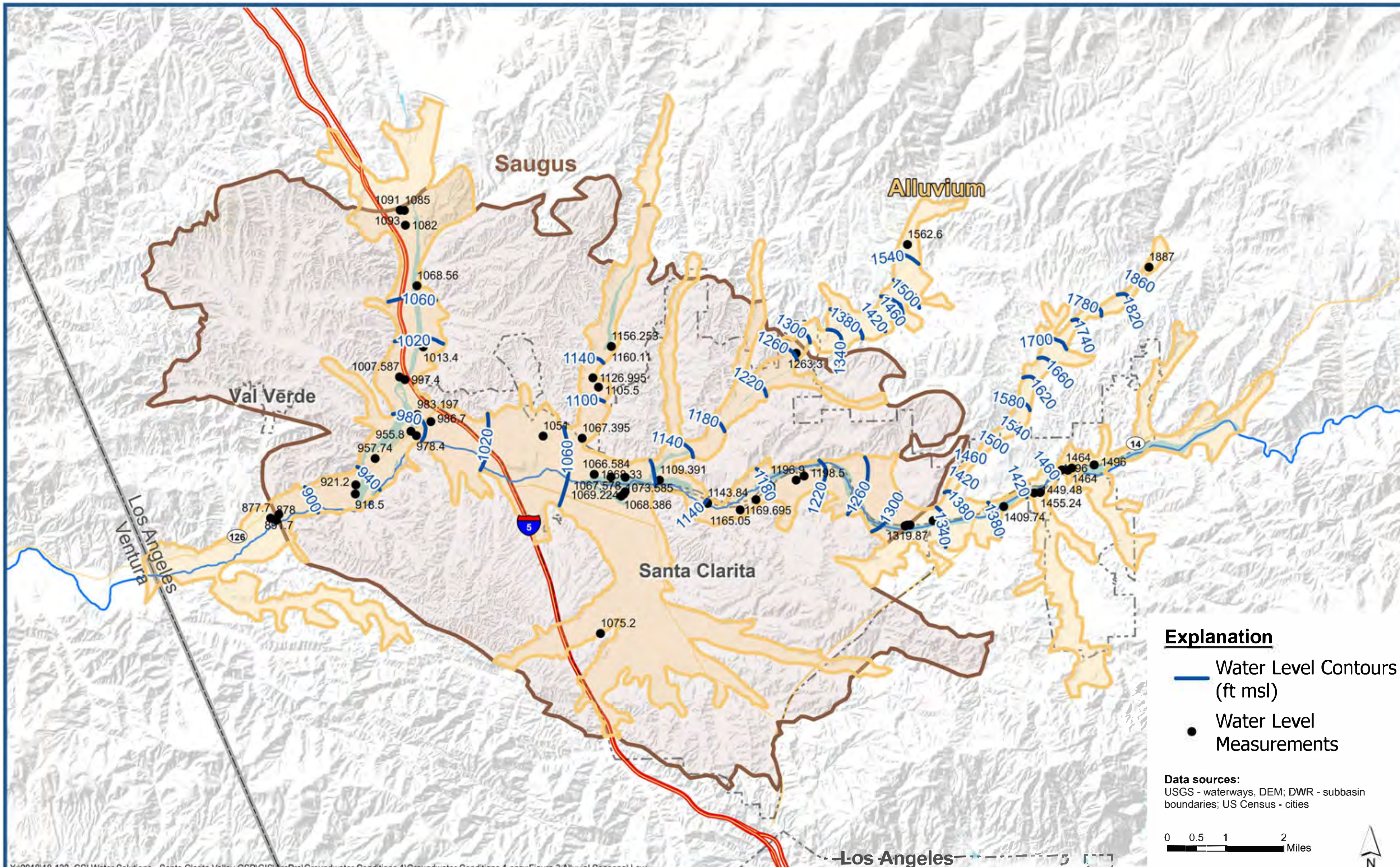

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Water Year 2018 Seasonal Low
Water Level Contours - Alluvial Aquifer

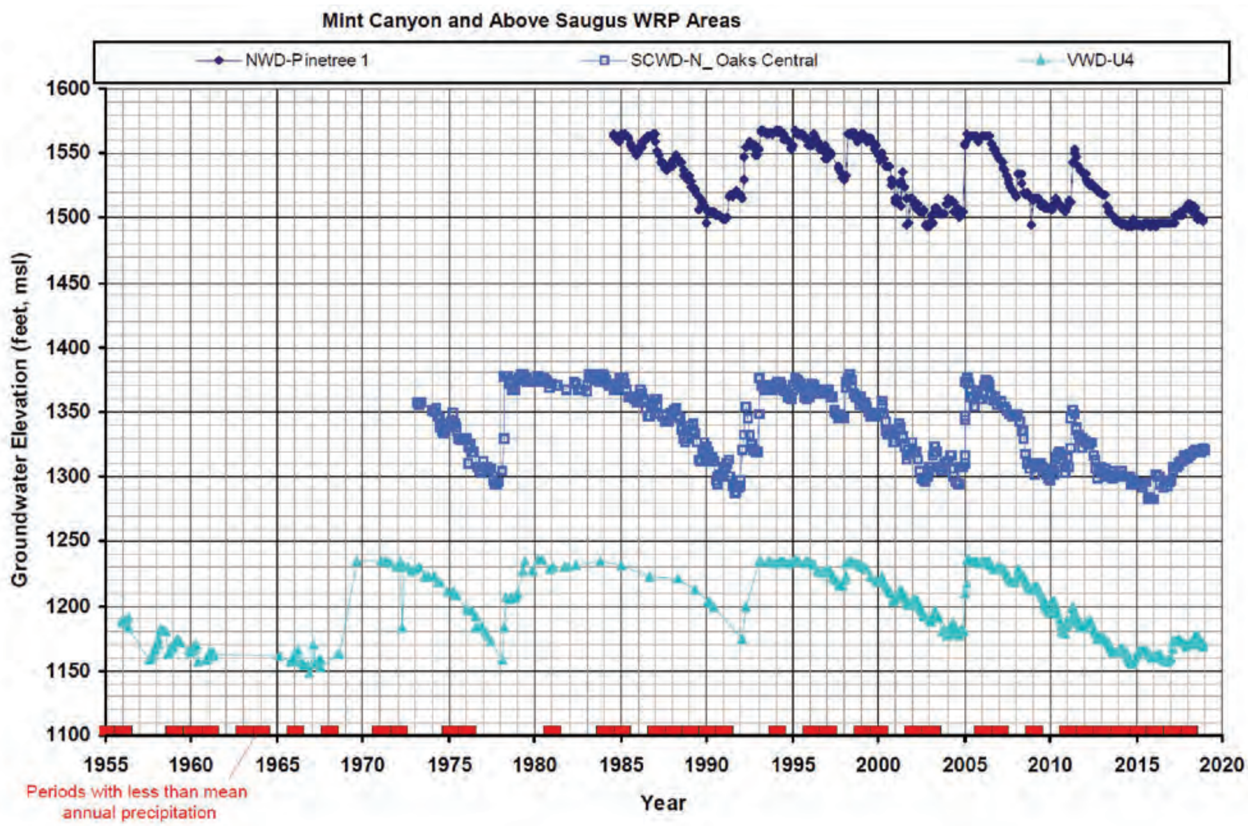
Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

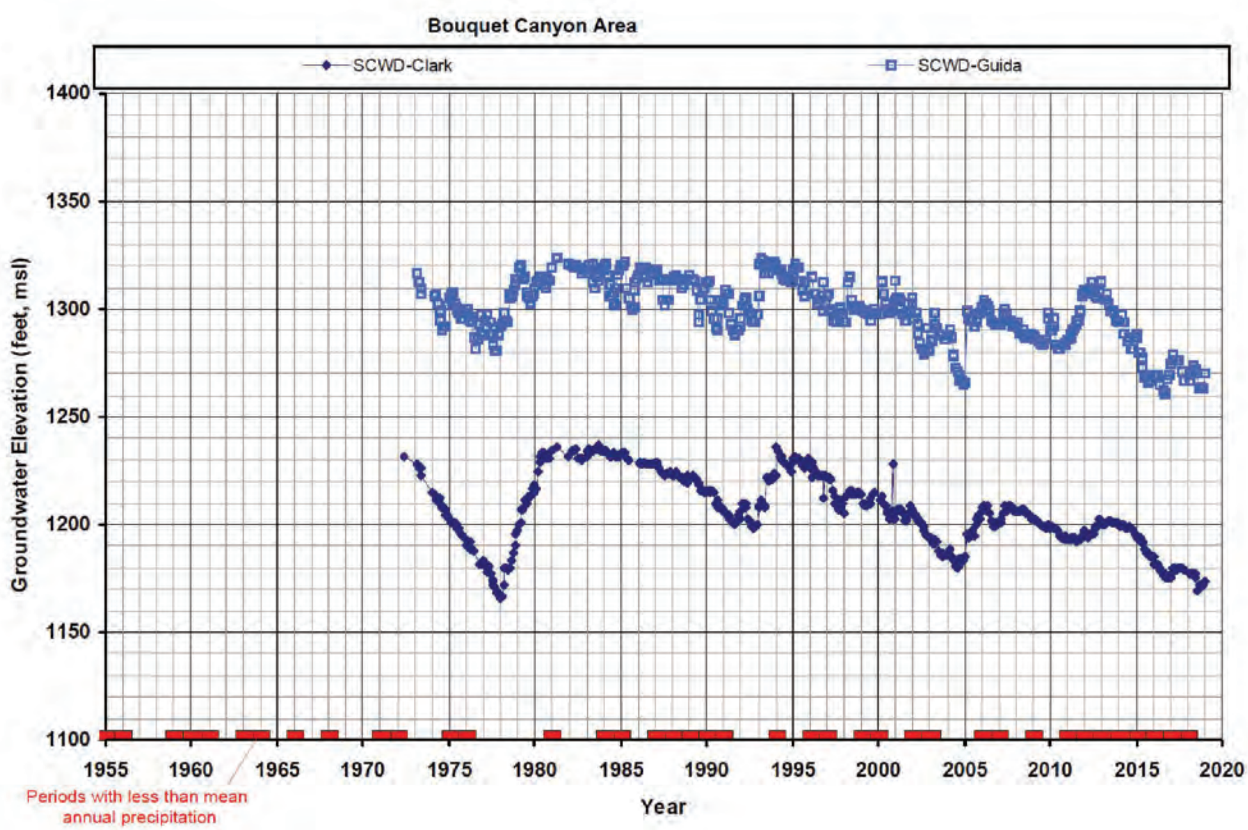
Figure 5-4

5.1.1.3 Water Level Hydrographs

Historical water level trends for wells in the subareas of the Basin that represent groundwater levels in those subareas are presented in Figures 5-5 and 5-6. The wells presented in these hydrographs are located in different areas of the Basin and represent groundwater levels in the Alluvial Aquifer in those areas (see Figure 5-7). Figure 5-5 includes wells in the eastern part of the Basin (Mint Canyon, Santa Clara River area above Saugus WRP, and Bouquet Canyon) where water levels are heavily influenced by climatic conditions and seasonal pumping. Wells in the Mint Canyon area and Santa Clara River area above the Saugus WRP all exhibit a similar pattern of gradual declines over 5- to 10-year periods when there are below normal periods of rainfall, followed by rapid recoveries during wet periods. Generally, one to two consecutive wet years can provide enough recharge to replenish the Alluvial Aquifer in the eastern areas of the Basin. Wells in the eastern portion of the Basin have shown substantially lower water levels during extended drought periods (e.g., 2006–2019), causing a reduction in well production in this area. Since 2006, the Basin has experienced a long-term dry period interrupted by a wet year in 2011 and 2017. Over the past 10 years, the average seasonal variation between high and low conditions in the Mint Canyon and above Saugus WRP area was approximately 16 feet. This small amount of variation is due primarily to a lack of recharge and the effect depressed groundwater levels in this area have had on minimizing groundwater production. Over multi-year drought periods, water levels can decline by as much as 70 feet, which occurred in the Santa Clarita Water Division (formerly Santa Clarita Water Company) (SCWD)-North Oaks Central from 2011 through 2016. Wells in the Bouquet Canyon area show a less rapid decline and recovery. Declines in groundwater levels during extended dry periods is not an indication of overdraft, which is why it is important to look at a long-term period of time that represents average annual climatic conditions. With this in mind, over the past 30 years, these wells have exhibited stable water levels with periods of rising levels during wet periods and declining water levels during droughts. Over the past 10 years, the average seasonal variation in water levels was approximately 10 feet.

Figure 5-6 represents the historical groundwater levels measured in wells located in the western part of the Basin (San Francisquito Canyon, Santa Clara River below Saugus WRP, Castaic Valley, and below Valencia WRP). Groundwater levels in the western part of the Basin exhibit similar trends to those in the eastern portion of the Basin (San Francisquito and below Saugus WRP) VWD-W11, VWD-9, VWD-Q2, and NLF-W5. However, the magnitude of water level declines during periods of reduced rainfall are significantly less due to the recharge from the two WRPs and the upward vertical gradient from the Saugus Formation into the Alluvial Aquifer. This influence is indicated in the hydrograph for well VWD-I. Since 2010, the average variation between seasonal high and seasonal low water levels was approximately 10 feet. Over drought periods, depth to water has ranged between 20 and 50 feet as exhibited in VWD-I and VWD-W11 from 2011 through 2016, respectively. All the Alluvial Aquifer wells completed in the Castaic Creek drainage and the western portion of the Basin below the Valencia WRP along the Santa Clara River remained stable over various hydrologic wet and dry periods. Since 2010, the average variation between seasonal high and low water levels on average is approximately 9 feet, similar to other areas of the Basin in the Alluvial Aquifer. Over drought periods, water levels have declined by as much as 40 feet as exhibited in VWD-D from 2011 through 2016. Other wells, such as NLF-B10 and NLF-B4, have shown almost no change in water levels over dry periods. Refer to Appendix C, the *Hydrogeologic Conceptual Model: Groundwater Conditions in the Santa Clara River Valley Groundwater Basin, East Subbasin* (Appendix A of that report) for hydrographs of historical groundwater elevations for all Alluvial Aquifer wells having long-term monitoring data.





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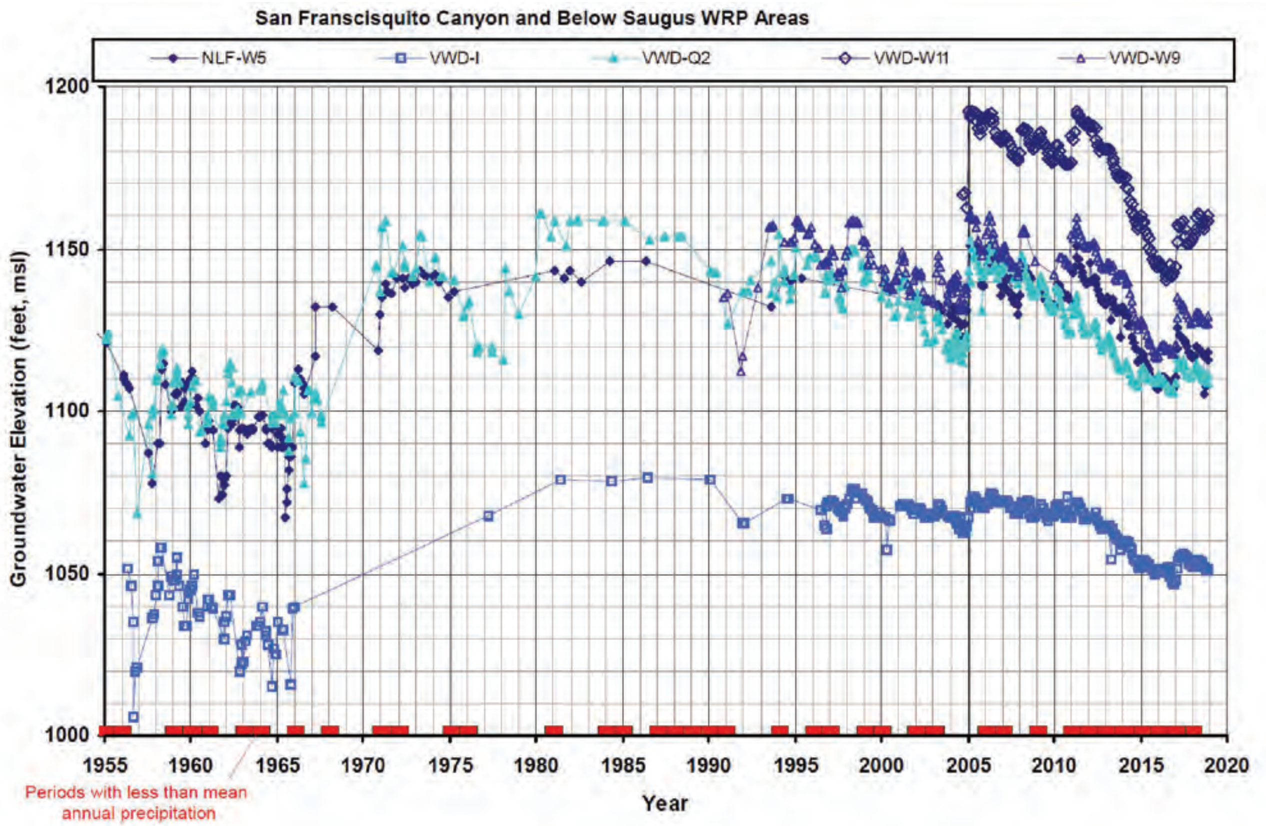
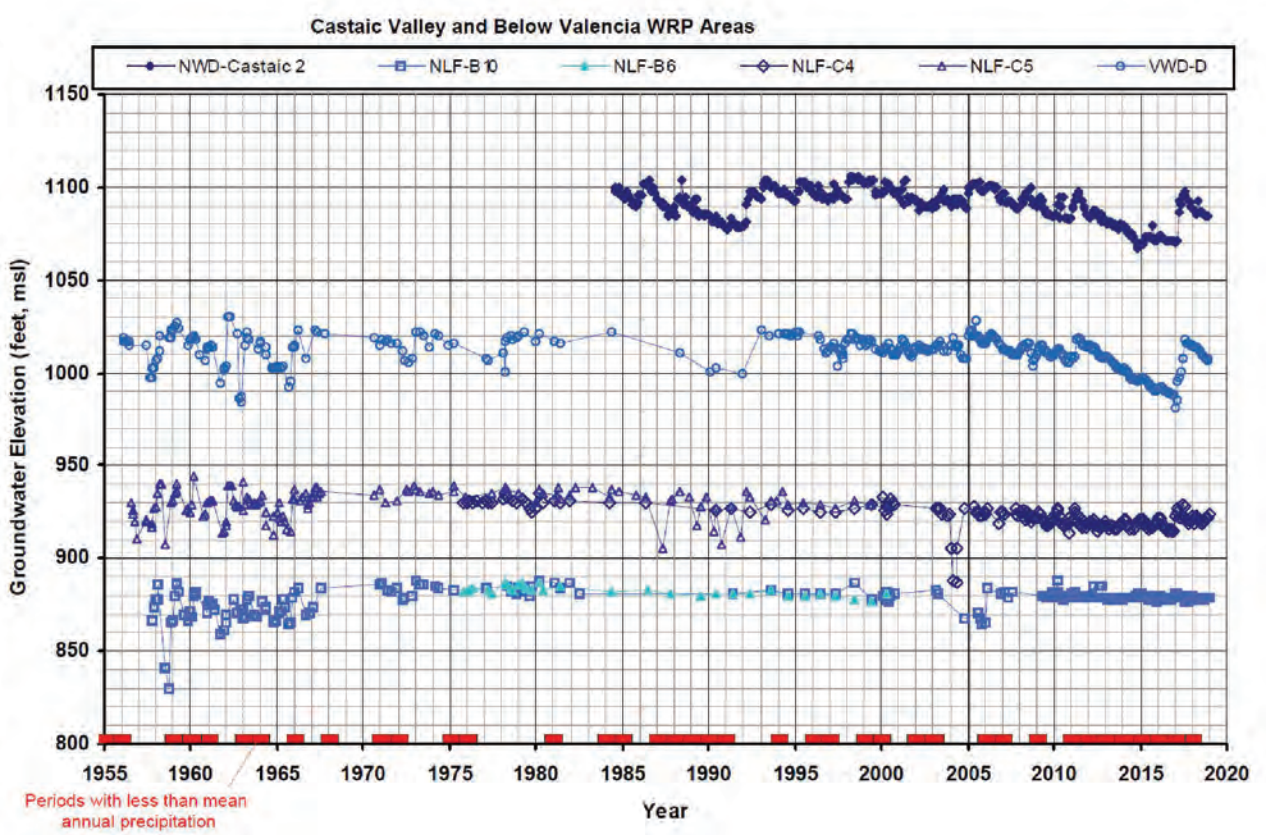
Groundwater Elevations in Eastern Santa Clarita Valley Alluvial Wells

Santa Clara River Valley East Subbasin
Santa Clarita Valley, Los Angeles County, California

Figure 5-5





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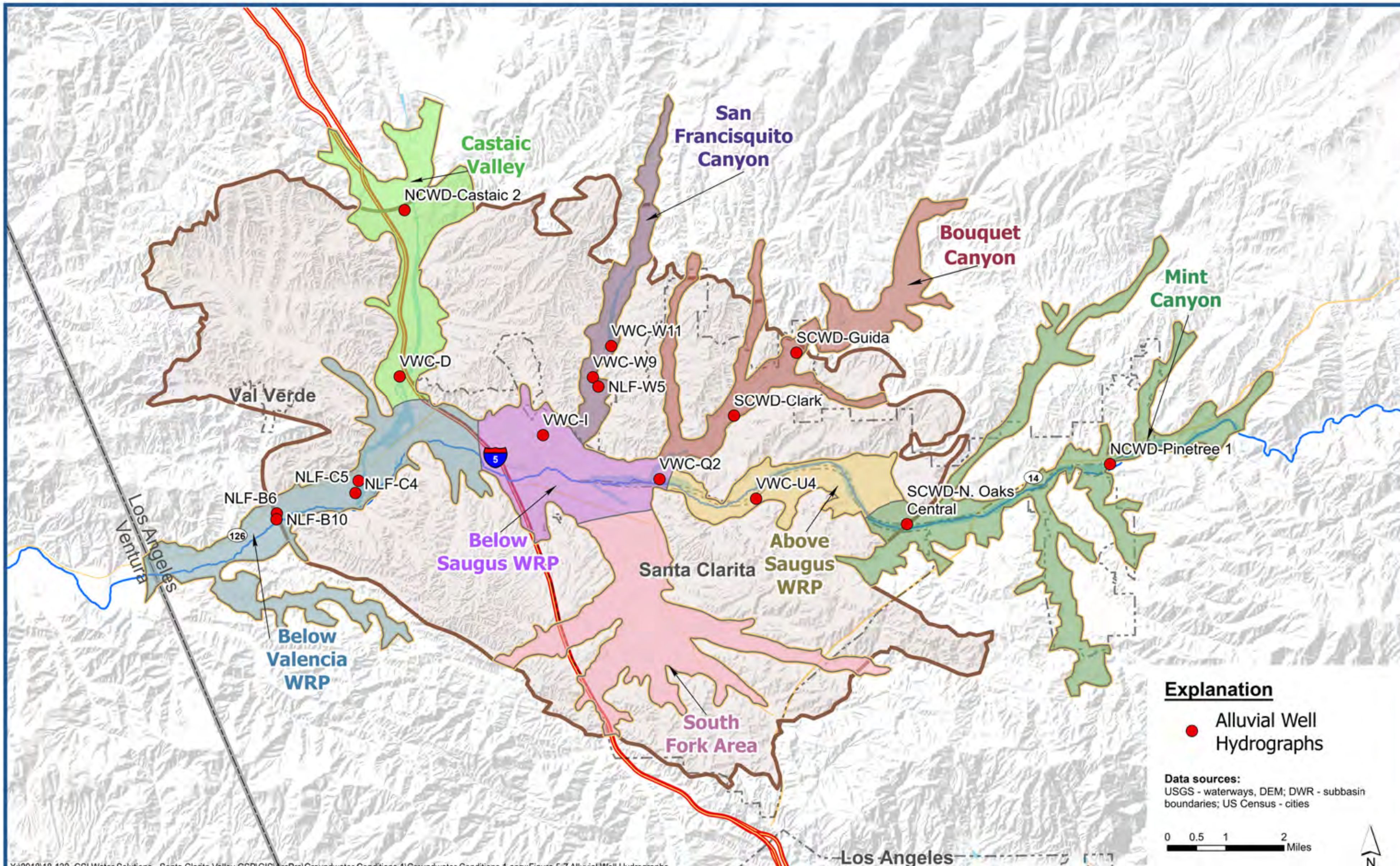
Groundwater Elevations in Western Santa Clarita Valley Alluvial Wells

Santa Clarita Valley Water Report
Santa Clarita Valley, Los Angeles County, California

Figure 5-6



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Alluvial Well Hydrographs

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-7

5.1.2 Saugus Formation Aquifer

5.1.2.1 Groundwater Occurrence

The Saugus Formation Aquifer underlies the Alluvial Aquifer and is present throughout the entire Basin, unlike the Alluvial Aquifer. The Saugus Formation can be further subdivided into two units. The upper portion, which is up to 5,000 feet thick and consists of coarse-grained sand and gravel beds, contains the majority of the accessible groundwater. The lower portion, known as the Sunshine Ranch Member, is up to 3,500 feet thick and is composed of fine-grained sediments with low permeability. The Sunshine Ranch Member does not provide groundwater in sufficient quantity or adequate quality for municipal use (RCS, 2002). Generally, the upper 1,000 to 2,000 feet of the upper portion of the Saugus Formation is utilized for municipal groundwater production. The underlying 3,000 feet is not utilized for municipal supply.

The primary sources of recharge to the Saugus Formation include percolation from the Alluvial Aquifer (particularly on the east end of the Basin), direct recharge from precipitation, and inflow from outside the Basin (LSCE, 2003). Discharge from the Saugus Formation is primarily from groundwater extraction and flow to the Alluvial Aquifer in the western portion of the Basin (CH2M HILL, 2004).

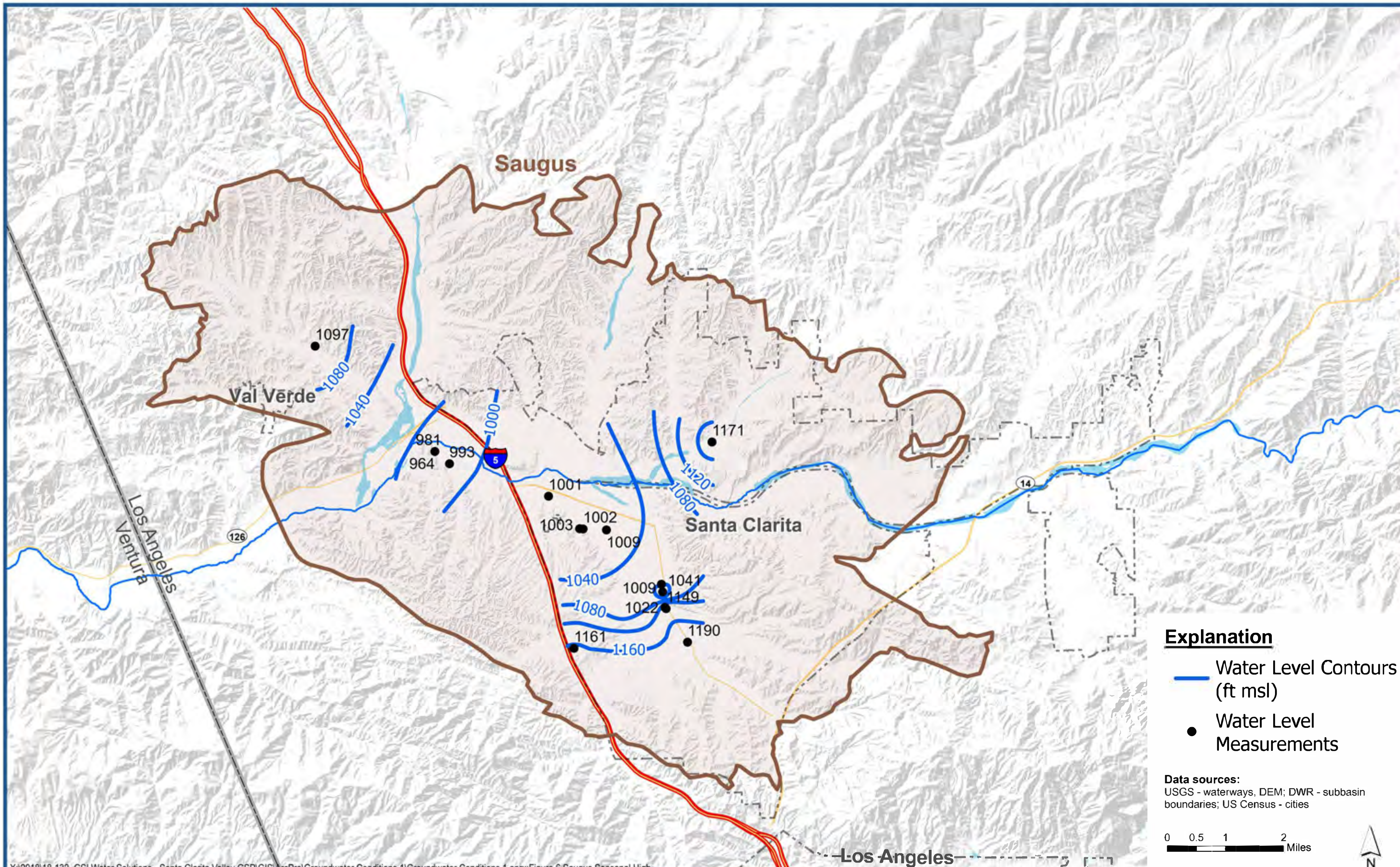
5.1.2.2 Flow Direction - Water Level Contours

Under seasonal high conditions, groundwater depths range between 50 and 185 feet bgs with groundwater elevations ranging between 964 and 1,190 feet msl (see Figure 5-8). Water level measurements across the Saugus Formation are limited due to the lack of wells in many areas of the Basin where the Saugus Formation is present. However, utilizing available data, the general groundwater flow direction is predominantly east to west toward Interstate 5 (I-5). West of I-5, data are limited; however, the direction of flow in this part of the Basin is thought, based upon groundwater modeling results, to be generally westerly toward where the Saugus Formation naturally discharges to the alluvium. As shown on Figure 5-8, there also appears to be a component of flow from the northwest to southeast, perhaps toward major production wells in the central part of the Basin. During seasonal low conditions, groundwater depths range between 50 and 217 feet bgs and groundwater elevations range between 956 and 1,192 feet msl (see Figure 5-9). The direction of flow during seasonal low conditions is similar to seasonal high directions. Groundwater flow conditions based on 2018 water level measurements are similar to the contours presented for the fall 2000 in CH2M HILL, 2004.

5.1.2.3 Water Level Hydrographs

Historical water level trends for selected Saugus Formation wells are presented in Figure 5-10 and well locations are illustrated in Figure 5-11. The spatial extent and availability of groundwater level data for the Saugus Formation is limited to two areas (South and Central/West). Groundwater elevation data extends to the mid-1960s in only one well. VWD-160 shows a trend of gradual rising and falling groundwater elevations in response to wet and dry periods with historical highs occurring in the mid-1980s. Two dry periods that occurred in the early 1990s and from the mid-2000s to 2019, resulted in groundwater levels declines of approximately 100 feet. Following the first dry period, groundwater levels recovered, however full recovery from the most recent dry period has not occurred by 2019 as the Basin has been in an extended dry period since 2006, with the exception of 2011.

All the Saugus Formation wells show this general trend. The downward trend in the most recent dry period was a result of lower amounts of recharge rather than from an increase in groundwater extractions from the Saugus Formation. In recent years in the South Area groundwater levels have shown an upward trend (NWD-12 and VWD-159) due to increased rainfall since 2016 as compared to prior years. Since 2010, the average variation between seasonal high and seasonal low water levels in the south area was approximately 18 feet, and the average variation in the central/west area was approximately 16 feet. All available historical water level data for Saugus Formation wells are included in Appendix C, the *Hydrogeologic Conceptual Model: Groundwater Conditions in the Santa Clara River Valley Groundwater Basin, East Subbasin* (Appendix A of that report).



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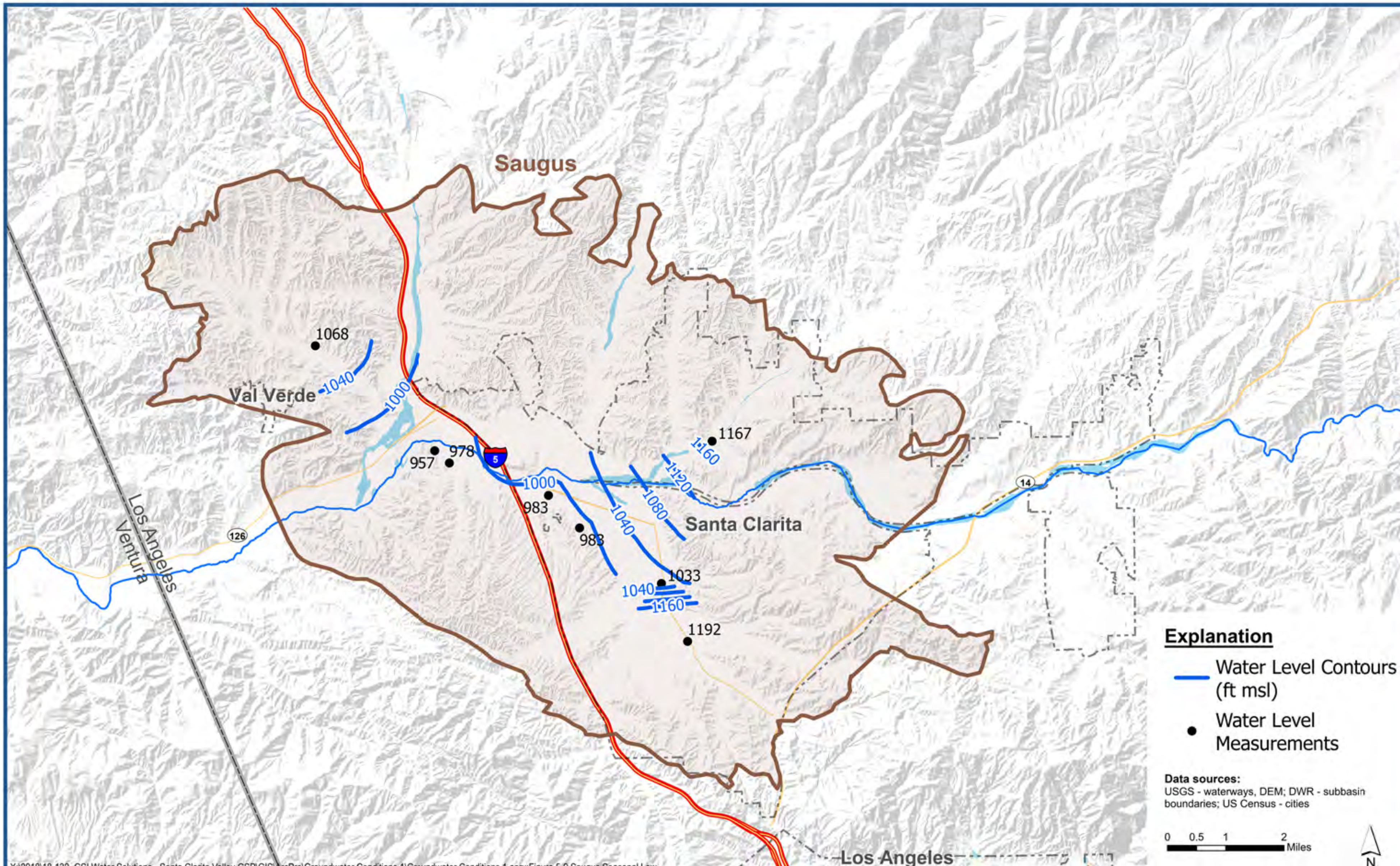
Water Year 2018 Seasonal High
Water Level Contours - Saugus Formation Aquifer

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-8



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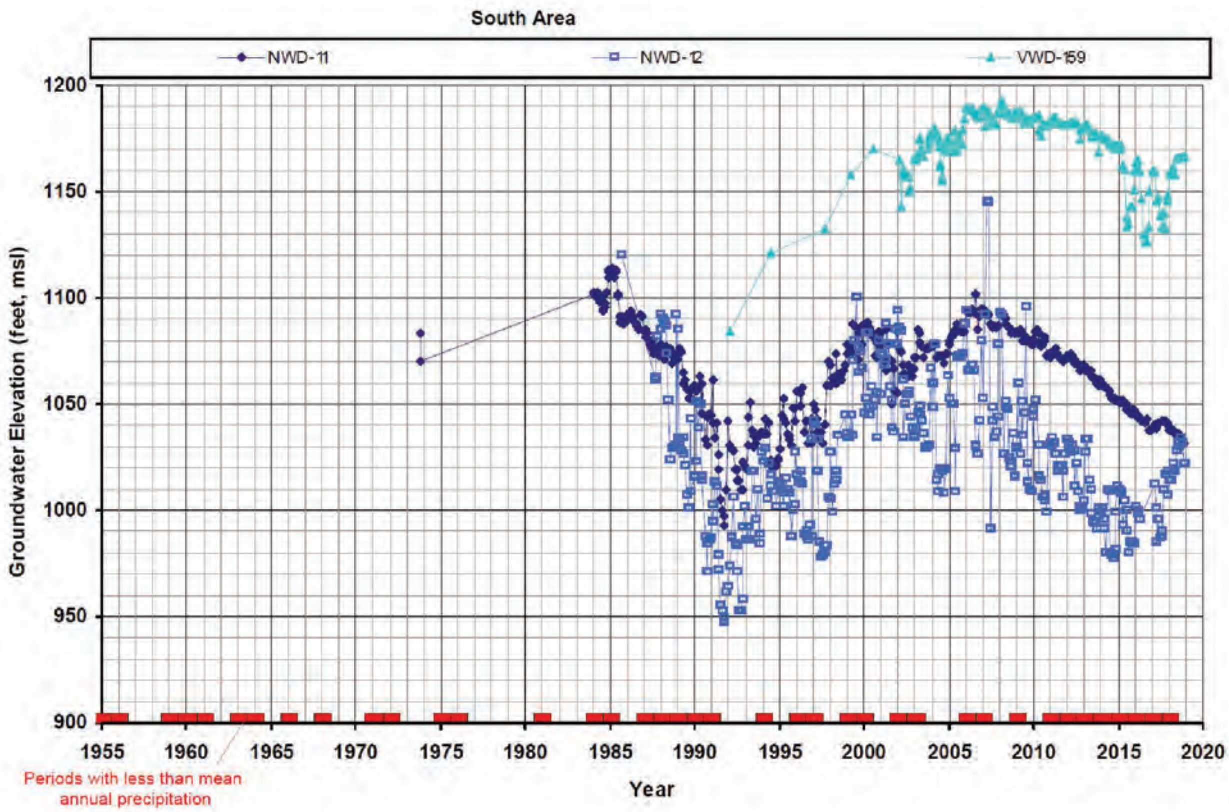
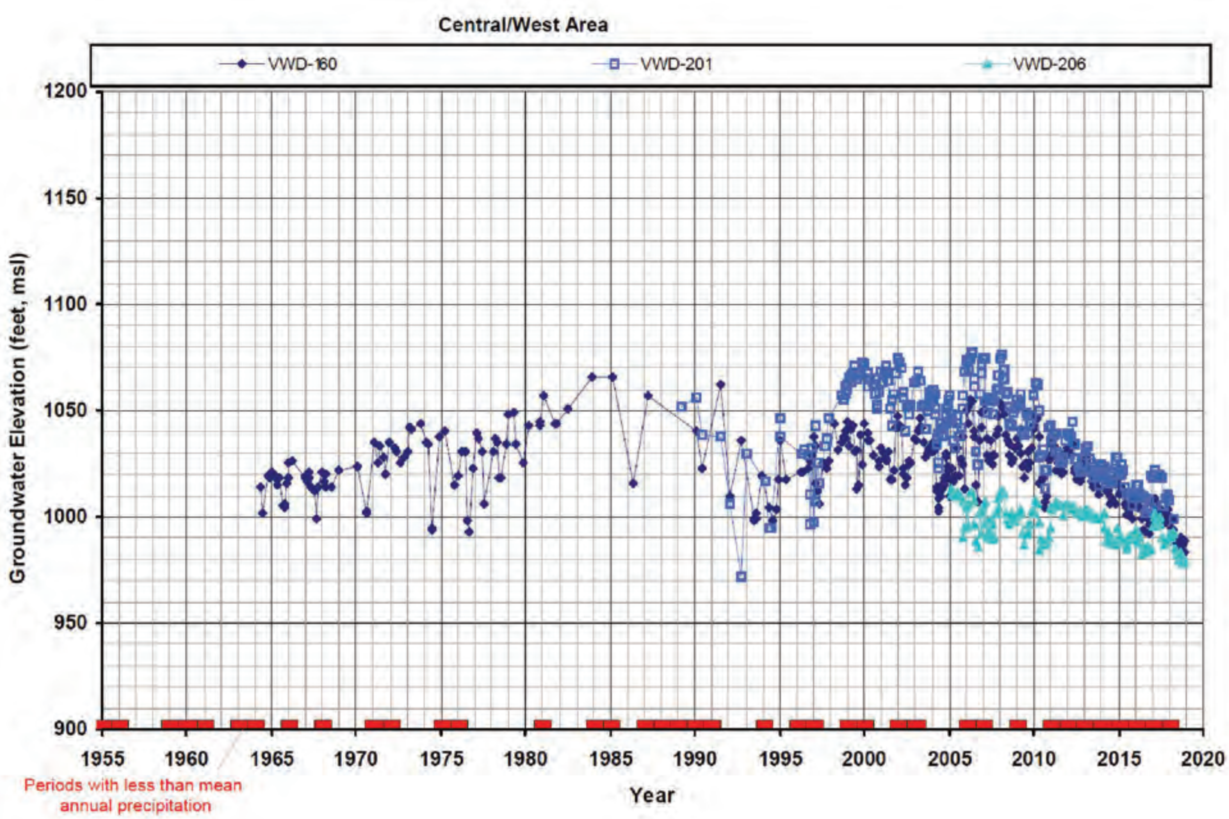
Water Year 2018 Seasonal Low
Water Level Contours - Saugus Formation Aquifer

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-9





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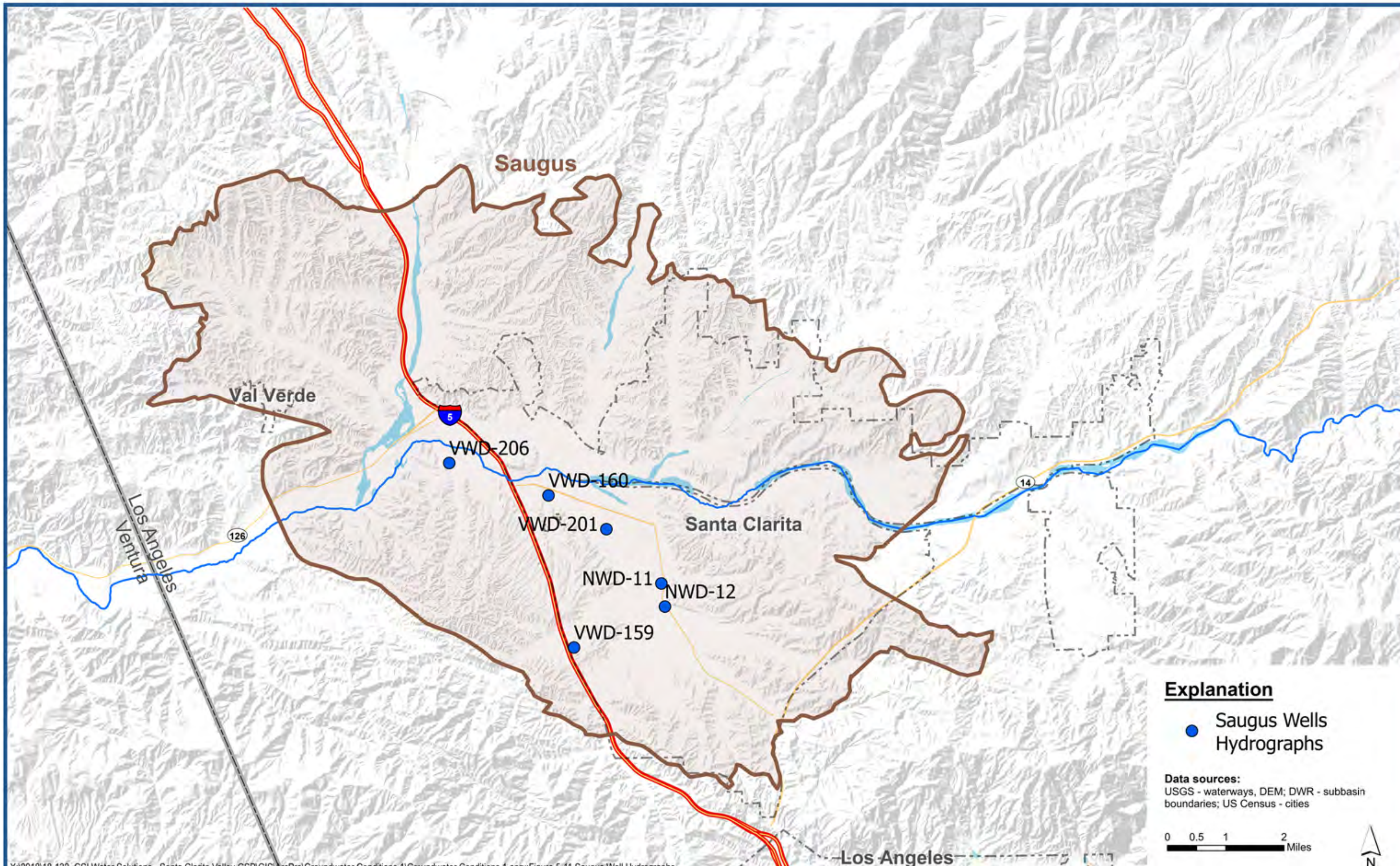
Groundwater Elevations in Saugus Wells

Santa Clara River East Subbasin Groundwater Sustainability Plan

Figure 5-10



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Saugus Well Hydrographs

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-11

5.1.3 Horizontal Gradient

5.1.3.1 Alluvial Aquifer

The horizontal hydraulic gradient is as high as 0.018 foot per foot (ft/ft) (95 feet per mile [ft/mile]) in eastern portions of the Basin in the Mint Canyon area and as low as 0.005 ft/ft (29 ft/mile) in the west along the Santa Clara River (see Figure 5-3). Under seasonal low conditions, the gradient in the east is the same as seasonal high conditions at approximately 0.018 ft/ft (95 ft/mile), but with a slightly steeper gradient in the west at 0.006 ft/ft (31 ft/mile) (see Figure 5-4).

5.1.3.2 Saugus Formation

Under seasonal high conditions, the horizontal hydraulic gradient is approximately 0.008 ft/ft (42 ft/mile) (see Figure 5-8). Under seasonal low conditions, the hydraulic gradient is approximately 0.007 ft/ft (35 ft/mile) (see Figure 5-9). Gradient values are based on groundwater flow from east to west. In the western portion of the Basin where the groundwater flow directions are northwest to southeast in the area east of I-5, there was insufficient data to calculate a horizontal flow gradient.

5.1.4 Vertical Gradient Between Principal Aquifers

The vertical gradient between the Alluvial Aquifer and Saugus Formation is the mechanism to assess flow between the two aquifers. Vertical gradients or flow can be either in an upward or downward direction. For example, if the water level in the Alluvial Aquifer is higher than the water level in the Saugus Formation at a particular location, there is the potential for groundwater to move vertically from the Alluvial Aquifer to the Saugus Formation. The reverse can also occur in areas where groundwater elevations in the Saugus Formation are higher than those in the Alluvial Aquifer. The magnitude and direction of vertical gradients were determined based on the average seasonal high-water level since 2010 at two locations in the Basin where groundwater level data from Saugus Formation wells is generally available along with nearby wells screened in the Alluvial Aquifer. The average vertical gradient was determined in the vicinity of Saugus well VWD-201 located in the south area, and at the Saugus well VWD-207 area located in the western portion of the Basin. Results are presented in Table 5-1. The negative value in the South area indicates a downward gradient (i.e., groundwater elevations in the Alluvial Aquifer at this location are higher than groundwater elevations measured in the Saugus Formation). The positive values indicate an upward gradient from the Saugus Formation to the Alluvial Aquifer. These estimates are based on available groundwater level measurements in both aquifers.

Table 5-1. Approximate Aquifer Vertical Gradient

Basin Area	Aquifer – Seasonal Condition	Average GWE	Gradient (ft/ft)
South Area	Alluvial – All VWD Monitor Wells	1079	-0.04
	Saugus – VWD-201	1024	
Western Area	Alluvial – VWD-E14	983	0.003
	Saugus – VWD-207	984	

Notes

ft/ft = foot per foot GWE = groundwater elevation
VWD = Valencia Water Division (formerly Valencia Water Company)

5.1.5 Change in Groundwater Storage

Change in groundwater storage can be estimated using groundwater elevation data from successive seasonal high periods; or using water budget results from a groundwater flow model. The change in storage of water using the change in water level approach is a function of aquifer storage coefficients, amount of water level change, and areal extent of water level changes. A change in storage calculation using the water budget approach calculates the difference between recharge and discharge terms. The water budget approach using the Basin groundwater model is used in this Groundwater Sustainability Plan (GSP) for each of the principal aquifers when it is available. The groundwater flow model will calculate the change in groundwater storage for the historical, current, and projected water budget periods.

5.1.6 Subsidence

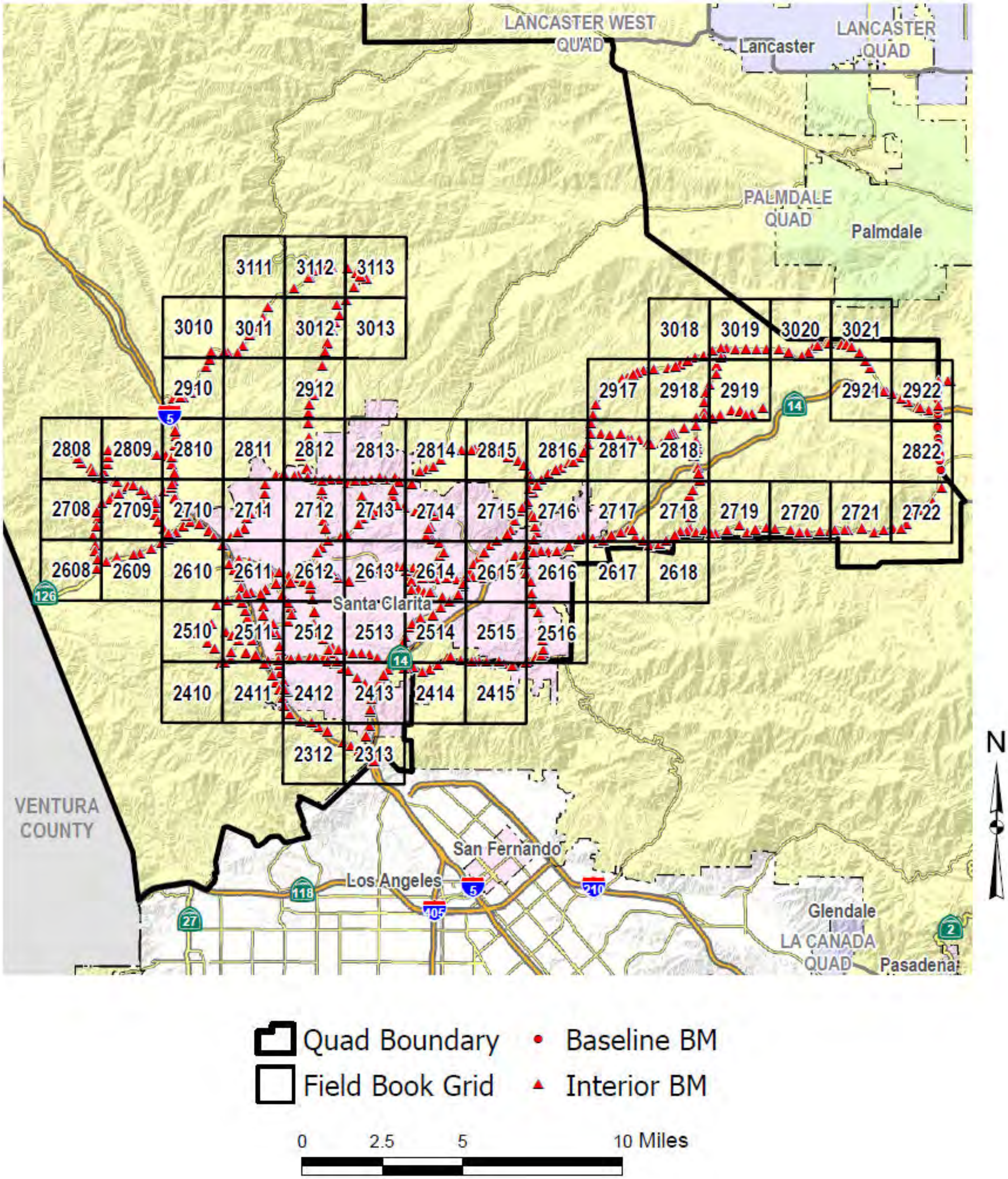
This section presents a summary of the available information pertaining to subsidence in the Basin. A more detailed discussion can be found in Appendix C (LSCE Subsidence TM, 2021). According to the U.S. Geological Survey (USGS), land subsidence is a phenomenon found across the United States, affecting the land surface of over 17,000 square miles in 45 states (Galloway et al., 1999). Land subsidence in California is commonly a result of fluid withdrawal (oil or groundwater). The principal causes of land subsidence are aquifer system compaction (caused by reduction in hydraulic head affecting the physical structure and orientation of clay minerals and drainage of organic soils. Subsidence can occur in two forms, elastic and inelastic (or permanent). Generally, subsidence occurs on a seasonal basis. When groundwater pumping occurs and groundwater levels decline, the land surface can subside. When groundwater levels recover following wetter conditions and reduced groundwater pumping, the land surface can recover, similar to compressing and releasing a spring. The amount that the ground surface subsides and subsequently "springs back" is considered elastic subsidence. This cycle occurs every year and is common everywhere there are seasonal variations in groundwater levels. Conversely, the amount of decline in the ground surface elevation that remains regardless of groundwater level recovery is considered to be inelastic subsidence. Under SGMA, only inelastic subsidence is to be evaluated in this GSP. For inelastic subsidence to occur in an area, that area generally requires two primary conditions. One is to have wells screened in aquifers that contain substantial amounts of clay within the depth interval that the well is constructed. The second condition is that there needs to be a multi-year period during which groundwater levels in the aquifer are at elevations below historical low levels in that area of the Basin. If both conditions do not occur, then inelastic subsidence related to groundwater pumping is unlikely to occur in appreciable quantities to impact critical infrastructure. Short term declines in groundwater levels over one or two years likely will not result in significant amounts of inelastic subsidence and impacts to infrastructure. This is based on data collected areas in the San Joaquin Valley that have experienced significant amounts of subsidence and where there have been significant investments in subsidence monitoring networks.

As mentioned above, when discussing the potential for inelastic land subsidence in any area, it is important to consider the type of subsurface materials that could contribute to subsidence combined with well construction data, pumping records and groundwater level measurements through a multi-year period of record. As described above, the upper portion of the Saugus Formation generally consists of sands and gravels, while the Sunshine Ranch member is composed primarily of fine-grained materials. However, the upper portion of the Saugus Formation, in some but not all areas where there are current wells, contains lenses of silt and clay, which are located within the depth interval that some Saugus Formation wells are perforated and extract groundwater. However, based on an evaluation of existing geologic data for Saugus Formation wells, these materials are not laterally continuous. In addition, the Saugus Formation has not been pumped significantly to cause extended periods of groundwater level declines and there has been no evidence that groundwater pumping-induced subsidence has occurred. Through the last 19 years of reviewing and reporting on the geology and water resources in the Basin, there has not been evidence of chronic groundwater level declines in areas with Saugus Formation geology with silts and clays within the screened intervals of municipal supply wells that would contribute to subsidence (LSCE, 2017).

5.1.6.1 Subsidence Data Sources

There are three sources of information on subsidence in the region. These sources include benchmark survey data from LADPW from a comprehensive network of benchmarks located throughout the County of Los Angeles (LA County). Unfortunately, LADPW provides general benchmark locations on maps, but exact coordinate information is not available at this time. The second source of data is from the Department of Water Resources SGMA Data viewer. The TRE Altamira InSAR Dataset contains vertical displacement data from 2015 through September 2019. These data were collected by the European Space Agency Sentinel-1A satellite and processed by TRE Altamira. The data set covers more than 200 groundwater basins across the state at a resolution of approximately 100 square meters. The third source of data involves land surface elevation monitored at two continuous global positioning system (CGPS) sites, one located in the Basin north of the Santa Clara River (station SKYB) and the other outside the Basin to the north just east of I-5 (station CTDM) as shown in Figure 5-12. The data from these two stations are reported by UNAVCO from its Data Archive Interface (http://www.unavco.org/data/data.html). Data collection has been ongoing since the early 2000s with daily measurements.

The LACDPW has a network of over one hundred benchmarks in the Basin as part of a larger survey network in LA County (http://dpw.lacounty.gov/sur/BenchMark/). LACDPW reportedly surveys these benchmarks approximately every 6 years. The last survey in the Basin was conducted in 2018 and the surveys began in the 1950s and 1960s; however, prior to the 1995 survey, the vertical datum was NGVD27 and not NAVD 88. The NGVD27 and NAVD 88 referenced data cannot be compared without conducting a complex conversion. These benchmarks could be utilized as part of a subsidence monitoring network, pending LACDPW approval. These benchmarks are located in the “Newhall Quad.” The index of benchmarks contained in this quad is depicted in Figure 5-12 and the benchmarks are listed in Table 5-2. Land surface elevation data from these benchmarks that were measured using the NAVD 88 vertical datum required by DWR, date back to 1995. Benchmark measurements reflect a basic accuracy of ± 0.017 feet. Between 1995 and 2018, the total elevation decline of benchmarks located in the south/central area of the Basin in the vicinity of wells Saugus 1, Saugus 2, V201, and V205 ranged between 0.01 to 0.17 feet. West of these wells near wells V206 and V207 and south near well NCWD Saugus Formation wells, the total elevation decline over 1995 and 2018 ranged between 0.08 to 0.15 feet. These represent slight declines that average about 0.004 feet/year over this 24-year period. Groundwater elevations in the Saugus Formation historically have been most depressed in the early 1990s which corresponded to the highest amount of pumping form the Saugus Formation. The 1995 data set was collected by LACDPW about 1 or 2 years after the peak decline in groundwater levels. Due to experience in evaluation of subsidence occurrence in the San Joaquin Valley during short-term dry periods with high amounts of groundwater pumping (1 to 2 years in length), the amount of inelastic subsidence is dependent on local conditions and often include large proportions of elastic subsidence. Following the early 1990s when Saugus Formation pumping reached peak levels, groundwater pumping has not reached those levels. The yearly rate of subsidence that occurred between 1995 and 2018 was 0.0008 feet per year given the maximum subsidence of -0.179 feet. That rate is within the accuracy of the benchmark surveying equipment and is negligible. In the central and western areas, it not clear whether the measured declines in land surface elevation are caused by groundwater extraction, time of year measurements, or tectonics (given the proximity of the San Gabriel Fault).



Data sources:
LA County Department of Public Works

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Newhall Quad Benchmark Index

Santa Clarita Valley Water Report
Santa Clarita Valley, Los Angeles County, California

Figure 5-12

Table 5-2. Benchmark Elevation Data

Basin Area	Nearby Well	Benchmark	Year	Elevation (ft, NAVD 88)	Total Elevation Change 1995—2018 (ft)
Southern Saugus	VWD-206	1947	1995	1,059.463	-0.082
			2009	1,059.359	
			2018	1,059.381	
		1948	1995	1,034.371	-0.092
			2009	1,034.287	
			2018	1,034.279	
		5210	1995	1,061.530	-0.097
			2009	1,061.448	
			2018	1,061.433	
		5402	1995	1,031.950	-0.126
			2009	1,031.831	
			2018	1,031.824	
		7104	1995	No Data	No Data
			2009	1,047.77	
			2018	1,047.76	
		7106	1995	No Data	No Data
			2009	1,043.68	
			2018	1,043.67	
		7103	1995	No Data	No Data
			2009	1,023.59	
			2018	1,023.58	
	VWD-207	4511	1995	1,012.295	-0.149
			2009	1,012.182	
			2018	1,012.146	
		7204	1995	No Data	No Data
			2009	1,018.51	
			2018	1,018.51	
		6082	1995	No Data	No Data
			2009	1,019.99	
			2018	1,019.97	
	VWD-201	6077	1995	No Data	No Data
			2009	1,146.896	
			2018	1,146.766	
	VWD-205/205M	6078	1995	No Data	No Data
			2009	1,182.083	
			2018	1,182.019	
		5267	1995	1,151.717	-0.099
			2009	1,151.683	
			2018	1,151.618	

Basin Area	Nearby Well	Benchmark	Year	Elevation (ft, NAVD 88)	Total Elevation Change 1995—2018 (ft)
Southern Saugus		6076	1995	No Data	No Data
			2009	1,151.860	
			2018	1,151.785	
	Saugus-1	611	1995	1,157.803	-0.068
			2009	1,157.800	
			2018	1,157.735	
		6068	1995	No Data	No Data
			2009	1,166.50	
			2018	1,166.43	
		5311	1995	1,159.535	0.011
			2009	1,159.575	
			2018	1,159.546	
	Saugus-2	5260	1995	1,170.900	-0.056
			2009	1,170.923	
			2018	1,170.844	
		5312	1995	1,168.039	-0.041
			2009	1,168.086	
			2018	1,167.998	
		5259	1995	1,177.996	-0.089
			2009	1,178.015	
			2018	1,177.907	
	VWD-159	5375	1995	1,276.700	-0.042
			2009	1,276.714	
			2018	1,276.658	
		7054	1995	N/A	No data
			2009	1,329.124	
			2018	1,329.073	
		7055	1995	N/A	No Data
			2009	1,348.352	
			2018	1,348.324	
		5085	1995	1,317.921	0.005
			2009	1,317.966	
			2018	1,317.926	
	NWD-12	5256	1995	1,217.960	-0.074
			2009	1,217.936	
			2018	1,217.886	
		6066	1995	No Data	No Data
			2009	1,201.063	
			2018	1,201.025	

Basin Area	Nearby Well	Benchmark	Year	Elevation (ft, NAVD 88)	Total Elevation Change 1995—2018 (ft)
	NWD-13	5337	1995	1,192.215	-0.059
			2009	1,192.211	
			2018	1,192.156	
		6067	1995	No Data	No Data
			2009	1,193.131	
			2018	1,193.054	

Notes

ft = foot or feet

NAVD 88 = North American Vertical Datum of 1988

The TRE Altamira InSAR Dataset contains vertical displacement data from June 2015 through September 2019. These data were collected by the European Space Agency Sentinel-1A satellite and processed by TRE Altamira. As discussed above, the evaluation of subsidence occurrence requires the ability to quantify the occurrence of inelastic subsidence and not elastic subsidence. Elastic subsidence is greatest during seasonal periods (normally summer and fall) when seasonal groundwater levels are lowest. Inelastic subsidence generally is best quantified by evaluating changes in ground surface elevations during the winter/early spring periods when groundwater levels are generally at higher elevations and over a multi-year period. For the InSAR data, vertical displacement for the winter-to-winter period from 2015/2016 through 2018/2019 period over the entire Basin from the TRE Altamira InSAR Dataset is presented in Figure 5-13. This period of time represents the least amount of elastic subsidence which results in the change in elevation data being primarily related to inelastic subsidence and/or tectonic activity. Vertical displacement values in the Basin ranged between -0.25 and +0.25 feet between that 3-year period. In the south-central area of the Basin in the vicinity of wells V201, V205, Saugus 1, and Saugus 2 the range was 0.025 to 0.032 feet during that 3-year period.

The relatively stable trend of these plots, along with the positive values of displacement, indicate that no long-term subsidence is occurring in these monitored areas and the variations observed appear to be related to tectonic factors rather than from activities associated with groundwater pumping. Since the beginning of data collection in the early 2000s at both locations, the net vertical displacement is positive (0.05 feet) at the CTDM site and zero at the SKYB site. This means that the land surface has actually risen (positive displacement) or stayed the same in these areas since 2000. In any given year, the vertical displacement is generally less than 0.05 feet, with the exception of 2006 to 2007 at the SKYB site. Within the context of complex southern California geology, the elevation change (less than 0.2 feet vertical change over the last 20 years) seen at the two UNAVCO stations is likely due to tectonic activity as mentioned above.

The three data sets pertaining to subsidence all indicate minimal or no subsidence occurring in the Basin. LADPW benchmarks indicate an average ground surface elevation decline of less than 0.008 feet per year, the TRE Altamira InSAR Dataset indicates a ground surface elevation increase in the area of Saugus Formation wells, and the UNAVCO CGPS Dataset also indicates a ground surface elevation increase at various points in the Basin.

5.1.6.2 Projected Saugus Formation Pumping

The hydrographs in Appendix C, *Hydrogeologic Conceptual Model: Groundwater Conditions in the Santa Clara River Valley Groundwater Basin, East Subbasin and Subsidence Vulnerability Technical Memorandum* (LSCE, 2021) (see Appendix A of that document for the hydrographs) were prepared using results from the Basin numerical model and show historical groundwater level data along with projected (future) groundwater elevations. The comparison of the projected and historical data at each well shows simulated future groundwater levels, including during normal and drought periods. The future water levels are representative of "full build-out land use conditions" that include the sustained operation of wells V201 and V205 (in part for perchlorate removal), along with additional source capacity for extraction of groundwater from the Saugus Formation in the V206 and V207 area of the Basin that would allow SCV Water to extract approximately 35,000 acre-feet per year during multiple dry years.

Central Area

Projections of Saugus Formation groundwater pumping volumes in the central area (Saugus 1 and 2, V201, V205) are expected to be higher than historical amounts during normal *and* dry years. Groundwater model simulations of future normal year conditions (Saugus 1 and 2, V201) indicate groundwater levels will be maintained approximately 100 to 150 feet lower in normal years than in the past, with some shorter-term decreases in water level beyond these during drought.

Western Area

Projections of Saugus Formation groundwater pumping in the western area (V206, V207 and four to-be-constructed Saugus wells) are expected to be higher than historical amounts during dry years. Groundwater model simulations of future conditions (V206 and V207) indicate groundwater levels will be similar to historical normal year levels, but in drought years are projected to be approximately 100 to 150 feet lower than in the past.

5.1.6.3 Conclusions Regarding Potential for Subsidence

The potential for subsidence in the various areas of the Basin to occur in the future is difficult to predict or quantify based on the data sets evaluated and documented above. Groundwater elevations in the future, in particular at full build-out, will be lower than in the past. In some areas, groundwater elevations will be lower than past drought water elevations (western area), and in other cases groundwater elevations will be lower in both normal and drought conditions (central area). The central area appears to contain more compressible fine-grained layers than does the west and, because of these factors, there may be a potential for future subsidence, but it is difficult to predict, and should be monitored.

Further, these fine-grained materials are at depths that are several hundreds of feet below the potentiometric head in the Saugus Formation when observing both historical Saugus Formation groundwater levels and projected elevations based on model simulations (see Appendix C of this GSP and Appendix A of that appendix [LCSE, 2021]). This fine-grained unit placement is considered a more favorable condition than physically dewatering clays as the groundwater potentiometric surface becomes lower. These clay units are not as extensive in the western portion of the Saugus Formation in the vicinity of V206 and V207 and pinch out (become very thin) toward the South Fork area of the Basin where wells NC12 and NC13 are present. As mentioned above, data on the occurrence of clay beds in the vicinity of the four planned new Saugus Formation wells near the Magic Mountain area are not available, as the exact location of these wells has not been finalized nor the borings drilled.

5.1.7 Primary Uses of Each Aquifer

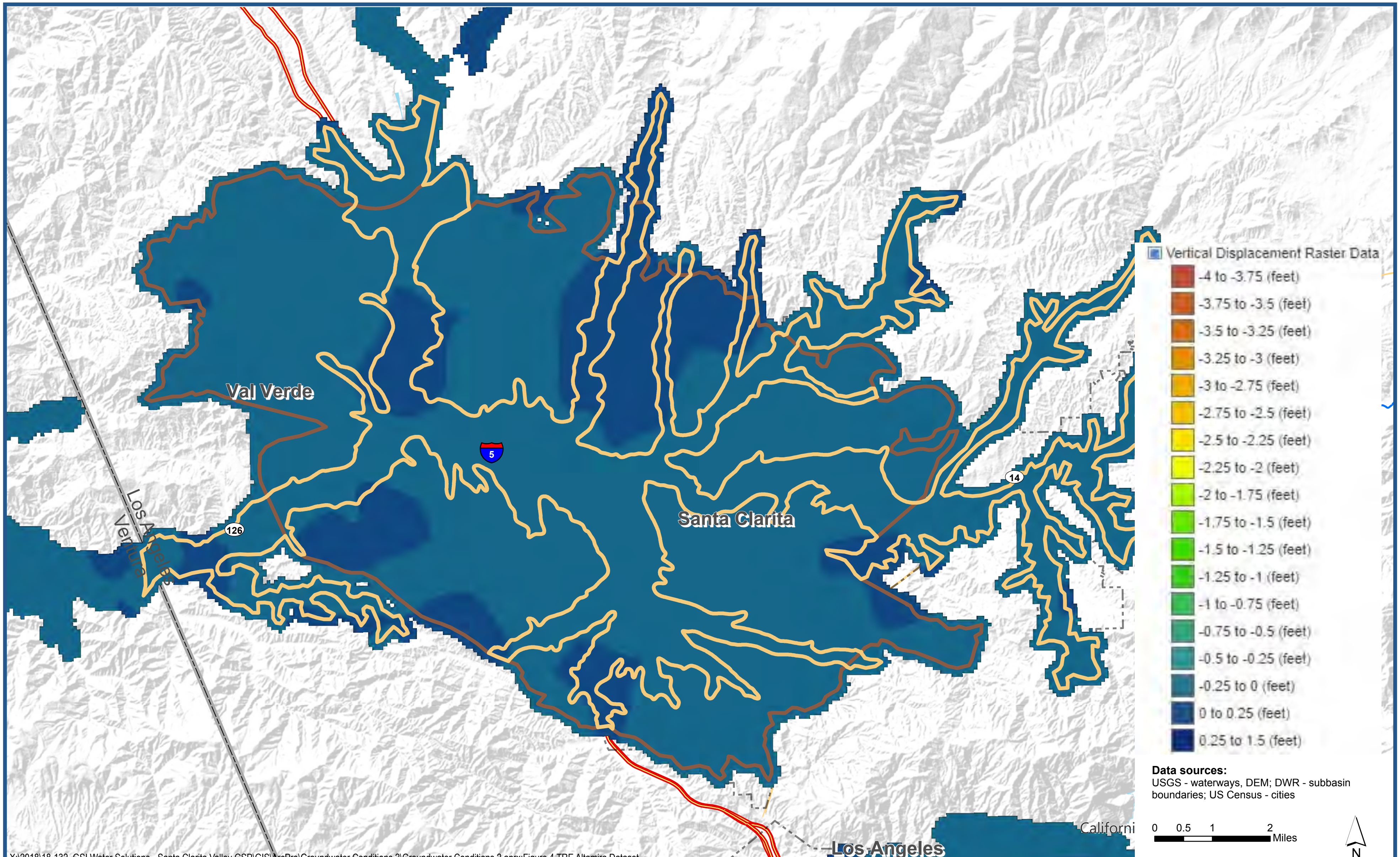
Groundwater production rates presented in this section for municipal/industrial, agricultural, domestic water users were obtained from the 2018 Santa Clarita Valley Water Report (LSCE, 2019). Each is summarized in the following sections.

5.1.7.1 Municipal/Industrial

Municipal/Industrial groundwater production for both the Alluvial Aquifer and the Saugus Formation from 1980 to 2018 are presented in Figure 5-15. Groundwater production in the Alluvial Aquifer has ranged from 8,684 to 27,919 acre-feet per year (AFY) with an average of 19,400 AFY. Production increased until the late 1990s, after which production remained at this level until 2015 when it began to decline rapidly. Saugus Formation production has ranged from 2,728 to 14,417 AFY with a long-term average of 6,750 AFY. Saugus Formation production peaked in the early 1990's for a short period before reaching its lowest point in 1999. Production gradually returned to normal levels and was relatively stable thereafter.

5.1.7.2 Agricultural

Agricultural production for both the Alluvial and Saugus Formation aquifers from 1980 to 2018 are presented in Figure 5-16. Alluvial Aquifer production ranged from 5,951 to 13,824 AFY with an average of 10,194 AFY. Alluvial Aquifer production has been relatively steady over the four decades presented in Figure 5-16 with year-to-year variation typically within 2,000 acre-feet (AF). Agricultural production from the Saugus Formation has been minor. Presently, there is no agricultural production from the Saugus Formation.



TRE Alatamira InSAR Dataset
(June 2015 - March 2019)

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-13

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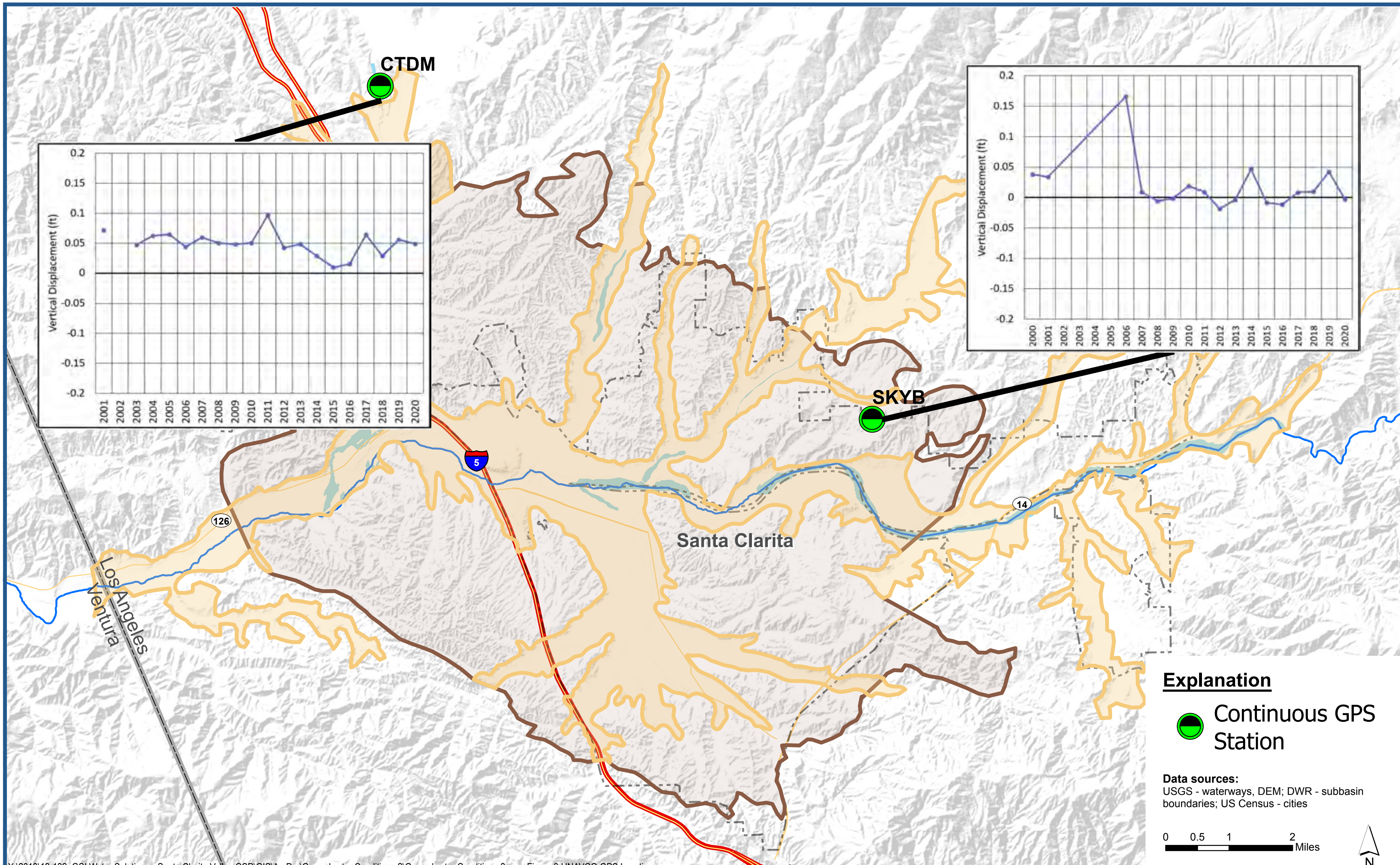

X:\2018\18-132_GSI Water Solutions - Santa Clarita Valley GSP\GIS\ArcPro\Groundwater Conditions 2\Groundwater Conditions 2.aprx:Figure 3 UNAVCO GPS Locations

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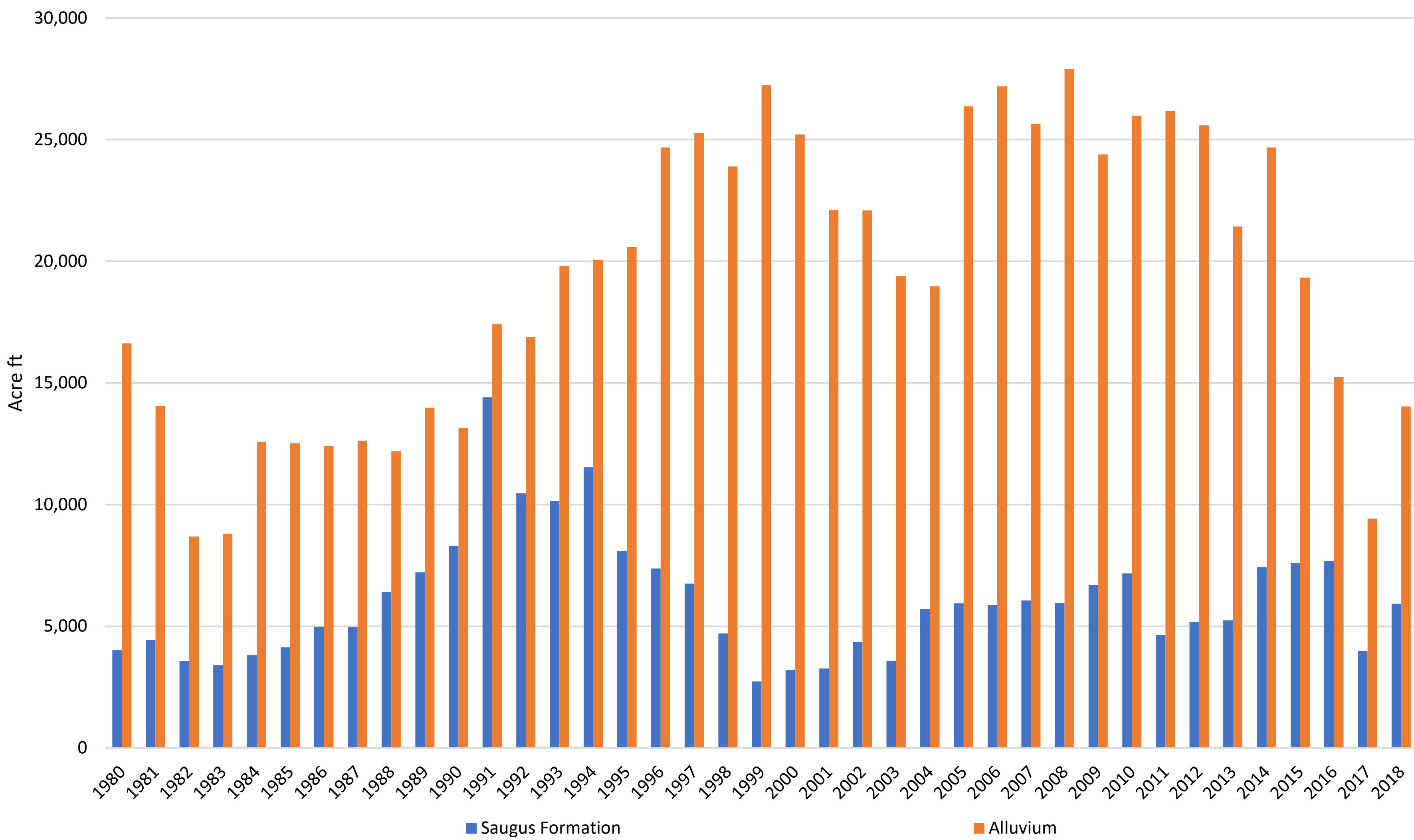
UNAVCO Continuous GPS Station Locations

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

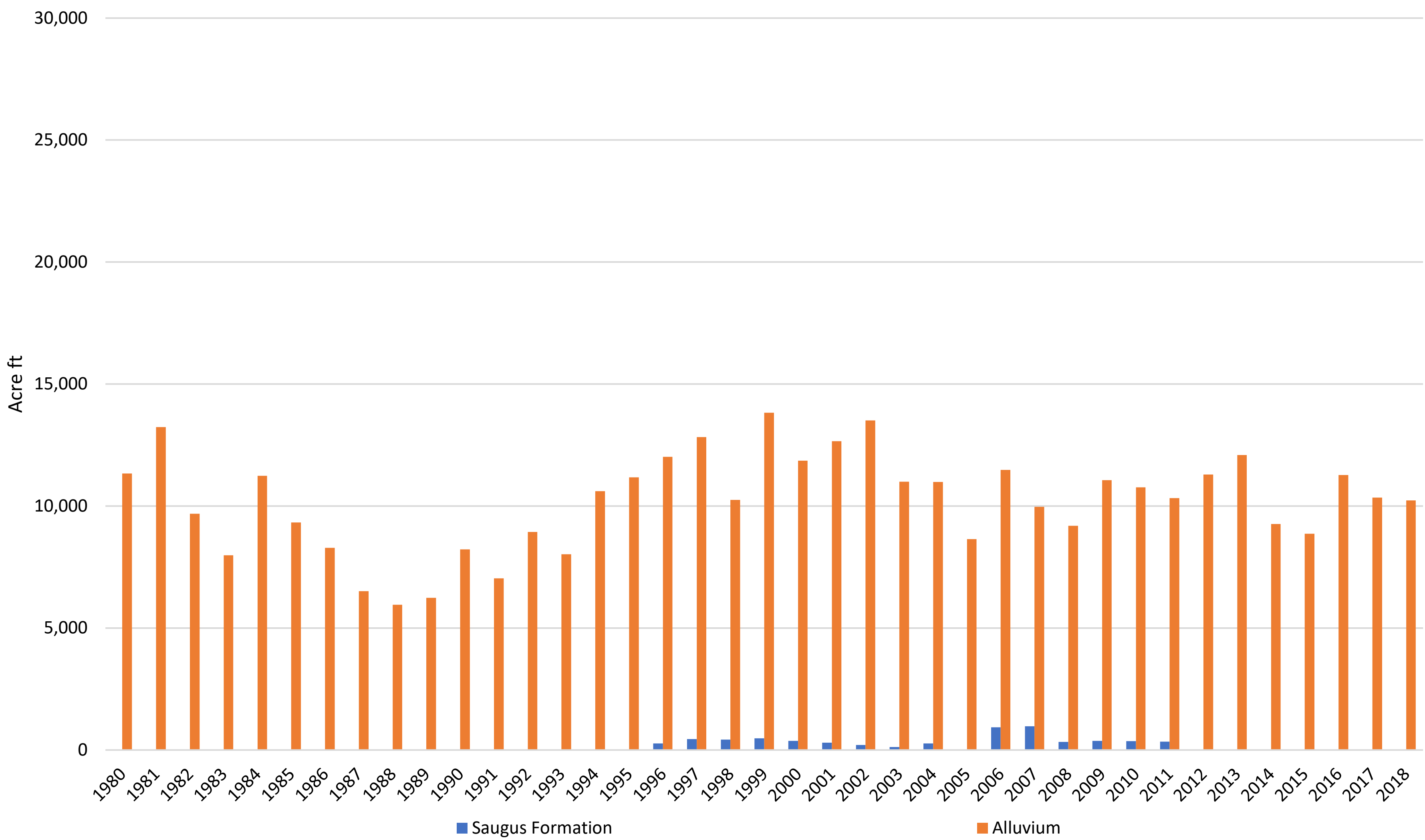
Figure 5-14



Municipal Groundwater Use

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-15



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Agricultural Groundwater Use

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-16

5.1.7.3 Private Domestic Uses

Private domestic uses of groundwater constitute a minor percentage of the total groundwater extraction in the Basin. Private domestic also includes groundwater production used for golf courses. Total domestic groundwater extractions by aquifer are presented in Figure 5-17. Alluvial Aquifer domestic well production values are estimated to range from 500 to 1,369 AFY with an average of 741 AFY.

5.1.8 Groundwater Quality

This section summarizes the constituents of general groundwater quality (from both natural and human-made sources) for both principal aquifers based on previous technical studies and monitoring performed by the Santa Clarita Valley Water Agency (SCV Water). Natural constituents discussed in Section 5.1 include total dissolved solids (TDS), chloride, nitrate, and sulfate. These constituents are naturally occurring in groundwater, but some constituents can also result from human activities.

Also discussed are anthropogenic groundwater constituents of concern (COCs) that have been observed in the Basin. The Santa Clarita Valley Water Report identifies perchlorate and volatile organic compounds (VOCs) as the primary human caused COCs. The most frequently detected VOCs in the Basin are trichloroethylene (TCE) and tetrachloroethylene (PCE). Less frequently detected compounds include chloroform, and 1,1-dichloroethene which have been detected in trace amounts below the state drinking water standards maximum contaminant level (MCL) in the Basin (LSCE, 2019). The Salt and Nutrient Management Plan (SNMP) prepared by SCV Water in 2016 identified dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs) as other COCs. A contaminant of emerging concern in the Basin are per- and polyfluoroalkyl substances (PFAS).

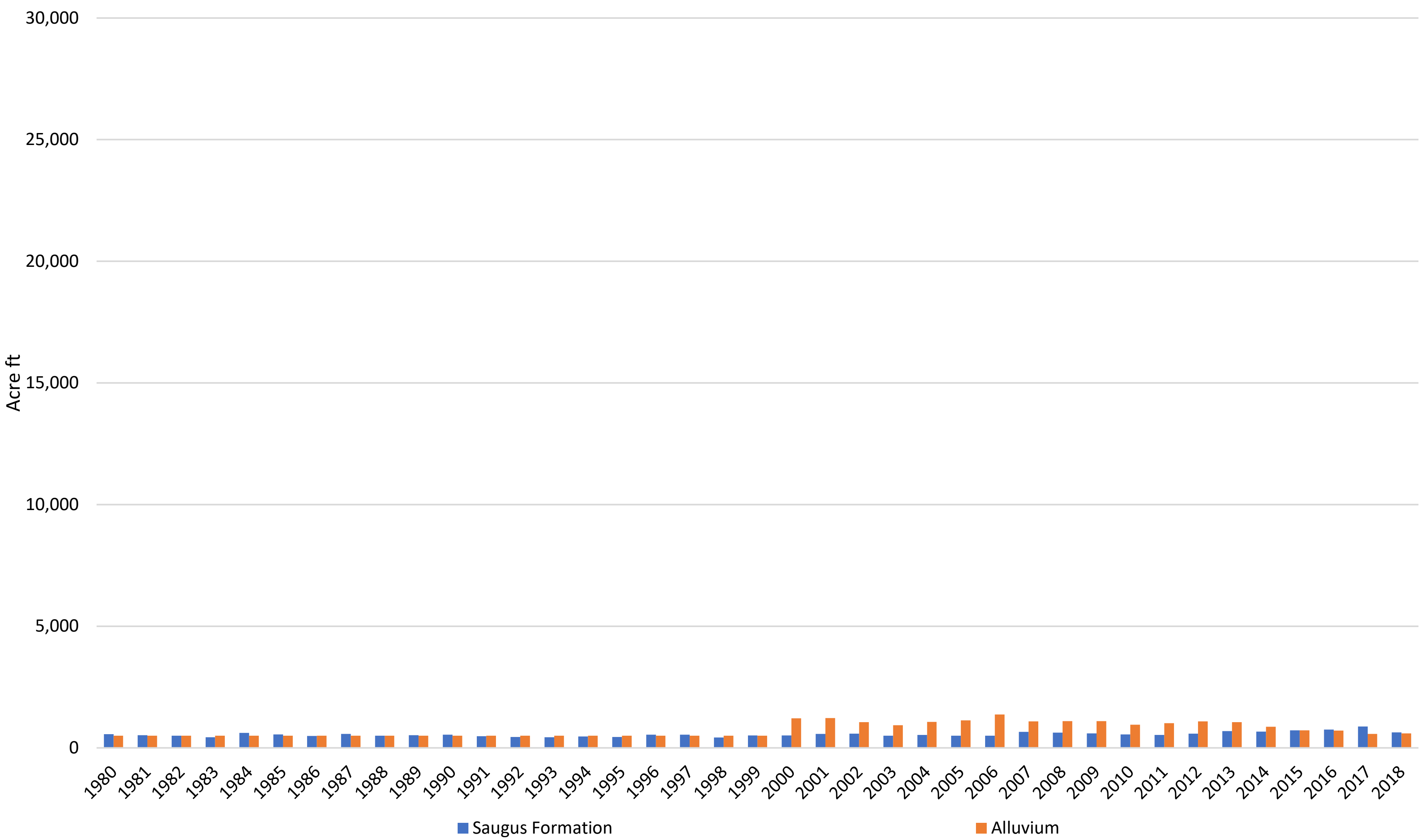
Groundwater quality concentration data are expressed in terms of milligrams per liter (mg/L) or parts per million (ppm) and also micrograms per liter (µg/L) or parts per billion (ppb). Historical and recent concentrations are compared to MCL and secondary maximum contaminant level (SMCL) that are based on California Division of Drinking Water (DDW) and U.S. Environmental Protection Agency standards. These are generalized standards for drinking water, which are set to protect public health. Groundwater quality concentrations are also compared to water quality objectives (WQOs) as set by the Los Angeles Regional Water Quality Control Board (LARWQCB) that are site specific based on location conditions. WQOs have been set by the LARWQCB for the Alluvial Aquifer but not for the Saugus Formation. The SNMP identifies WQOs for TDS, chloride, and nitrate, but state that further analysis is necessary to establish meaningful WQOs (GSSI, 2016).

Water quality concentration graphs for TDS, chloride, nitrate, and sulfate are presented in Appendix C, the *Hydrogeologic Conceptual Model: Groundwater Conditions in the Santa Clara River Valley Groundwater Basin, East Subbasin* (Appendix B of that report). Data through 2018 are included in the individual concentration graphs. A summary of groundwater quality data for each principal aquifer is presented below.

5.1.8.1 Groundwater Quality – Alluvial Aquifer

Total Dissolved Solids

The amount of dissolved solids or salts in water is represented by TDS. Water quality in terms of TDS has been described in the Water Report prepared for SCV Water for about 20 years. Groundwater quality conditions in the Alluvial Aquifer are described for the different zones shown in Figure 5-7. DDW recommends an SMCL for TDS of 500 mg/L, with an upper limit of 1000 mg/L and a short-term limit of 1,500 mg/L. In addition to the SMCL, the WQO values range between 700 and 1,000 mg/L.



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Private Domestic Groundwater Use

Santa Clara River Valley East Subbasin
Groundwater Sustainability Plan

Figure 5-17

In the Mint Canyon and Above Saugus WRP areas (see Figure 5-18), TDS concentrations show a long-term stable trend over the past 30 years except for well VWD-U4 that has shown an increasing trend overall with concentrations above the WQO. Concentrations in this well have decreased over the past 3 years.

In Bouquet Canyon, TDS concentrations show long-term stable trends over the past 30 years with minimal variation and may be correlated with periods of flow in Bouquet Canyon Creek (see Figure 5-18). TDS concentrations in Bouquet Canyon have ranged from approximately 400 to almost 900 mg/L historically. In 2018, TDS concentrations exceeded the historical range with a value of 910 mg/L in one of the wells in this area while another well was within the range. The WQO for Bouquet Canyon is 700 mg/L. The SNMP found that the average TDS concentration for this area was 710 mg/L, slightly above the WQO.

TDS concentrations in the western areas of the Basin exhibited similar patterns and responses to wet and dry periods as those observed in the eastern portions of the Valley (see Figure 5-19). TDS concentrations in San Francisquito Canyon and Below Saugus WRP areas historically have ranged from approximately 300 to 1,100 mg/L. In 2018, TDS concentrations were within historical ranges and ranged from approximately 580 to 960 mg/L. The WQO for San Francisquito Canyon and Below Saugus WRP is 700 mg/L.

In the Castaic Valley and Below Valencia WRP areas, TDS concentrations have historically ranged between 300 to 1,100 mg/L (see Figure 5-19). At times, variations in TDS concentrations appear to be related to wet and dry periods along with discharge from Castaic Lake. In 2018, there was only one analysis for TDS with a concentration of 460 mg/L, which is within the historical range. The WQO for the Castaic Valley and Below Valencia WRP areas is 1000 mg/L. The SNMP found that the average TDS in this area was 727 mg/L.

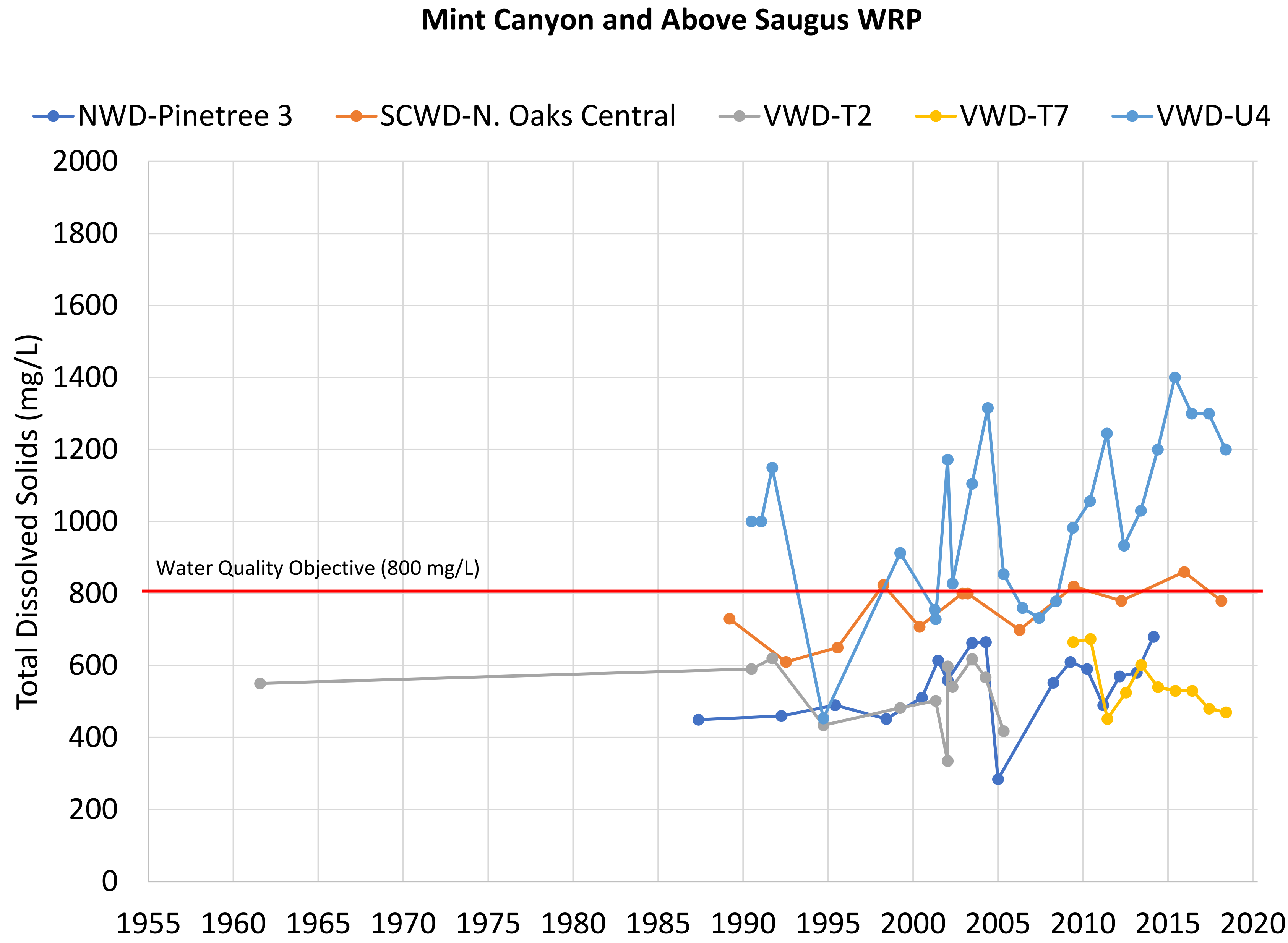
Box and Whisker plots illustrating summary statistics for TDS measured in wells located in each area are shown in Figure 5-20. This figure is based on data collected from 1990 through 2018. The largest range of values and highest concentration occurred in the Above Saugus WRP area. The Below Valencia WRP area displayed the smallest range but also the highest median value. Castaic Valley has the lowest median TDS concentrations. Below Saugus WRP, Bouquet Canyon, and Mint Canyon all exhibited similar distributions of TDS concentrations.

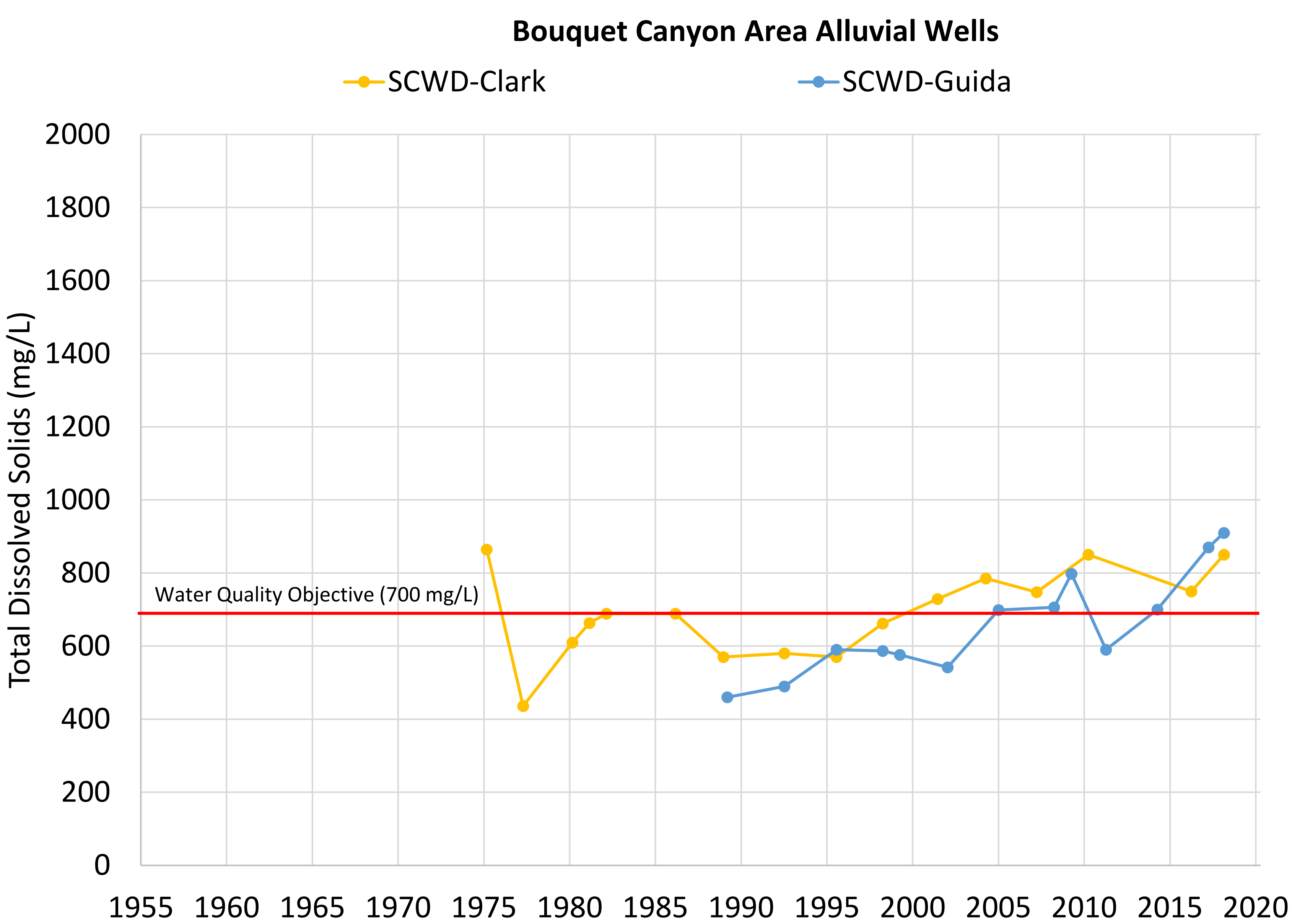
Long-term groundwater quality monitoring data for TDS shows a consistent pattern of meeting drinking water standards, although it appears to be intermittently affected by wet and dry cycles. This supports the conclusion that the Alluvial Aquifer remains a viable ongoing water supply source in terms of groundwater quality even with short-term exceedances of water quality standards in a few of the wells.

Chloride

Chloride is a naturally occurring inorganic salt, but higher concentrations in groundwater can be associated with anthropogenic activities such as urban runoff or discharge of recycled water (GSSI, 2016). High concentrations result in a salty taste when used for drinking water. The SCML for chloride recommended by DDW is 250 mg/L, with and upper limit of 500 mg/L and a short-term limit of 600 mg/L. The WQOs for chloride range from 100 to 150 mg/L.

Chloride concentrations in the Mint Canyon and Above Saugus WRP areas have historically ranged from 17 to 160 mg/L. Values in 2018 were between 46 and 120 mg/L (see Figure 5-21). Concentrations have increased and decreased over time likely due to wet and dry conditions. WQO for this area is 150 mg/L and all representative wells are currently below this level. The SNMP found that the average concentration for the Mint Canyon and Above Saugus WRP area was 89 mg/L and 72 mg/L, respectively.





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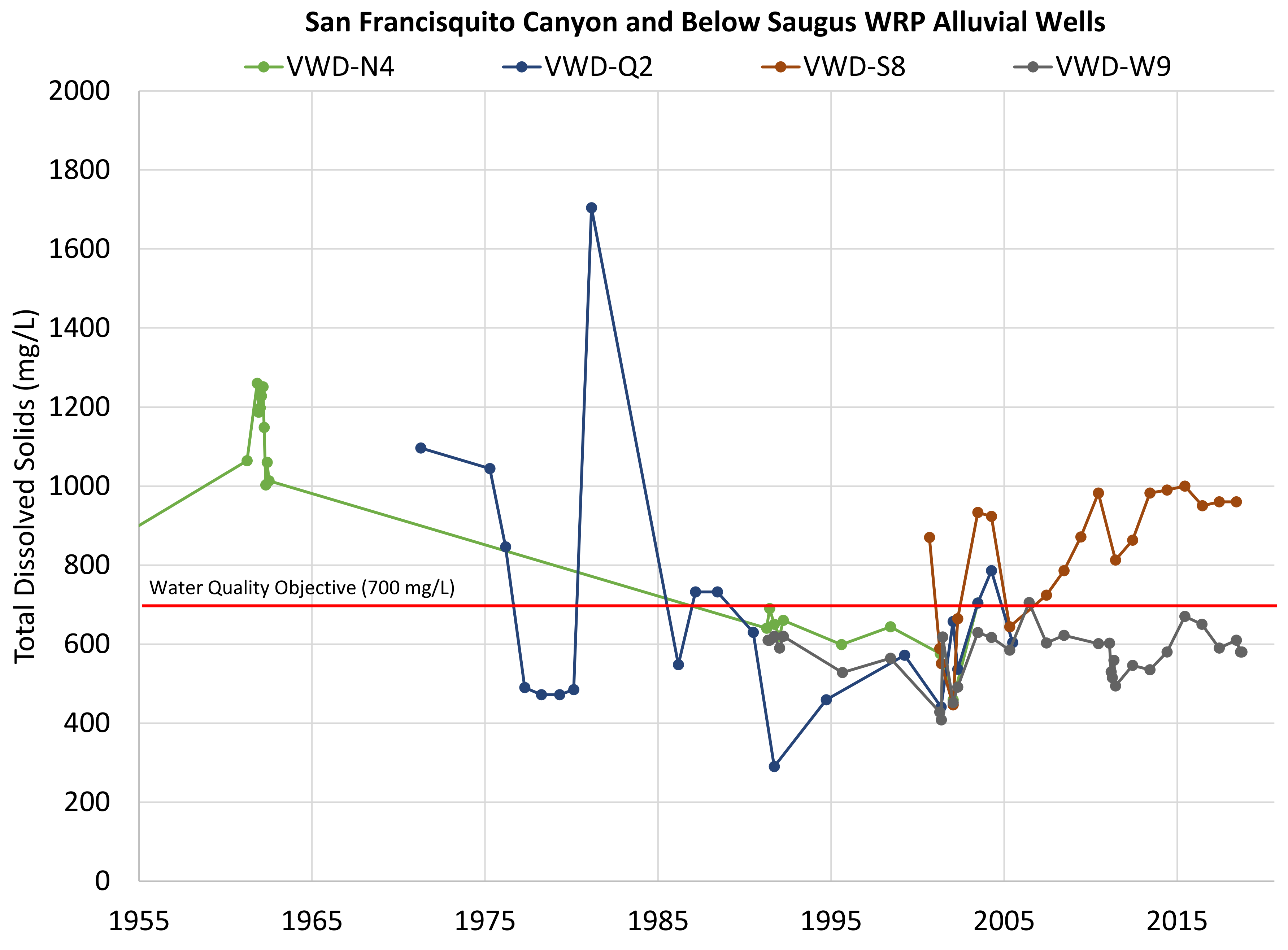
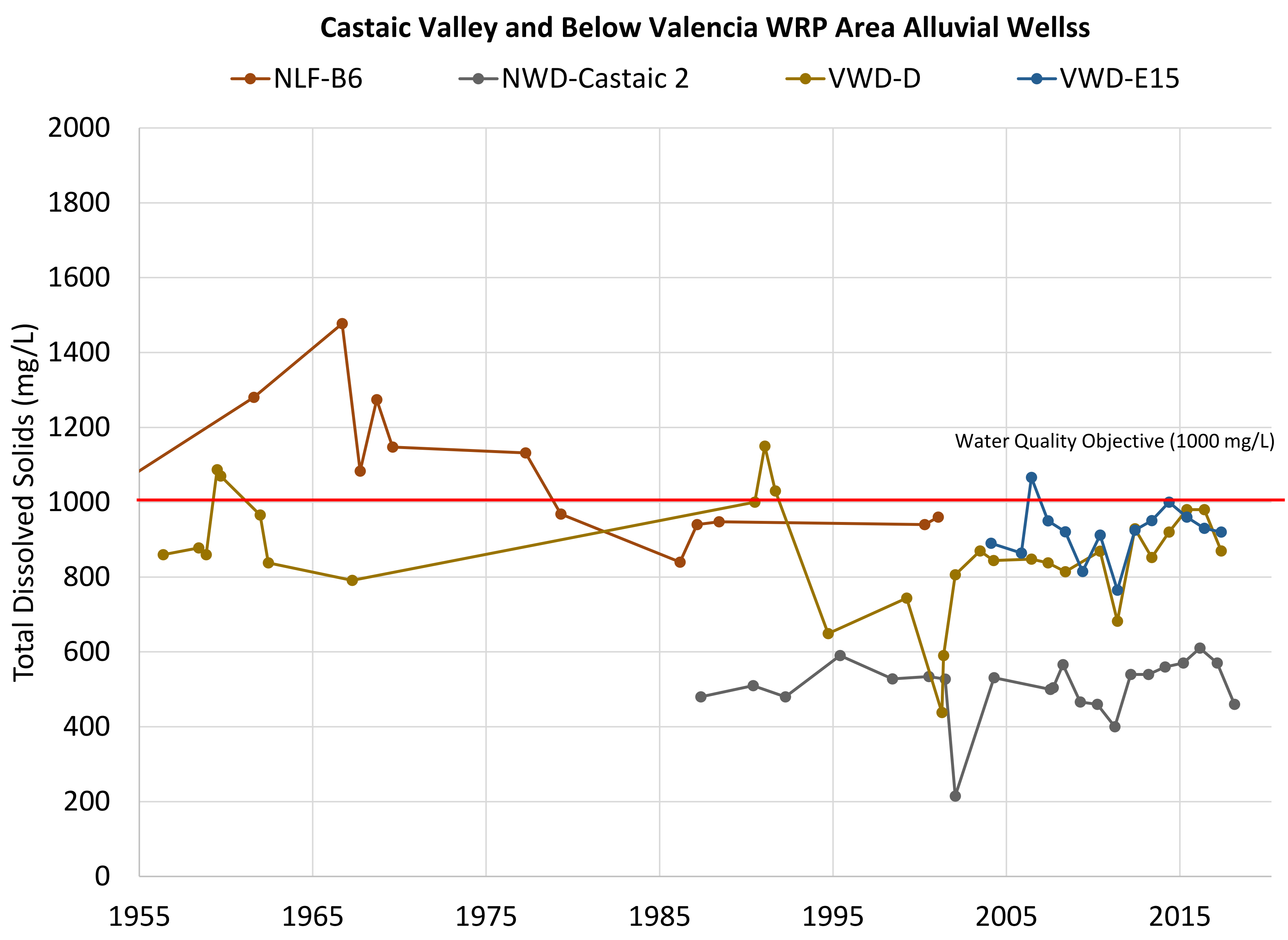
Groundwater Quality in Eastern Alluvial Wells

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-18





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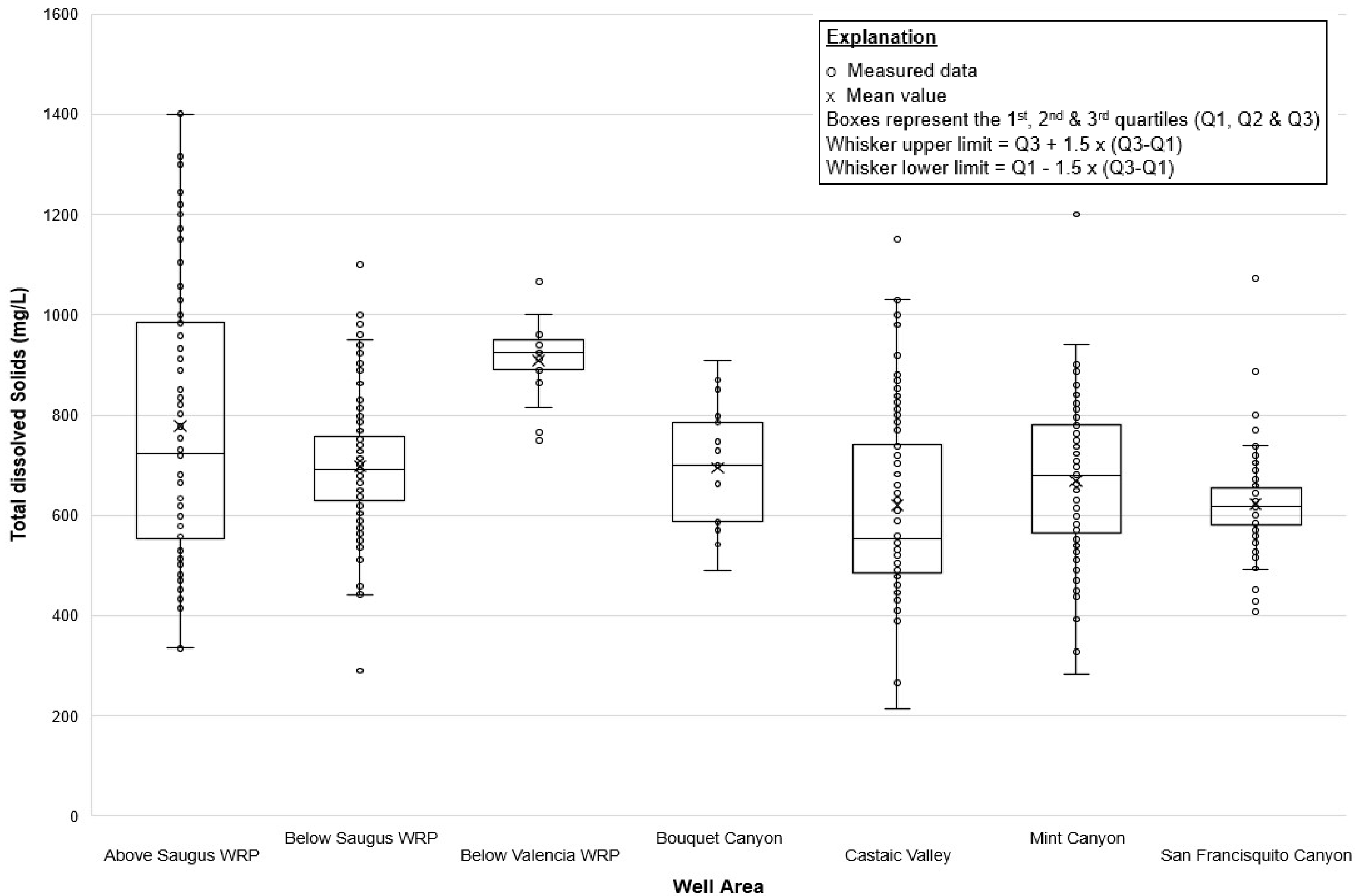
Groundwater Quality in Western Alluvial Wells

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-19



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Alluvial Aquifer TDS Box and Whisker Plot

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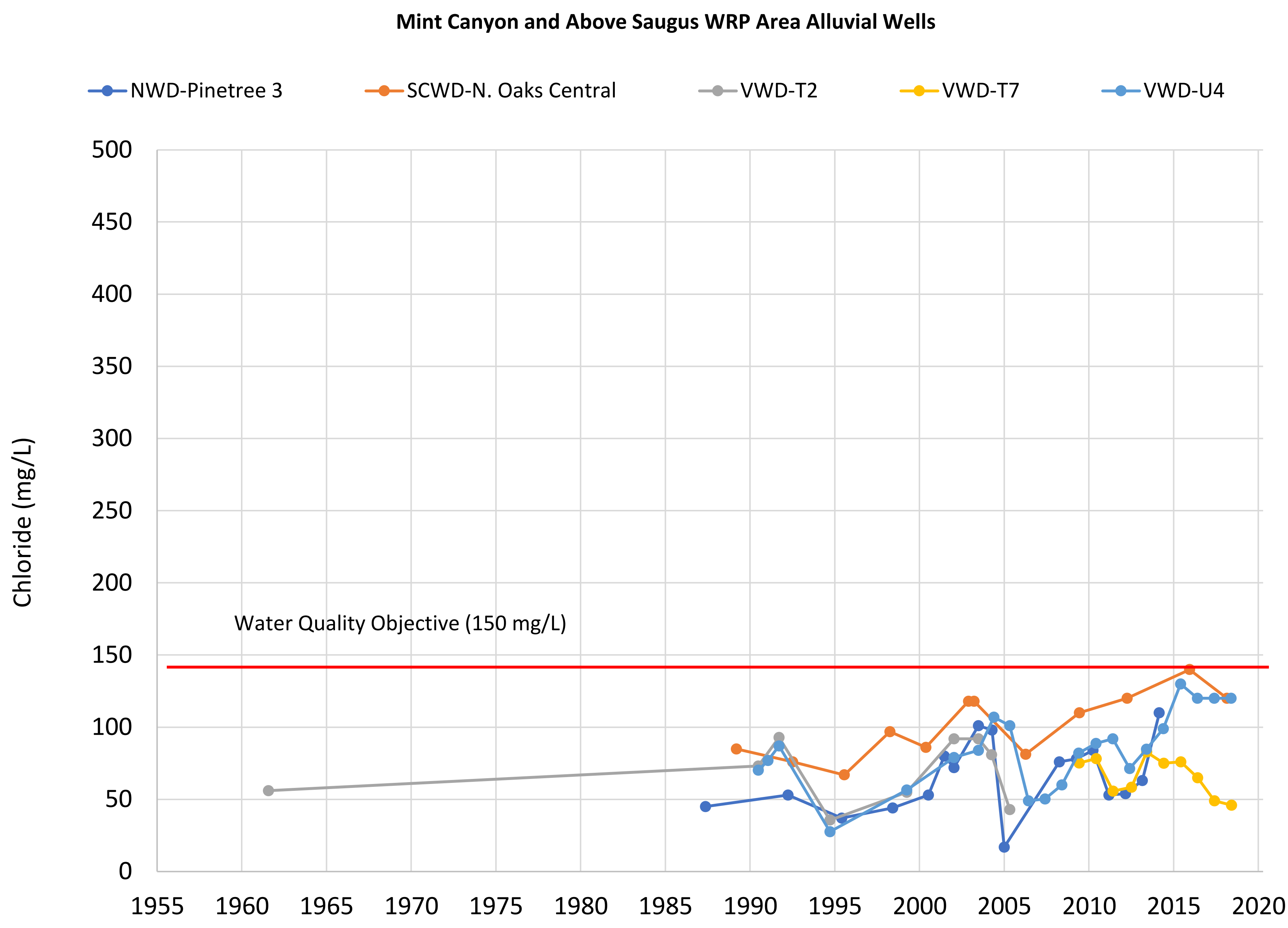
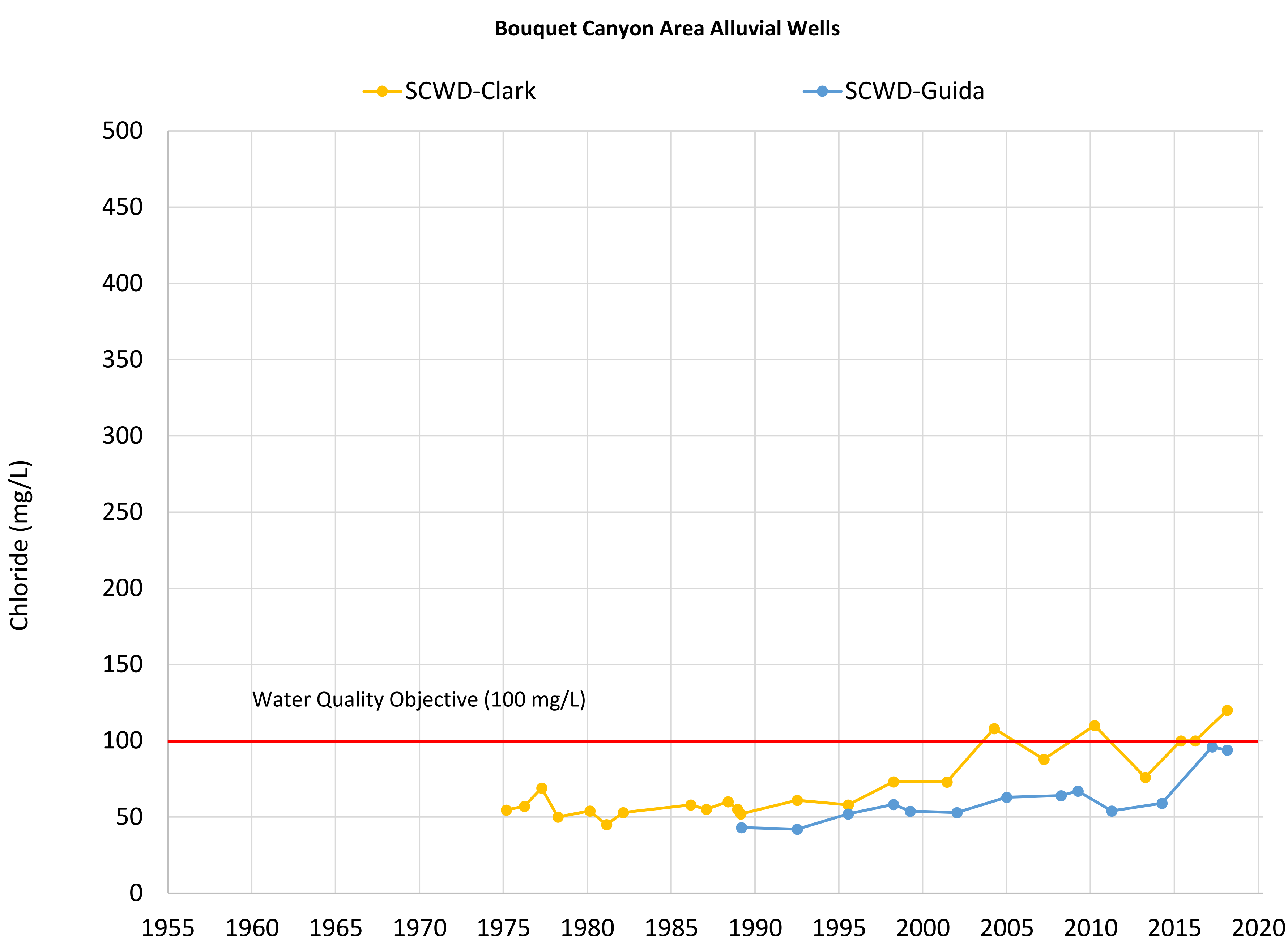
Groundwater Sustainability Plan

Figure 5-20





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Groundwater Quality in Eastern Alluvial Wells
Chloride

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-21

Chloride concentrations in the Bouquet Canyon have ranged between 40 and 120 mg/L (see Figure 5-21). Values in 2018 were between 94 and 120 mg/L. Historical data is available since the mid 1970's where chloride concentrations are generally stable and below the WQO of 100 mg/L. The SNMP found that the average concentration for this area is 77 mg/L.

Chloride concentrations in the San Francisquito Canyon and Below Saugus WRP areas range from 36 to 130 mg/L, with 2018 values between 62 and 130 mg/L (see Figure 5-22). Similar to other alluvial areas, chloride concentrations are stable but with a small increase in recent years. WQO for this area is 100 mg/L. The SNMP found that the average concentration for this area is 77 mg/L.

In the Castaic Valley and Below Valencia WRP Areas, chloride concentrations have ranged between 55 and 180 mg/L with a single 2018 measurement at 97 mg/L (see Figure 5-22). There has been a slight upward trend in chloride concentrations since the mid-1990s.

Chloride concentrations across the Alluvial Aquifer are presented statistically as Whisker plots in Figure 5-23. Chloride concentrations in the Above Saugus, Below Valencia, and Castaic Valley all have similar distributions. The highest median value occurred in the Below Valencia area and the lowest in the San Francisquito Canyon. The SNMP found that the average concentration for this area was 77 mg/L.

Nitrate

Nitrate is a compound that is associated with agricultural activities, septic systems, confined animal facilities, landscape fertilization, and water treatment facilities. Consumption of water with high concentrations of nitrate can have adverse health effects, specifically for infants under the age of six months who can develop methemoglobinemia or blue baby syndrome (SWRCB, 2017a). The MCL and the WQO objectives for each of the management areas for nitrate concentration is 45 mg/L (GSSI, 2016).

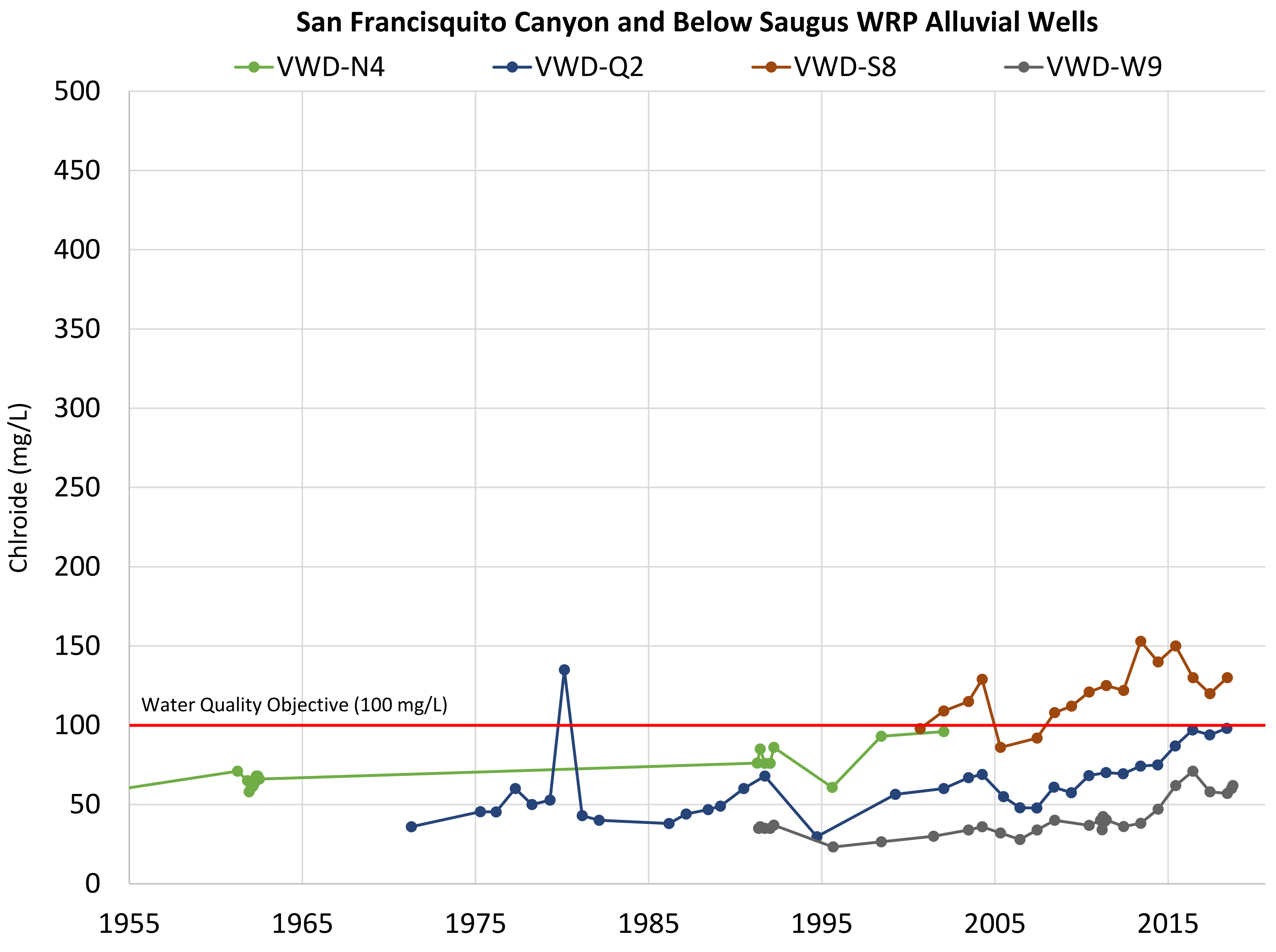
In the Mint Canyon and Above Saugus WRP areas, nitrate concentrations have ranged between non-detect (ND) and 38 mg/L. There is no apparent trend of increasing nitrate concentration in the Mint Canyon and Above Saugus WRP areas (see Figure 5-24). The average concentration identified in the SNMP for the Mint Canyon and Above Saugus WRP area were 20 and 21 mg/L, respectively.

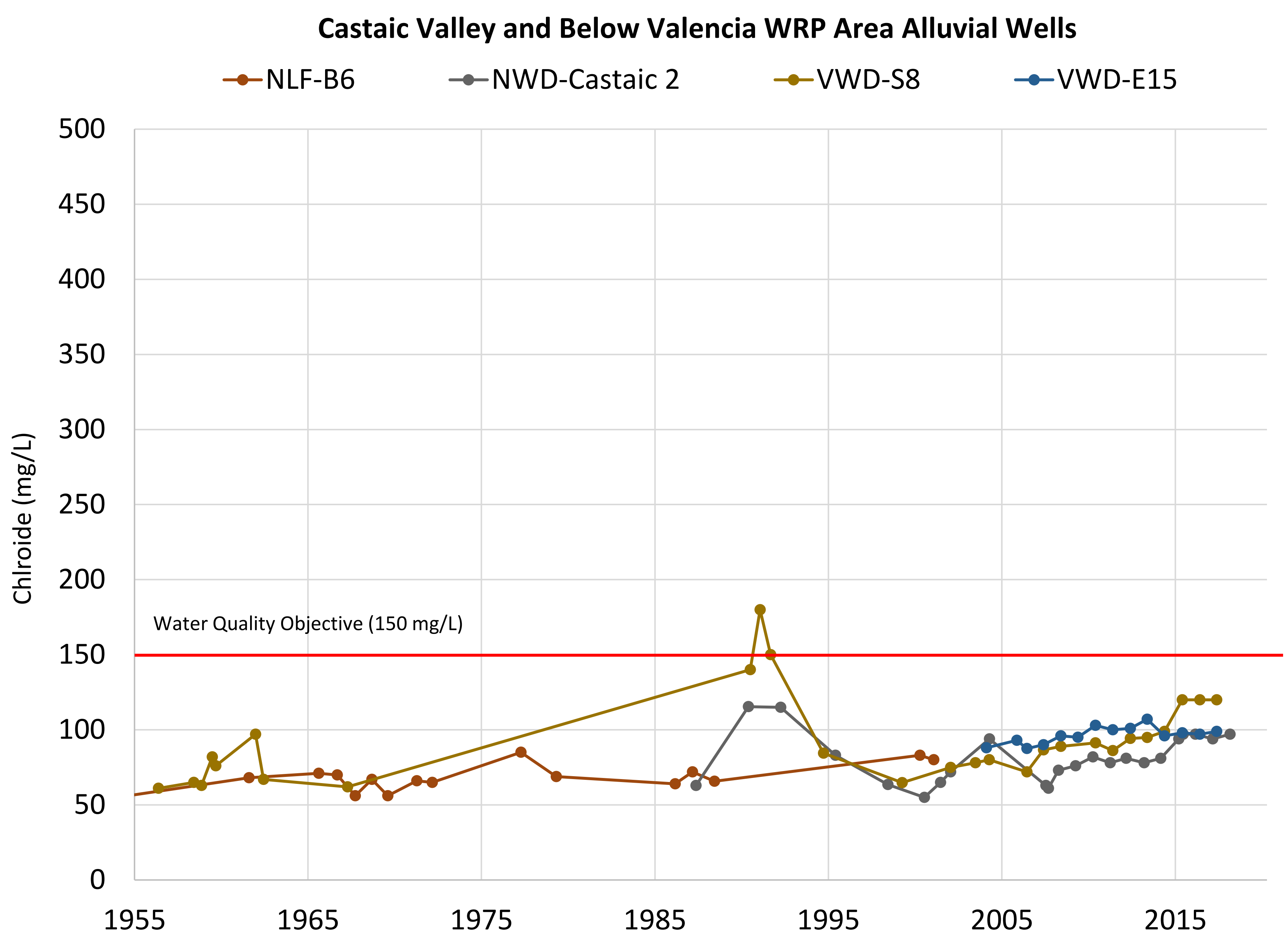
Nitrate concentrations in the Bouquet Canyon Area have ranged from 3 to 34 mg/L. Values have not shown any increasing trend over time (see Figure 5-24). Average concentration identified in the SNMP for this area was 16 mg/L.

Nitrate concentrations in the San Francisquito Canyon and the Below Saugus WRP area have ranged from ND to 50 mg/L. This area has exhibited a wide range of values dating back to the mid 1950's but has not shown any increasing trend over time (see Figure 5-25). Average concentration identified in the SNMP for this area was 16 mg/L.

In the Castaic Valley and Below Valencia WRP areas, nitrate concentrations have ranged from ND to 36 mg/L with the highest concentration occurring in the 1950's. There has not been an increasing trend in nitrate concentrations (see Figure 5-25). Average concentration identified in the SNMP for this area was 8 mg/L.

Figure 5-26 includes Box and Whisker plots representing the statistical distribution of nitrate concentrations across the Alluvial Aquifer that includes data from 1990 to present. Median concentrations are all well below the MCL and WQO of 45 mg/L. The lowest median value is in Castaic area while the highest is the Below Saugus WRP area.





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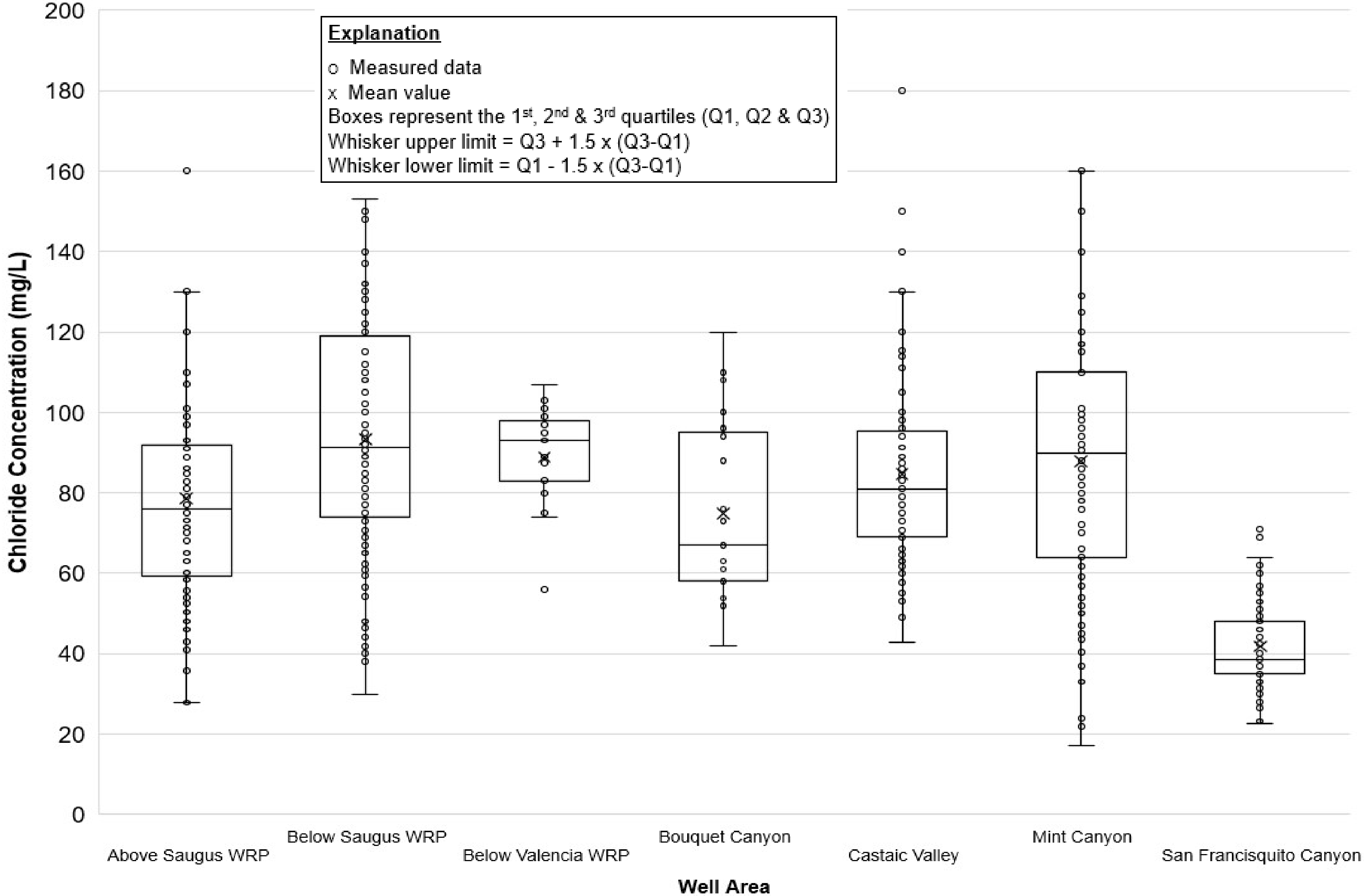
Groundwater Quality in Western Alluvial Wells
Chloride

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-22



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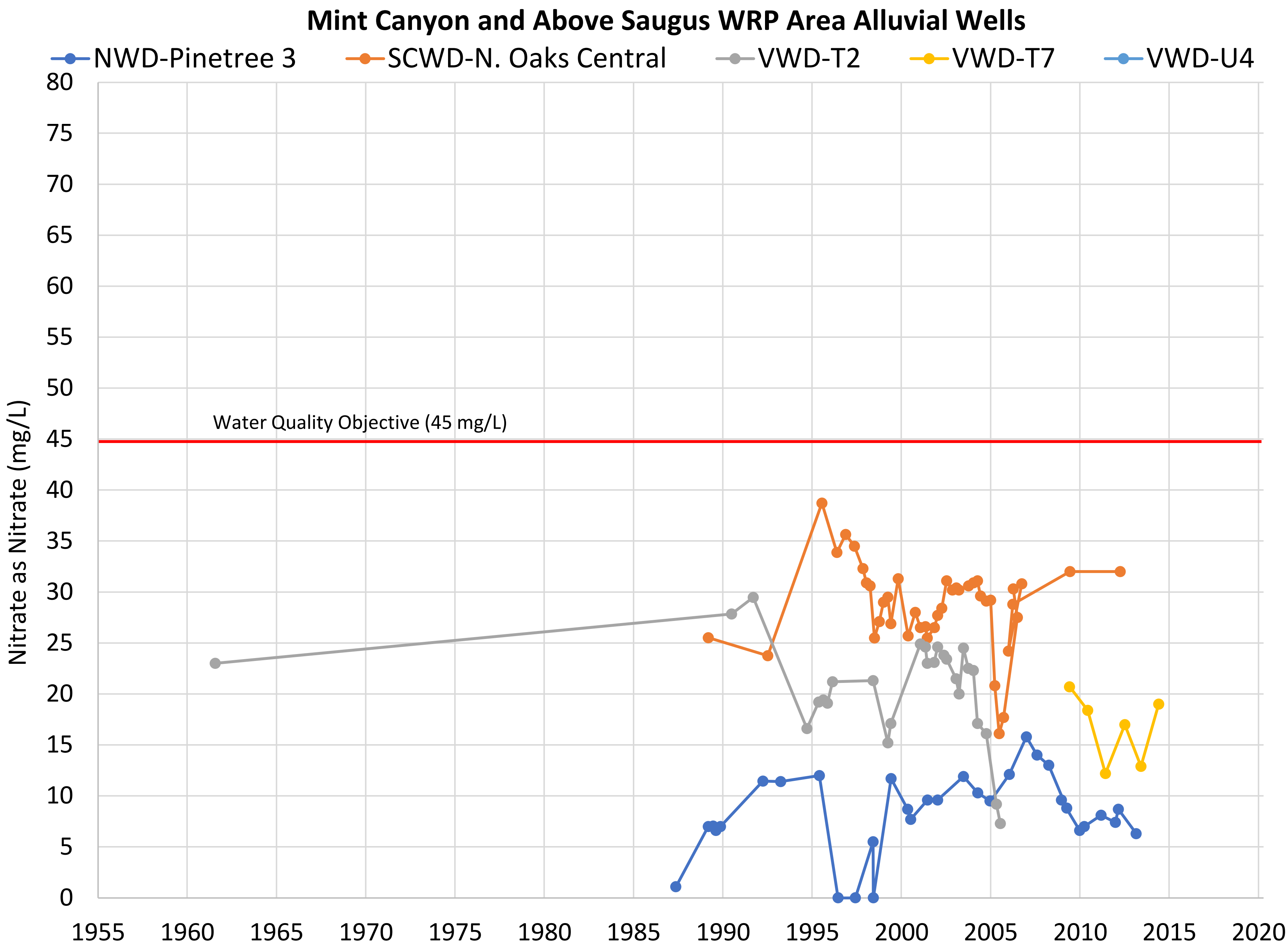
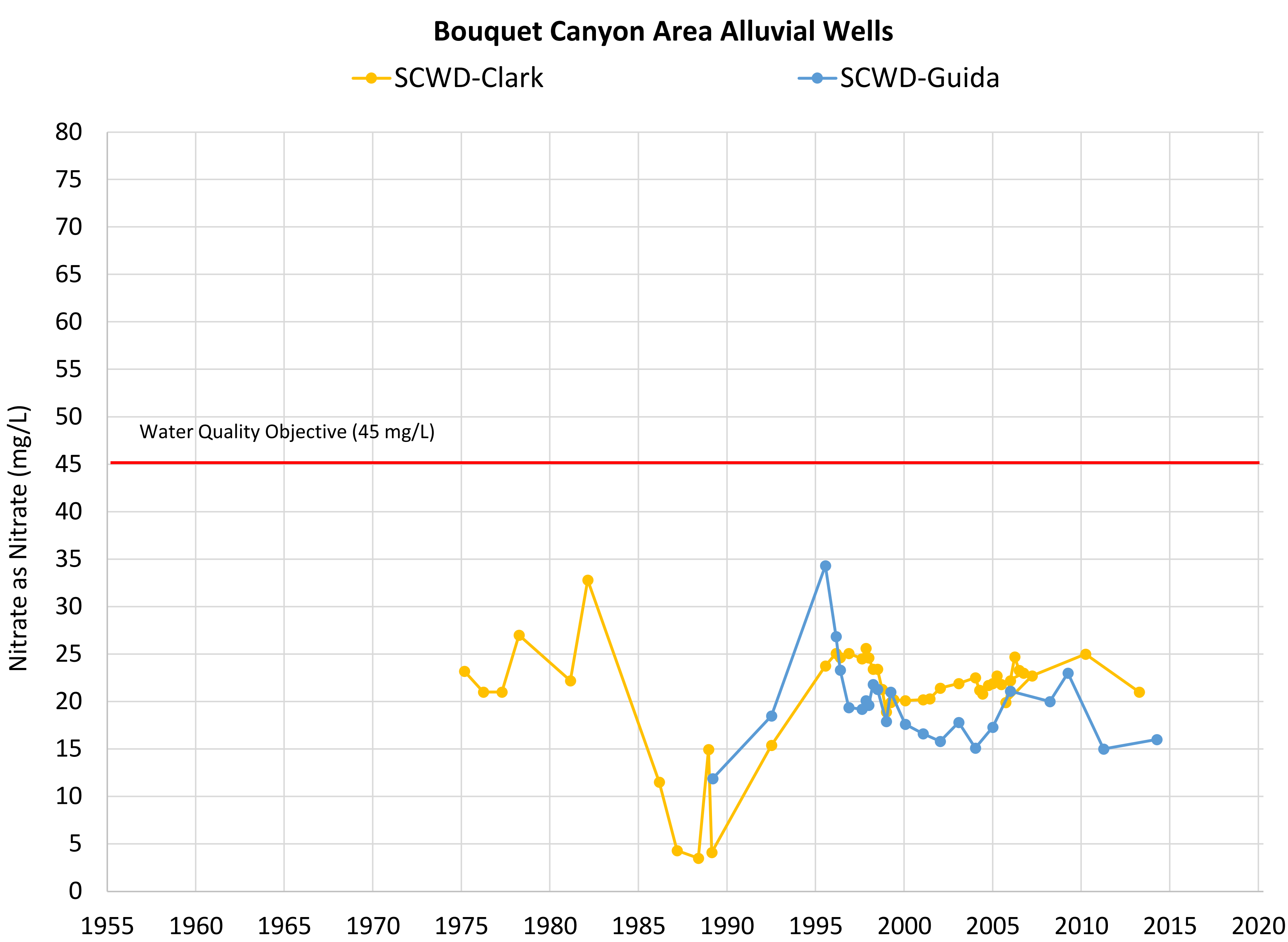
Alluvial Aquifer Chloride Box and Whisker Plot

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-23





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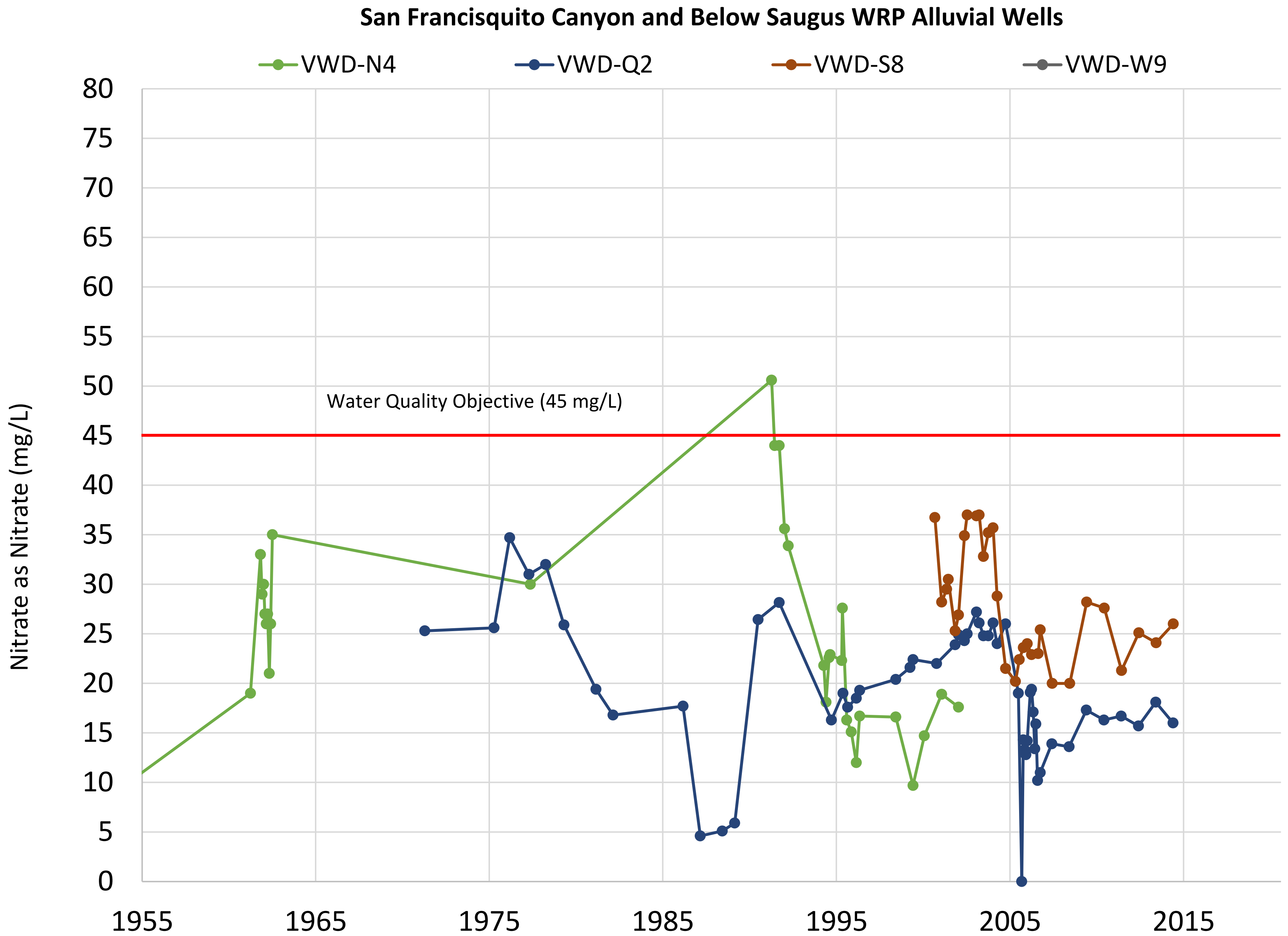
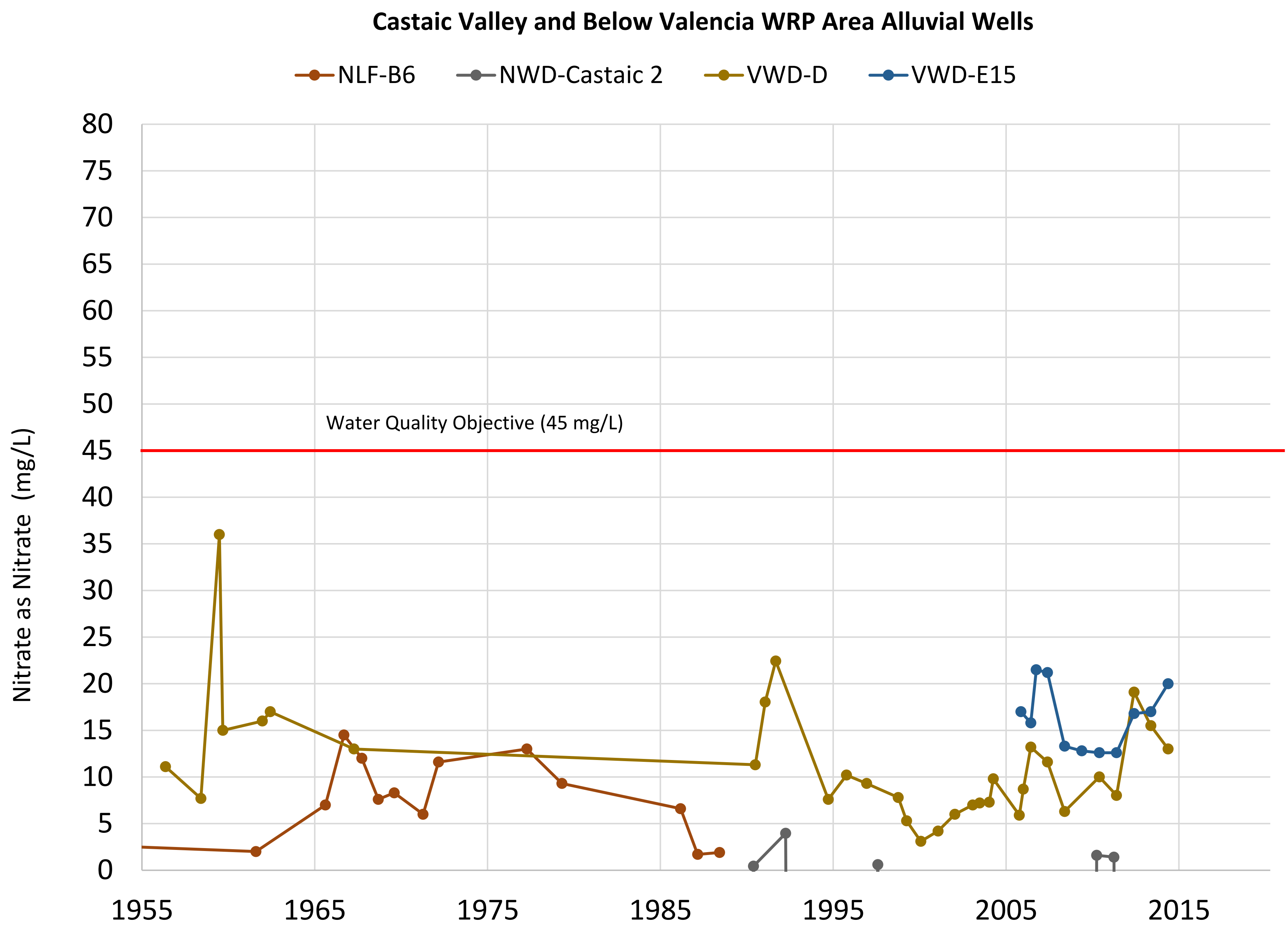
Groundwater Quality in Eastern Alluvial Wells
Nitrate

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-24





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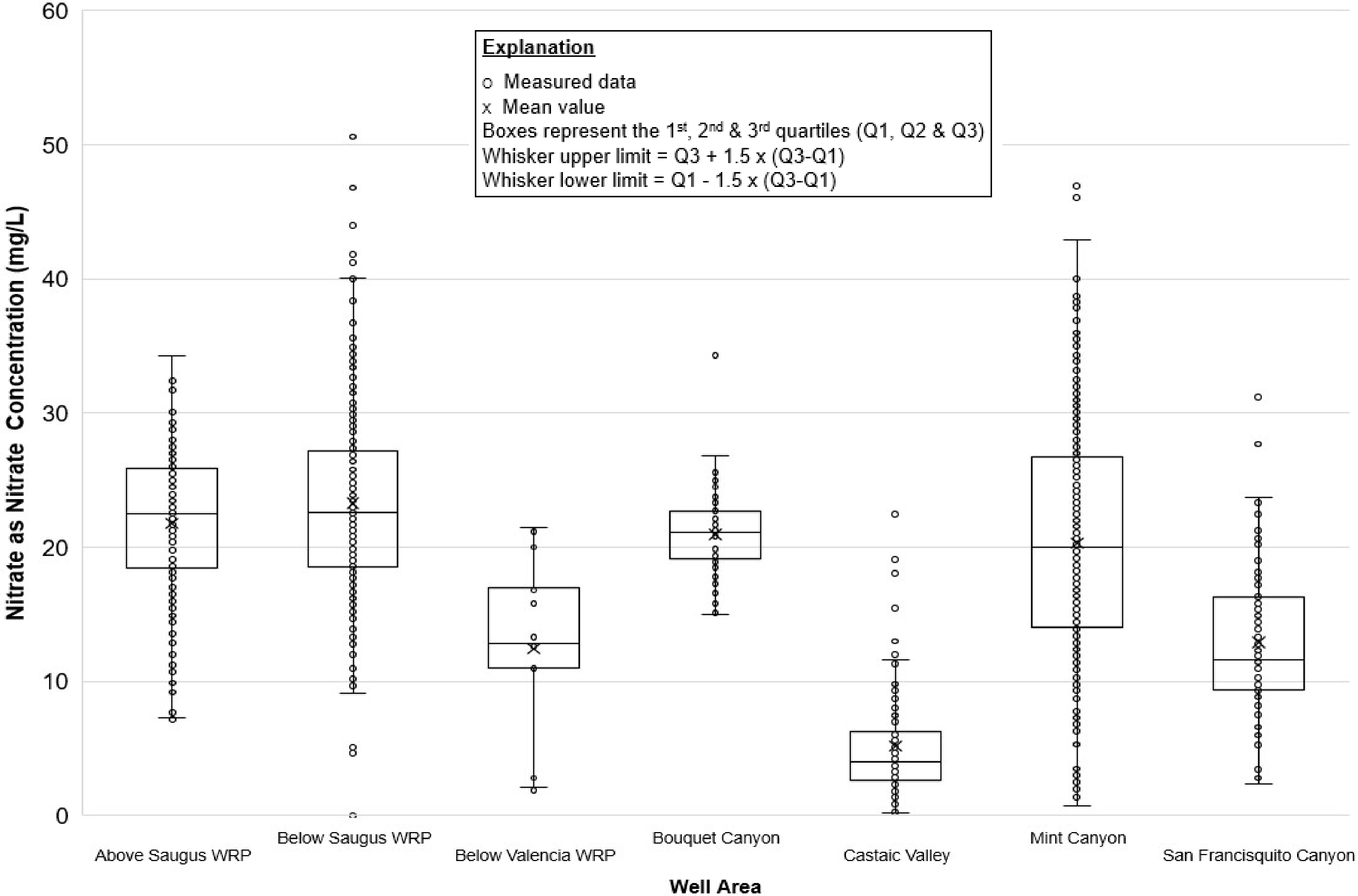
Groundwater Quality in Western Alluvial Wells
Nitrate

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-25



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Alluvial Aquifer Nitrate Box and Whisker Plot

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-26

Sulfate

Sulfate is naturally occurring in groundwater and can occur as a result as runoff from natural geological deposits and from industrial waste. Consumption of sulfate in high concentrations can have a laxative effect (WHO, 2004). The SMCL is 250 mg/L with an upper limit of 500 mg/L and a short-term limit of 600 mg/L. The WQOs for the Alluvial Aquifer range from 150 to 350 mg/L (GSSI, 2016).

In the Mint Canyon and Above Saugus WRP areas, sulfate concentrations have historically ranged between 34 and 538 mg/L (see Figure 5-27). In the set of wells shown on Figure 5-27, all wells except VWD-U4 exhibit a similar steady trend with values less than the WQO of 150 mg/L and no long-term increasing trend. VWD-U4 has shown a very wide range of sulfate concentrations with values exceeding the WQO and SMCL. The last available measurement for this well was in 2014 with a concentration of 440 mg/L. 2018 values were between 78 and 140 mg/L, which were measured at VWD-T7 and SCWD-N. Oaks Central, respectively (see Figure 5-27). VWD-U4 has had sulfate concentrations as high as 500 mg/L. The last measurement for this well was in 2014 with a concentration of 440 mg/L. The average concentration identified in the SNMP for the Mint Canyon and Above Saugus WRP area was 138 and 269 mg/L, respectively.

In the Bouquet Canyon area, sulfate concentrations have historically ranged from 89 and 260 mg/L. Values have shown little variation over time with a gradual increasing trend. 2018 values were 210 and 260 mg/L measured at SCWD-Clark and SCWD-Guida (see Figure 5-27). The WQO for this area is 250 mg/L. The average concentration identified in the SNMP for this area was 189 mg/L.

In the San Francisquito Canyon and Below Saugus WRP areas, sulfate concentrations have historically ranged between 46 and 506 mg/L. The highest value occurred in the early 1960s. Since the early 1990's values have been consistent in this area, showing a gradual increasing trend. In 2018, sulfate concentrations were between 160 and 300 mg/L (see Figure 5-28). The WQO for this area is 250 mg/L. The average concentration identified in the SNMP for this area was 189 mg/L.

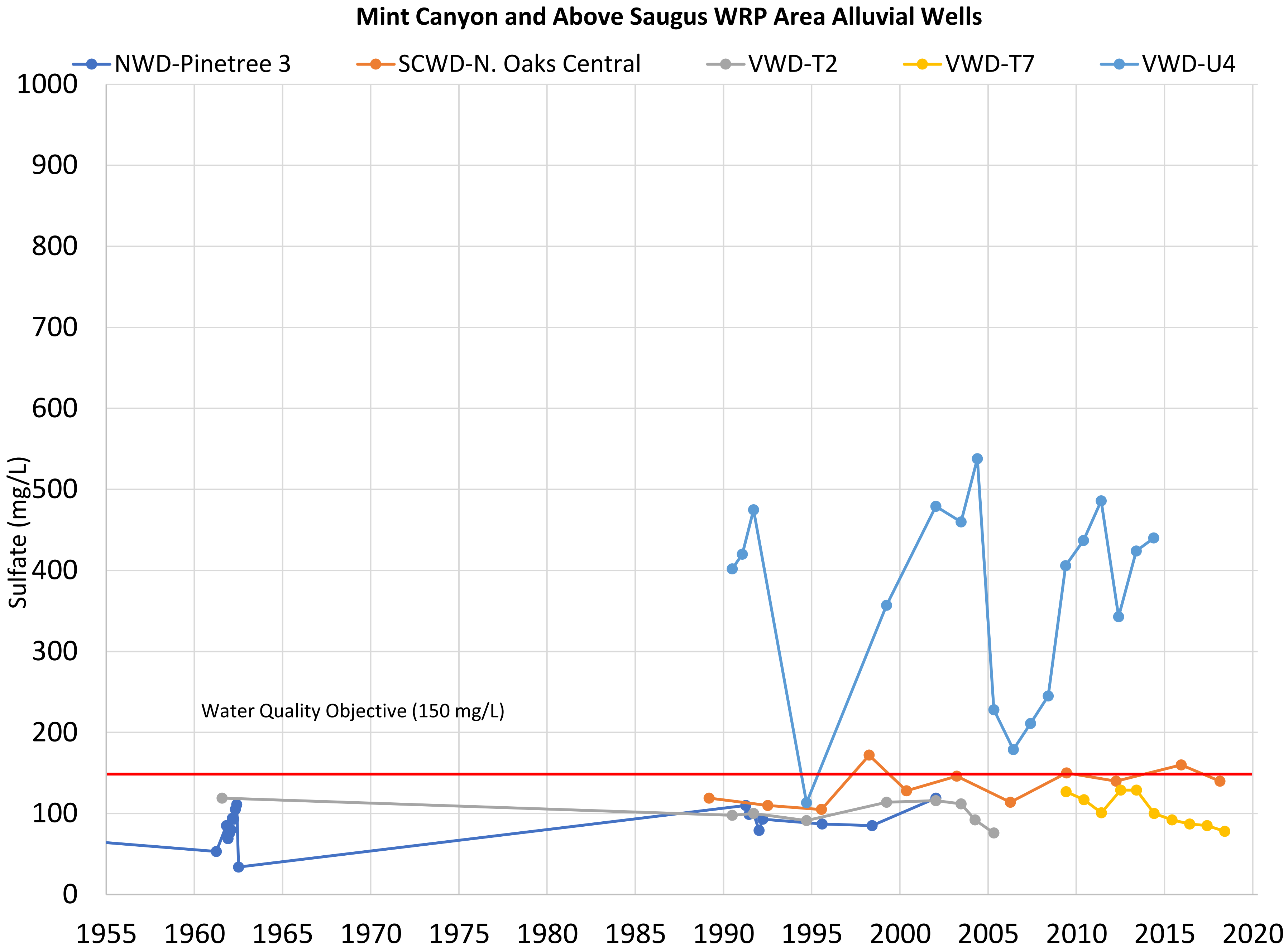
In the Castaic Valley and Below Valencia WRP areas, sulfate concentrations have historically ranged between 89 and 606 mg/L (see Figure 5-28). The historical high value occurred in the late 1960's with the historical low occurring in 2018. Wells in the area have exhibited a decreasing trend of sulfate concentration. The WQO for this area is 350 mg/L. The average concentration identified in the SNMP for this area was 246 mg/L.

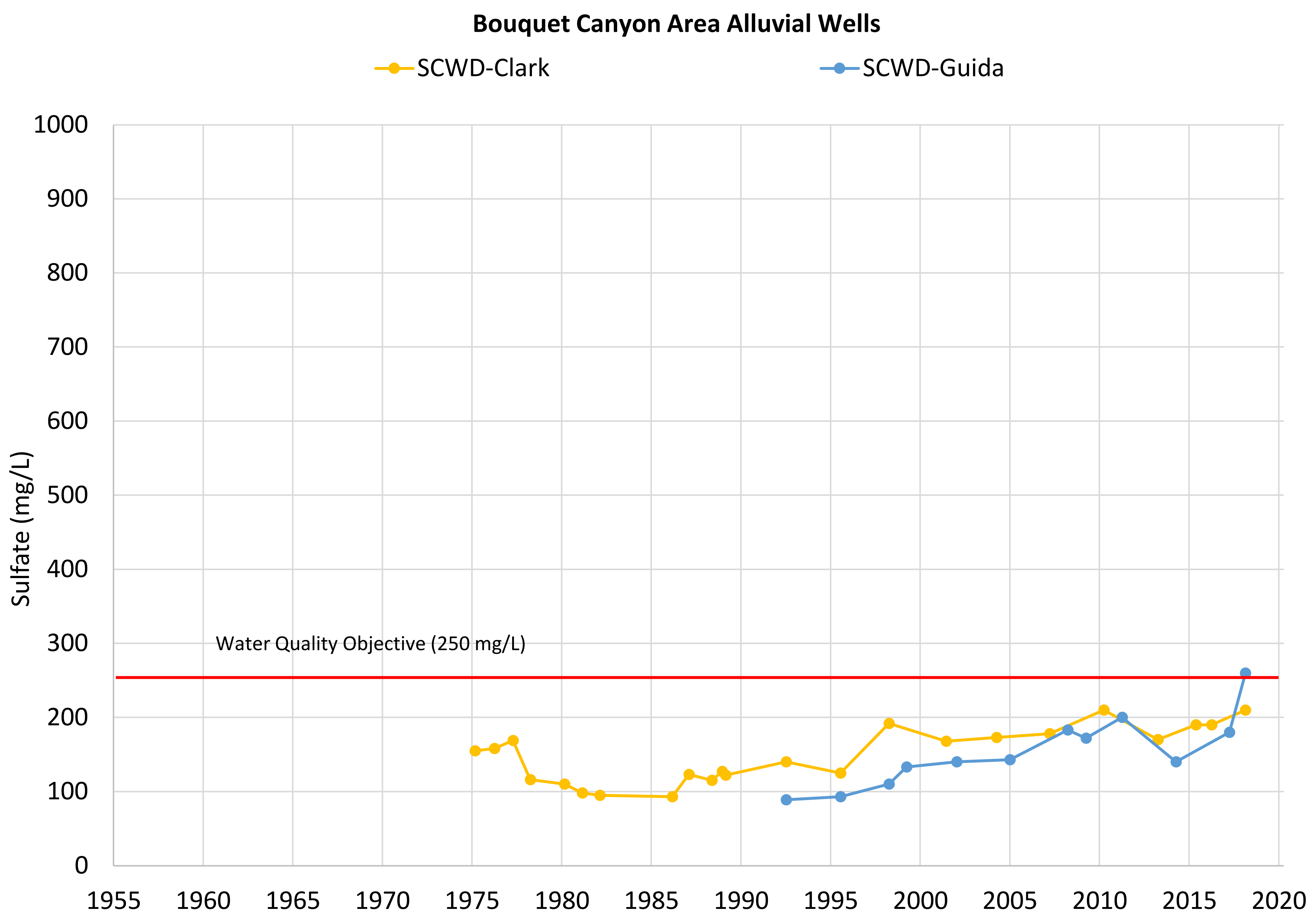
Figure 5-29 is a Box and Whisker plot that presents the distribution of sulfate concentrations across the Alluvial Aquifer with data from 1990 to present. The greatest variation occurs in the Above Saugus WRP area with the highest median value in the Below Valencia WRP area.

5.1.8.2 Groundwater Quality – Saugus Formation

Total Dissolved Solids

TDS concentrations for wells in the Saugus Formation are illustrated in Figure 5-30. Beginning in 2000, several wells within the Saugus Formation have exhibited an increase in TDS concentrations, similar to short-term changes in the Alluvial Aquifer, possibly as a result of decreased recharge to the Saugus Formation from the Alluvial Aquifer. From 2006 through about 2010, TDS concentrations had been steadily declining, followed by an increase through 2016 and a slight decrease in 2017/2018. TDS concentrations in the Saugus Formation remain within the range of historical concentrations and below the SMCL upper level. The WQO for the Saugus Formation is 700 mg/L. (GSSI, 2016). The average concentration identified in the SNMP was 636 mg/L. Groundwater quality within the Saugus Formation will continue to be monitored to ensure that the long-term viability of the Saugus Formation as a component of overall water supply is preserved.





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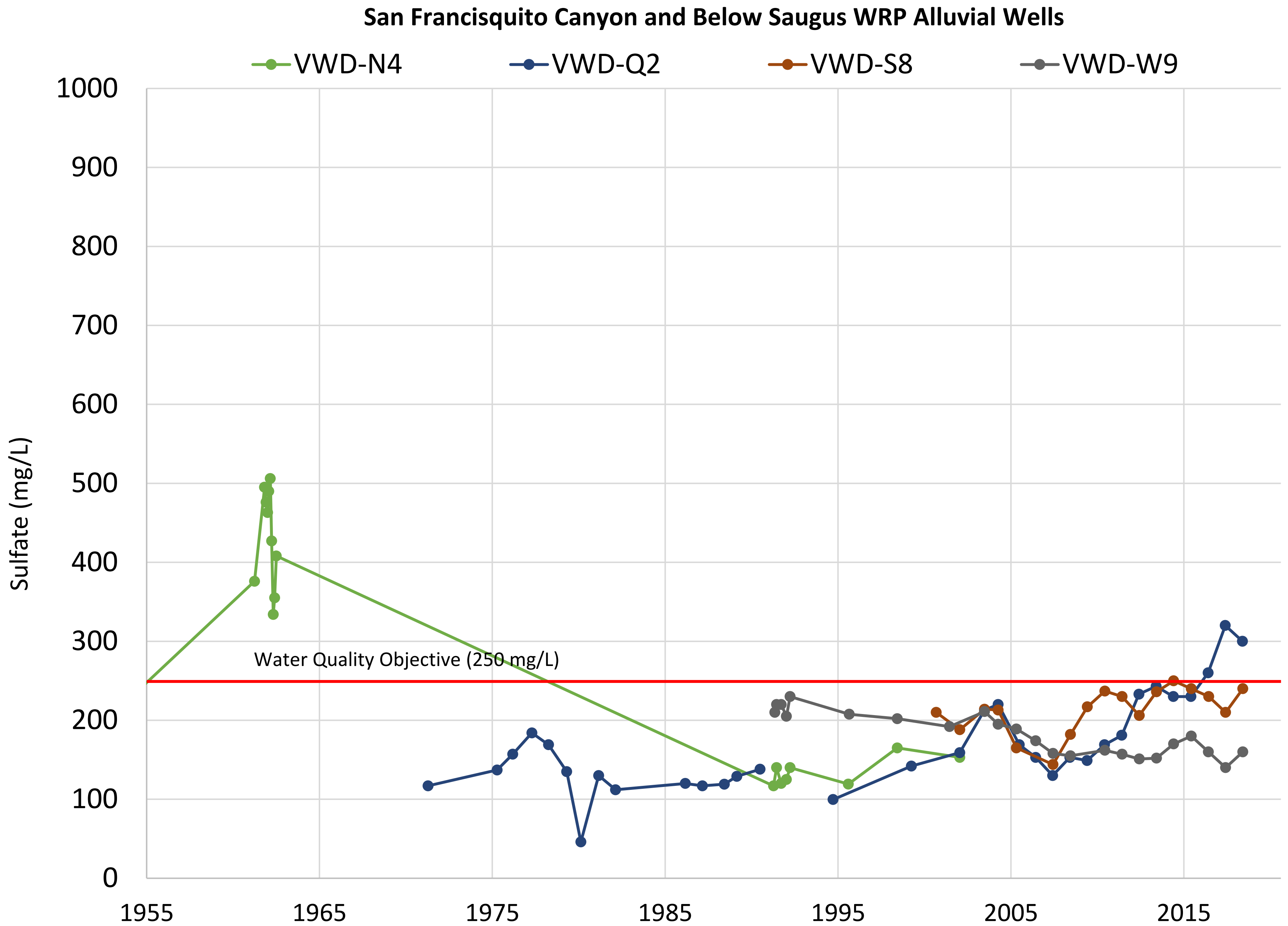
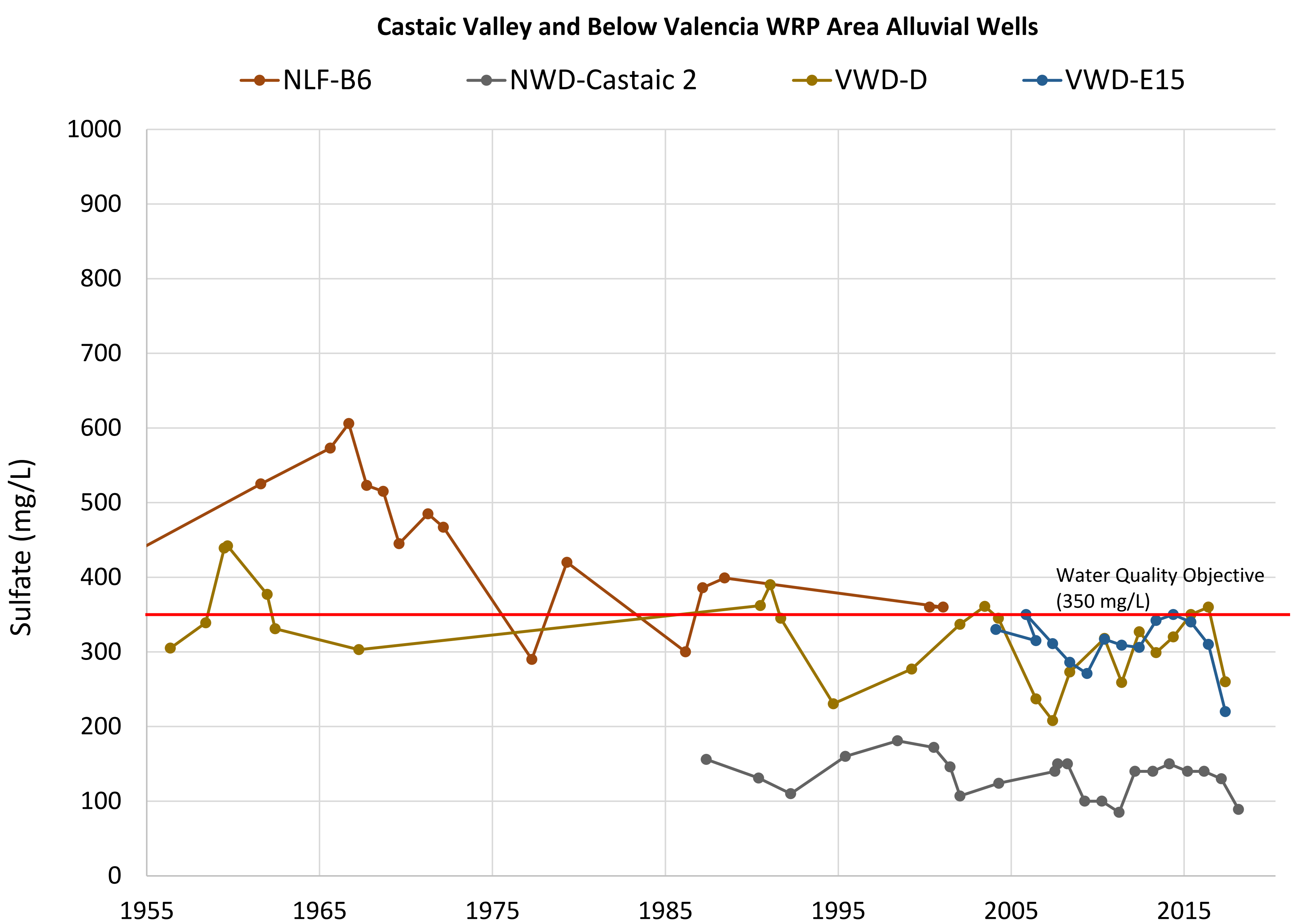
Groundwater Quality in Eastern Alluvial Wells
Sulfate

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-27





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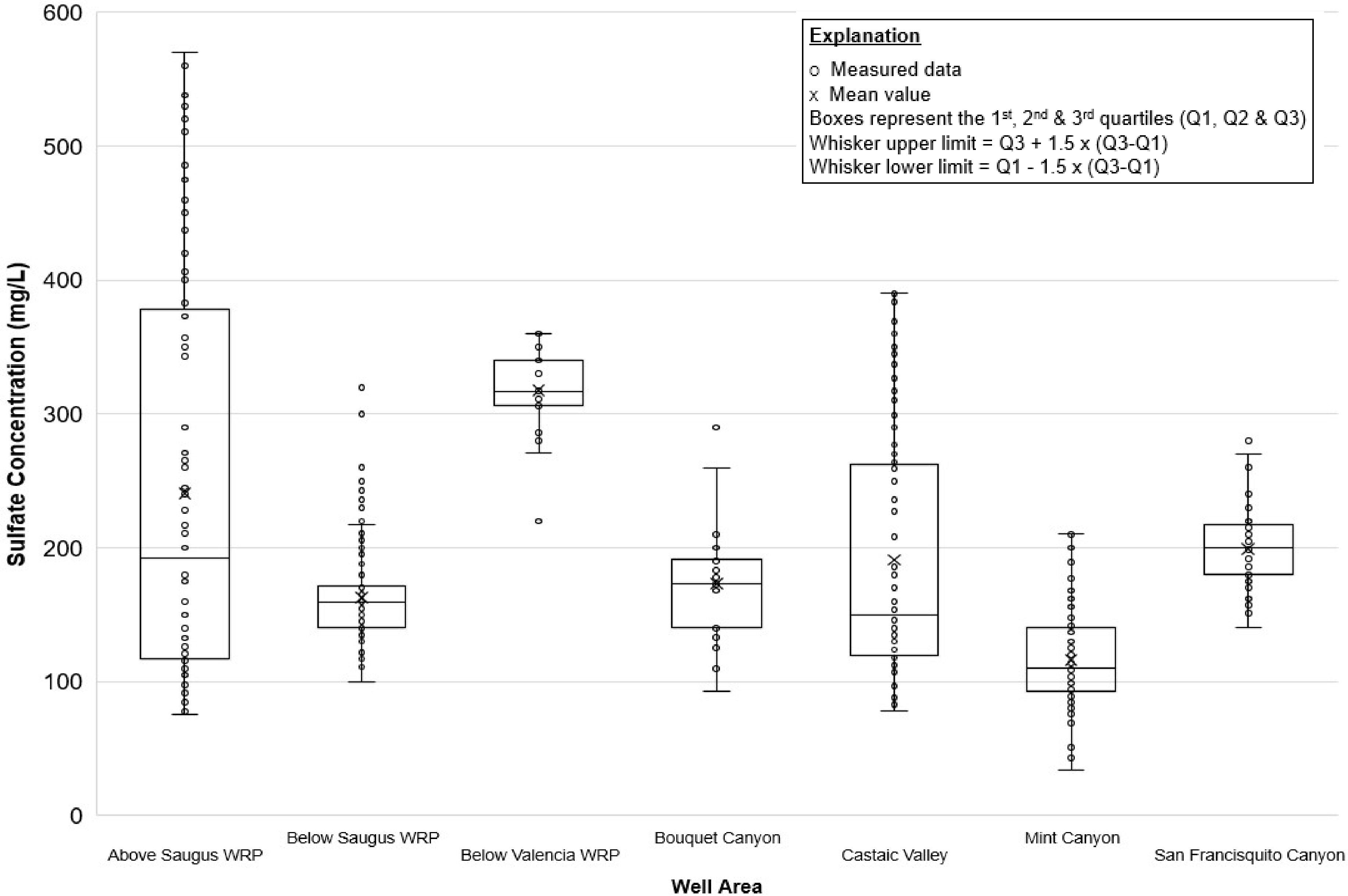
Groundwater Quality in Western Alluvial Wells
Sulfate

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-28



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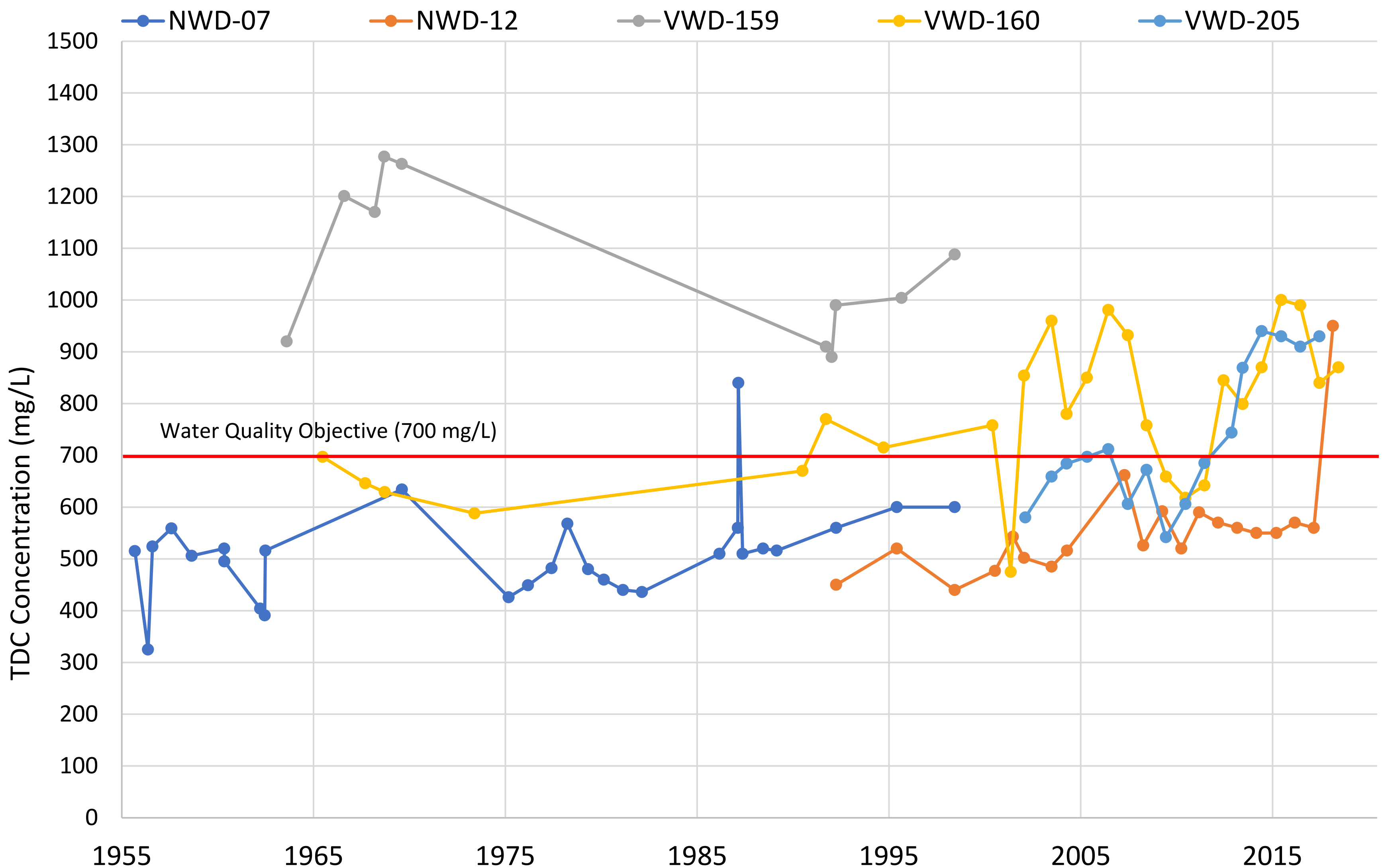
Alluvial Aquifer Sulfate Box and Whisker Plot

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-29



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Saugus Formation TDS Concentrations

Santa Clara River East Subbasin Groundwater Sustainability Plan

Figure 5-30

Chloride

Chloride concentrations for representative wells are presented in Figure 5-31. Historical chloride concentrations have ranged between 17 and 420 mg/L. Chloride concentration in the Saugus Formation have been stable for the past 50 years. The WQO for chloride in the Saugus Formation is 100 mg/L. The average concentration identified in the SNMP was 28 mg/L.

Nitrate

Nitrate concentrations for representative wells are presented in Figure 5-32. Nitrate concentrations in the Saugus Formation have ranged from ND to 28 mg/L. Values have historically been stable but have shown higher concentrations in recent years, but are still well below the WQO of 45 mg/L. The average concentration identified in the SNMP was 14 mg/L.

Sulfate

Sulfate concentrations for representative wells are presented in Figure 5-33. Historical sulfate concentrations have ranged from 80 to 730 mg/L. The highest concentrations have been observed in VWD-159, which has not been sampled since 1998. Sulfate concentrations in some wells completed in the Saugus Formation exceed the federal SMCL of 250 mg/L. Overall, sulfate concentrations have exhibited an increasing trend in recent years. The high sulfate in the Saugus Formation is mostly likely due to naturally occurring minerals present in the rock. The average concentration identified in the SNMP was 235 mg/L. A WQO for sulfate in the Saugus Formation is not identified in the SNMP.

5.1.8.3 Groundwater Constituents of Concern (Anthropogenic) in the Alluvium and Saugus Formation

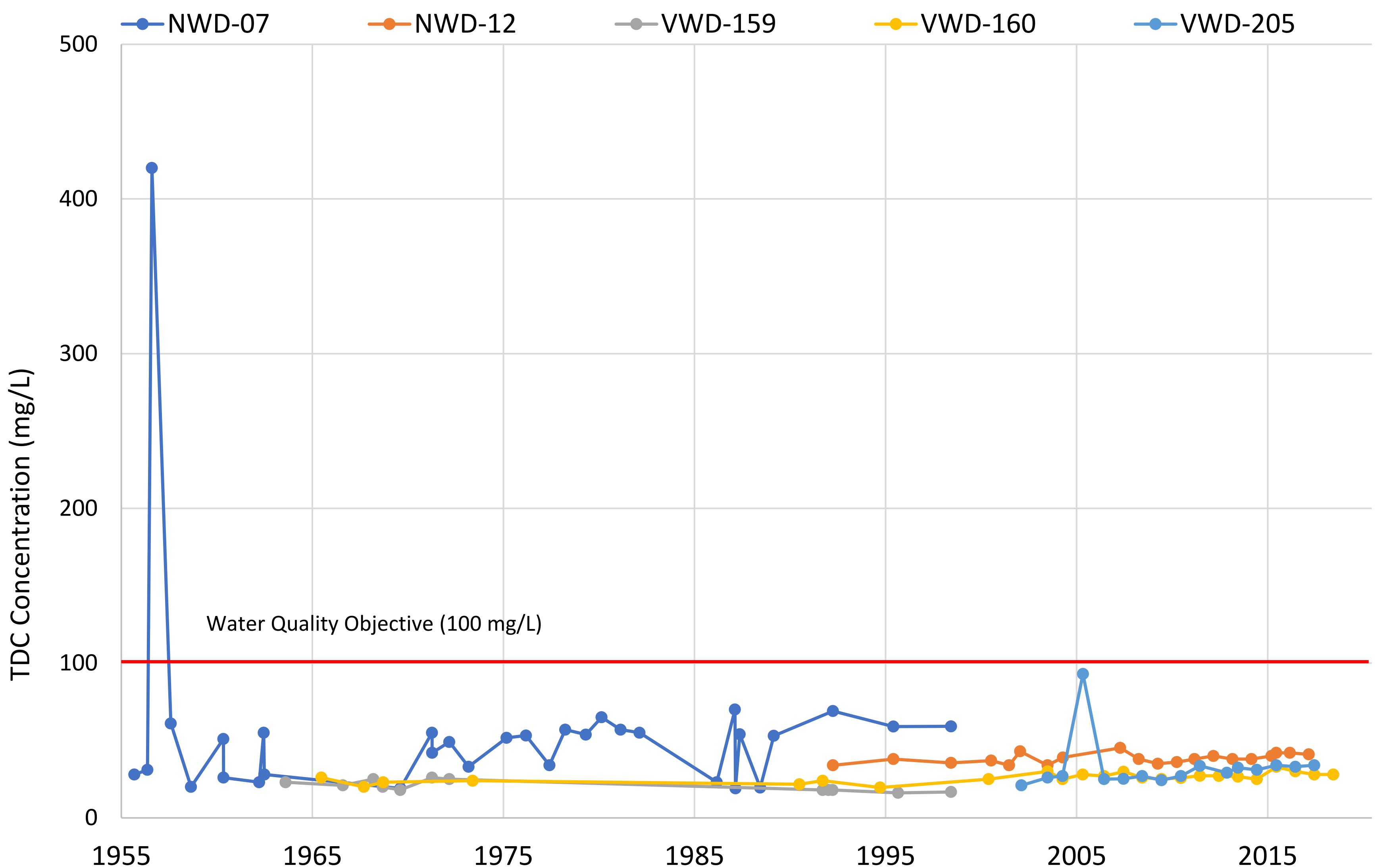
Groundwater COCs that have been measured in the Alluvial Aquifer and Saugus Formation include perchlorate, per- and PFAS, and VOCs such as TCE, and PCE. These contaminants have been identified in previous studies and are currently monitored under other state and federal regulatory programs (LSCE, 2019; GSSI, 2016).

Perchlorate and VOCs

Perchlorate is a regulated substance that is commonly used in propellants for rockets, missiles, and fireworks. Consumption of groundwater with high concentrations of perchlorate can result in issues with the thyroid gland (EPA, 2014). There have been several detections in the Basin, both in the Alluvial Aquifer and in the Saugus Formation. Perchlorate was first detected in the Basin in 1997 and since has been detected in a total of eight wells. Wellhead treatment systems have been built for four Saugus Formation production wells operated by SCV Water, with oversight from the California Department of Toxic Substances Control (LSCE, 2019). Details regarding ongoing and future monitoring of perchlorate concentrations in groundwater are provided in Section 7.2.6.1 of the GSP, along with a map (Figure 7-7) of the property that is the source of perchlorate detections in groundwater.

PCE is a VOC that is commonly associated with dry cleaning and metal degreasing processes. Long-term exposure at levels near the MCL can result in cancer. Other adverse effects include damage to the liver, kidneys, and central nervous system (SWRCB, 2017b). Detections of PCE have primarily occurred in the Alluvial Aquifer, however, the concentrations have been below the MCL.

TCE is a VOC that is primarily associated as a solvent to remove grease from metal parts. Long-term exposure could result in cancer. Exposure can also affect the central nervous system with symptoms such as light-headedness, drowsiness, and headache (SWRCB, 2017c). Detections of TCE have primarily occurred in the Alluvial Aquifer, however, the concentrations have been below the MCL. Table 5-3 presents the number of wells with detections above the reporting limit and MCL for perchlorate and each VOC of interest across the Basin.



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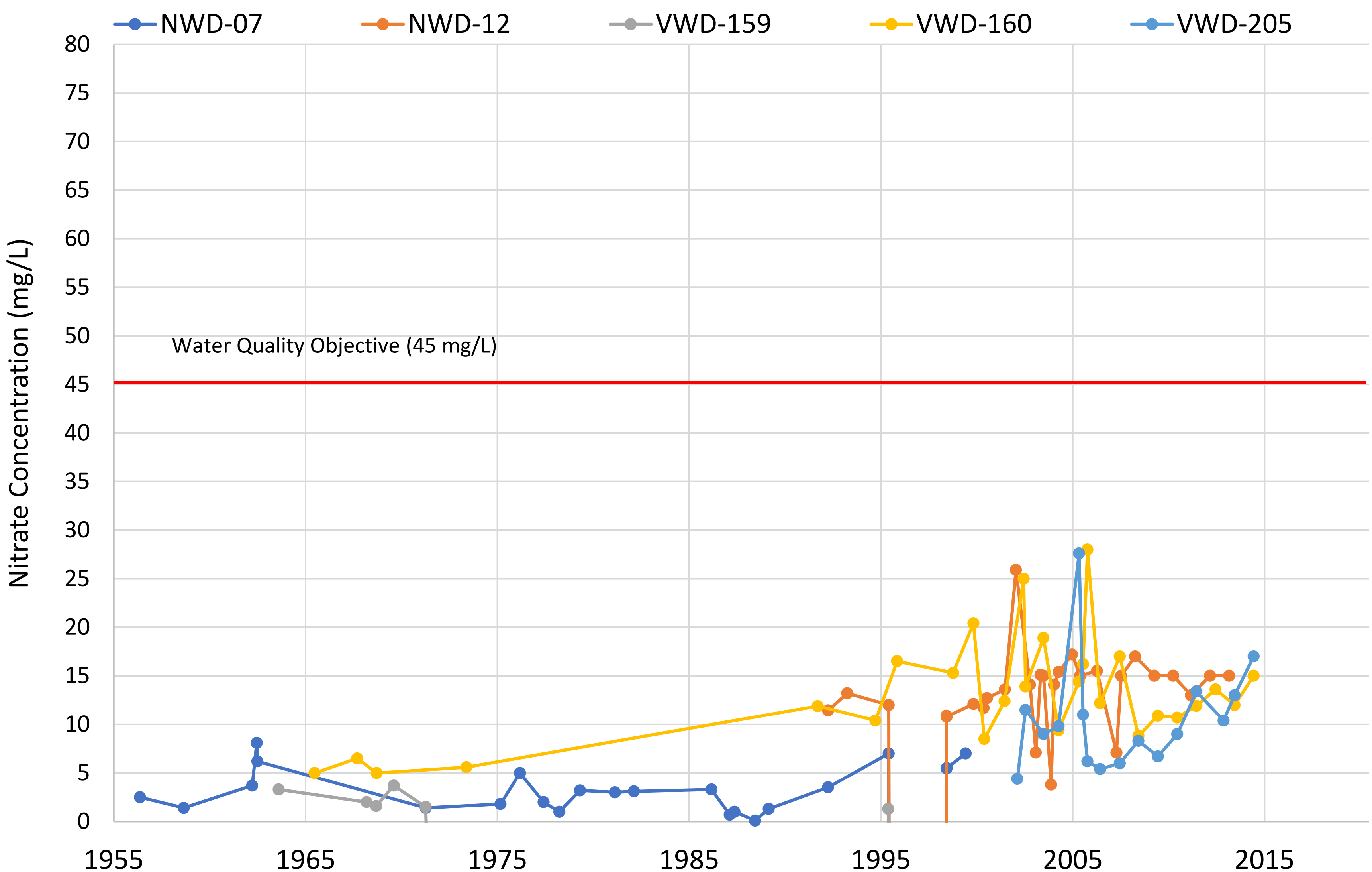
Saugus Formation Chloride Concentrations

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-31



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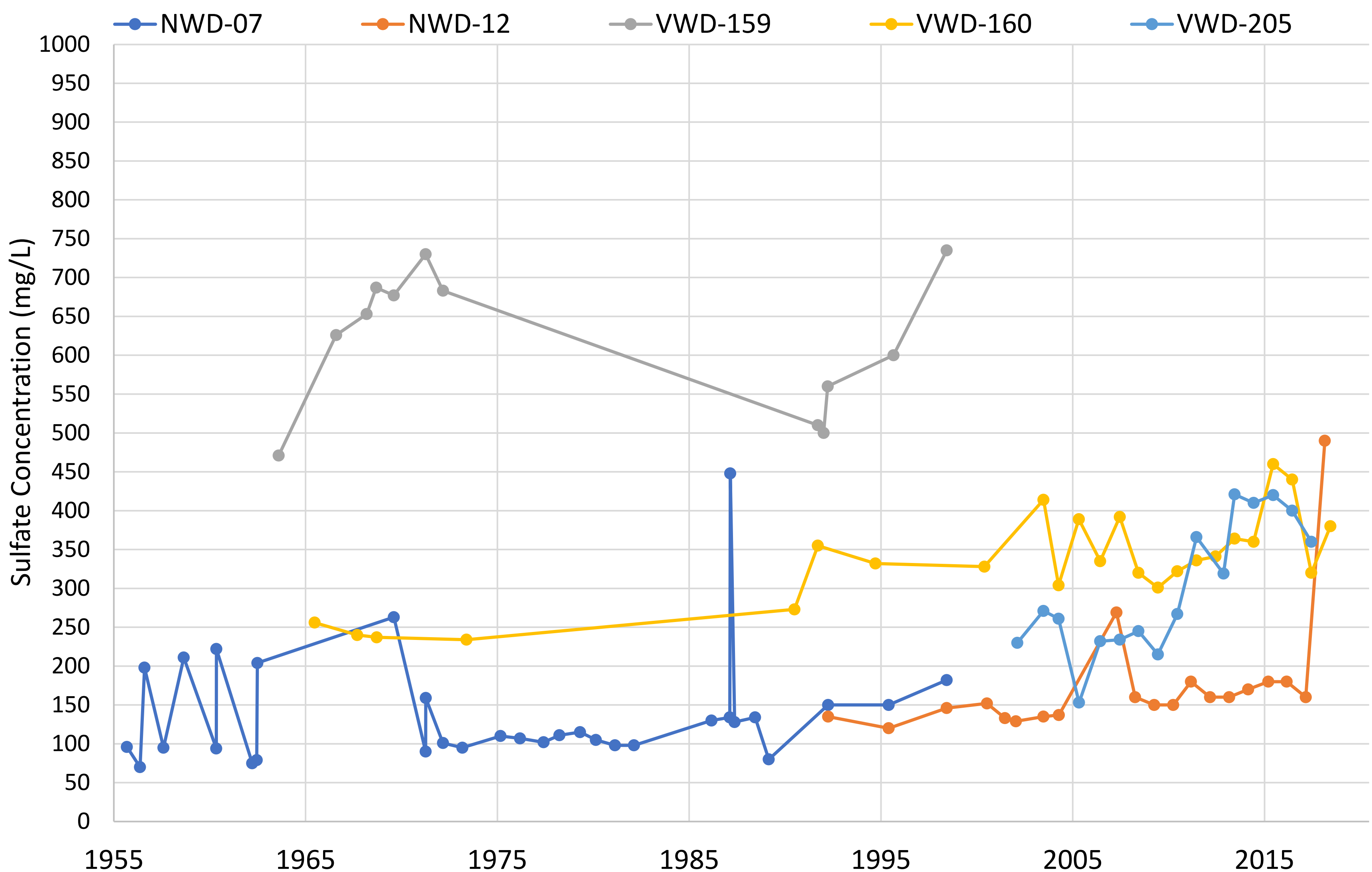
Saugus Formation Nitrate Concentrations

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-32



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Saugus Formation Sulfate Concentrations

Santa Clara River East Subbasin
Groundwater Sustainability Plan

Figure 5-33

Table 5-3. Wells with Perchlorate and VOC Detections

COC	Alluvial Wells with Detections > RL	Saugus Wells Detections > RL	RL	Max Concentration	MCL	Wells with Detections Above MCL	Units
Perchlorate	2	6	4	47	6	7	µg/L
Tetrachloroethylene (PCE)	14	1	0.5	2.6	5	0	µg/L
Trichloroethylene (TCE)	4	6	0.5	4.4	5	0	µg/L

Notes

COC = constituent of concern MCL = maximum contaminant level

RL = reporting limit VOC = volatile organic compound

PFAS

PFAS refers to the larger group of COCs of per- and polyfluoroalkyl substances. Formerly extensively used in firefighting foams, non-stick coatings, cookware, carpets, and furniture, these substances tend to accumulate in groundwater and long-term exposure could potentially affect the immune system, thyroid, liver, and can cause cancer. The most common types of PFAS are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). They are a contaminant of emerging concern that are not currently regulated. DDW has identified notification levels for PFAS concentrations that is a precautionary health-based measure for concentrations of chemicals in drinking water that warrant further monitoring and assessment (SWRCB, 2020).

The California Department of Toxic Substances Control and LARWQCB are overseeing the monitoring of and response to detections of constituents of concern exceeding the MCLs. SCV Water is actively addressing the issue with the regulatory agencies and has taken wells out of service that have detections above reporting limits until wellhead treatment systems are deployed.

The following is a SCV Water news release from March 13, 2020:

> *SANTA CLARITA –SCV Water has taken proactive steps to protect public health by voluntarily removing 13 of its groundwater wells from service. This move follows the State Water Resources Control Board – Division of Drinking Water (DDW) Feb. 6, 2020, decision to lower its response level guidelines for two chemicals found in low concentrations in drinking water across the state.*
>
> *Voluntary quarterly sampling of all active wells was done in February, and this action is based on those results for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). The Agency did not find more or higher levels of the chemicals, but instead is taking action based on the lowered response levels set by the DDW.*
>
> *The action this week is not related to the COVID-19 virus. The virus is not found in drinking water.*
>
> *Under the new levels, 14 of the 44 agency wells are impacted. This accounts for approximately 34 percent of the Agency's groundwater supply. In 2019, groundwater accounted for just 28% of the total water used in the SCV Water service area. SCV Water will continue to rely on its diverse water supply portfolio, including imported and banked water, to minimize supply impacts to customers.*
>
> *"SCV Water has a diverse and resilient water supply, so this action will not impact the availability of water to our customers," stated Matt Stone, general manager. "However, with some groundwater*

> *wells temporarily offline, it remains important that customers continue to use water efficiently in their homes and on their landscapes.*
>
> *Last month, the DDW lowered its response levels to 10 parts per trillion (ppt) for PFOA and 40 parts per trillion (ppt) for PFOS. The state's previous response level set a combined 70 ppt for PFOA and PFOS. These response levels are some of the most stringent guidelines in the nation, and lower than the Environmental Protection Agency's Lifetime Health Advisory level of 70 ppt. For perspective, one part per trillion would be equal to four grains of sugar in an Olympic-size swimming pool.*
>
> *The updated guidelines are part of DDW's statewide effort to assess the scope of water supply contamination by PFOS and PFOA.*
>
> *"We have three quarters of sampling data we can factor in now, giving us a head start in addressing the new guideline," stated Matt Stone, general manager of SCV Water. "Our top priority is providing clean and reliable water to our customers. We immediately removed one well from service last year when it exceeded the original response level, and we have taken the same actions for the 13 additional wells that exceeded the revised response level."*
>
> *SCV Water is also quickly moving forward with the construction of several water treatment plants to return affected wells back to service. The first PFAS treatment facility has started construction and is expected to be in operation by June of this year, restoring three key wells to service, which provides enough groundwater for 5,000 families. The fast-tracked project is estimated to cost $6 million to build and $600,000 annually to operate. Additional groundwater treatment facilities are in the planning and design phase.*
>
> *"We are committed to clear and timely communication with our customers about all water quality changes and how we plan to address them," said Stone. "Our customers are our top priority, and we are committed to rigorously testing our water thousands of times per year to ensure it meets or surpasses all water-quality standards and is safe for our customers to drink."*
>
> *Per- and polyfluoroalkyl substances (PFAS) are a group of manmade chemicals that are prevalent in the environment and were commonly used in industrial and consumer products to repel grease, moisture, oil, water and stains. Water agencies do not put these chemicals into the water, but over time very small amounts enter the water supplies through manufacturing, wastewater discharge and product use. Exposure to these chemicals may cause adverse health effects.*
>
> *For more information and resources on PFAS, visit yourSCVwater.com/pfas.*

5.2 Groundwater-Surface Water Interaction

This section examines the relationship between groundwater and surface water in the Basin. The goals of this evaluation are as follows:

- Evaluate the relationship between alluvial groundwater levels and surface water flows in the Santa Clara River downstream of the Saugus and Valencia WRPs.
- Understand the principal factors affecting groundwater levels downstream in comparison with other factors.
- Identify where groundwater levels lie relative to the bottom of the river channel (thalweg) as an indication of whether the river is gaining (groundwater discharging into the river) or losing (surface water infiltrating to groundwater) during different climatic conditions.

Section 5.2.1 describes the authors' conceptual understanding of the relationship between the surface water and groundwater in the Basin.

5.2.1 Conceptual Understanding of the Relationship between Groundwater and Surface Water and Effects of Urbanization

The Santa Clara River is the primary surface water drainage feature in the Basin, flowing generally from east to west (see Figure 5-34). The river is interconnected directly with the Alluvial Aquifer, primarily in the western and central portions of the Basin. The river also has an indirect connection with the Saugus Formation in the western portion of the Basin, which is an area where the Saugus Formation is discharging its water into the Alluvial Aquifer, and thereby providing an upwards driving force for groundwater to discharge into the Santa Clara River in certain localized reaches west of I-5 at certain times. Figure 5-35 is a conceptual diagram that illustrates the various components of the hydrologic cycle in the Basin and the relationship between the river, the Alluvial Aquifer, and the Saugus Formation. Rainfall falling in the upper elevations of the watershed infiltrates into the soil, where some of the water evaporates or is transpired by vegetation and the remainder becomes stormwater that can also infiltrate to groundwater. A portion of the rainfall runs off the land surface and flows into side canyons and tributaries to the river. In the urban areas, precipitation falling on impervious surfaces is directed to storm drains that flow to the river or the stormwater is directed to swales and allowed to percolate in some locations.

5.2.1.1 Groundwater Pumping

The history of groundwater pumping in the Basin dates back to at least the 1930s. Groundwater pumping peaked in the 1950s and 1960s, when groundwater was extracted almost exclusively for agricultural operations. Estimated groundwater extraction based on the number of acres of agriculture, typical crops, and growing practices during that period indicate annual demand of approximately 50,000 AFY.

In the late 1960s agricultural operations began to be replaced by urban land uses. Newly built urban uses were served by local water companies that provided only groundwater. As agricultural groundwater pumping was being reduced in the Basin, urban groundwater pumping became the largest groundwater demand, and between 2005 and 2014 pumping ranged from 27,000 AFY to 35,000 AFY for urban and 13,000 AFY to 17,000 AFY for agricultural purposes. Generally, over the past 70-year history, groundwater extraction transitioned from its highest volume serving primarily agriculture to a moderately lower volume serving urban uses and some agriculture.

Water demand for agricultural and municipal use varies seasonally, with the highest demand occurring in summer due to agricultural and urban irrigation demand. Locally, municipal water supply is made up by roughly a 50:50 blend of groundwater and imported water each year. Municipal pumping data indicate groundwater pumping in August, the period of highest demand, is almost twice the lowest-demand period in February. Groundwater extraction for agriculture is also higher during the summer months but is dependent on a variety of criteria that are highly dependent on cropping patterns.

Increased groundwater extraction in the summer months temporarily lowers the water table and, thus, can temporarily reduce the amount of shallow groundwater discharging to the river in some areas. Shallow groundwater levels and river flows in the summer are also affected by other important factors, principally water consumption from vegetation in and near the river corridor. It is believed that invasive species such as Arundo donax (Arundo) significantly contribute to this water consumption. Groundwater levels in the Alluvial Aquifer are also affected by discharges from the Saugus and Valencia wastewater reclamation plants that discharge into the river.

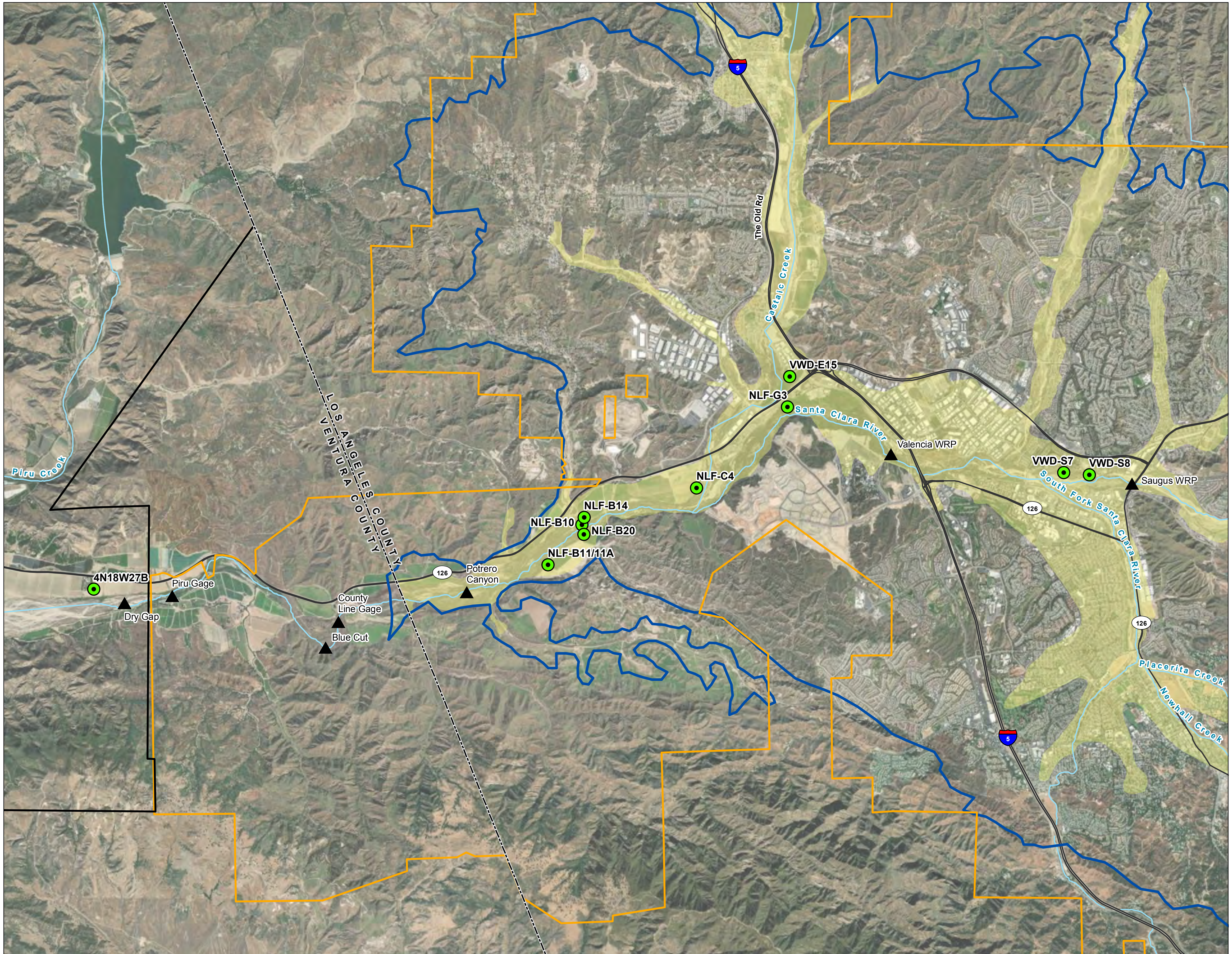

FIGURE 5-34

Wells Used for Evaluating Groundwater-Surface Water Interactions

Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan

LEGEND

- Key Well
- Point of Interest
- Alluvial Aquifer
- Service Area Boundary for SCV Water
- UWCD Boundary
- Santa Clara River Valley Groundwater Basin, East Subbasin

All Other Features

- County Boundary
- Major Road
- Watercourse

NOTES

SCV Water: Santa Clarita Valley Water Agency
UWCD: United Water Conservation District

N

0 3,000 6,000 9,000
Feet

GSI Water Solutions, Inc.

Date: December 9, 2021
Data Sources: USGS, Maxar Imagery (2019), DWR Bulletin 118

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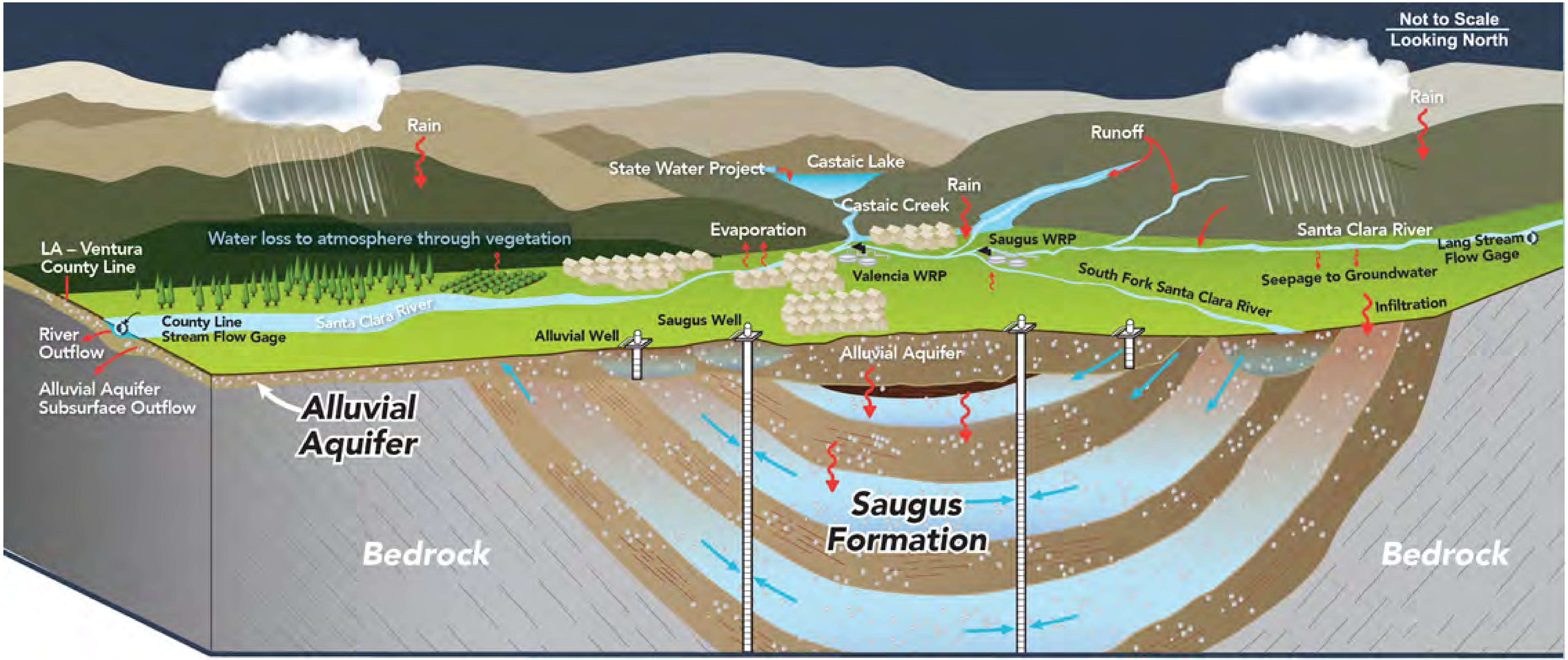

FIGURE 5-35

Conceptual Surface Water and Groundwater Flow Diagram

Santa Clara River Valley Groundwater Basin, East Subbasin

GSI Water Solutions, Inc.

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5.2.1.2 Influences of Urbanization

As land use shifted from agricultural to urban use in the Basin, it also changed the groundwater and surface water interactions in some areas. While less water was pumped from the Basin for irrigation of crops, less recharge from deep percolation of irrigation water below the root zone was also occurring. Some of this reduction in groundwater recharge was offset by deep percolation from urban landscaping irrigation. Additionally, less infiltration from precipitation occurs because of the addition of impervious surfaces that accompany urbanization.

Importation of State Water Project water into the Basin began in the 1980s. These flows increased the recharge into the Basin from urban irrigation and discharges from the WRPs, resulting in a net increase in the amount of water in the groundwater/surface water system. The net effect of these factors has resulted in more water entering and leaving the Basin.

Water used indoors makes its way to either the Saugus or Valencia WRPs, and most of the water that is treated at these WRPs is discharged to the Santa Clara River or is redirected into a nonpotable recycled water system. A portion of the pumped groundwater and imported water also is used for outdoor irrigation of yards, parks, and landscaping; this irrigation water is transpired by vegetation and a lesser portion infiltrates to groundwater. In more rural areas that are unsewered, individual parcels are served by a combination of municipal and private wells, and a portion of the water recharges the groundwater system through septic tank drain fields. Some of this water that recharges the water table has the potential to make its way back to the Santa Clara River, though most of the septic systems are located away from the river in alluvial tributary valleys or on bedrock outcrops of the Saugus Formation and older rock units.

5.2.1.3 Groundwater-Surface Water Exchange

The amount and direction of the exchange between the Santa Clara River and the alluvial groundwater system in the Basin is dependent on a number of factors including cycles of wet/normal/dry rainfall conditions, WRP discharges to the river, releases from Castaic Reservoir, ET from riparian vegetation along the river corridor, stormwater flows, and groundwater pumping. As will be discussed in Section 5.2.4, there are areas where it is likely that the river is receiving groundwater flow and other areas where the river is recharging groundwater, depending on the time of year and the hydrologic factors mentioned here.

Because the river flows across the alluvium in the Basin, the river is an important source of recharge to the Alluvial Aquifer and the Saugus Formation, particularly east of I-5 and in the river's tributary valleys. Groundwater flows horizontally within the alluvium and, in some locations, percolates downward into the underlying Saugus Formation. As presented in a technical memorandum prepared by Luhdorff & Scalmanini Consulting Engineers (LSCE, 2021), most of this deep percolation recharge from the Alluvial Aquifer into the Saugus Formation occurs on the eastern end of the Basin from just west of the mouth of Mint Canyon downstream to roughly the location of the Saugus WRP. The river is generally losing in this portion of the Basin, meaning that river water is infiltrating to the groundwater table. Beginning roughly at the mouth of San Francisquito Canyon, significant reaches of the river appear to be gaining (meaning that groundwater is discharging to the river), particularly during normal and wet years. A significant reason for this is the addition of water into the river from WRP discharges. In addition, the reach from Castaic Creek to just upstream of Potrero Canyon appears to be gaining during most hydrologic periods as a result of Saugus Formation groundwater discharging to the Alluvial Aquifer and then to the river in this area. From this location downstream to the western basin boundary (which is near the LA/Ventura County line [county line]), the river flows on top of a thin layer of alluvium that is roughly 10 to 30 feet thick. Because only low-permeability Pico Formation mudstone and claystone underlies this area, flow across the western boundary of the Basin into the Piru Subbasin occurs in the alluvium and as surface water, but this river section is predominantly losing in this area because of the lack of an upwelling of deeper groundwater from the Pico Formation (in contrast to the upwelling that occurs further upstream where the Saugus Formation is present).

5.2.2 Data Evaluation Methodology

The area of interest for this study is the reach of the Santa Clara River extending from the Saugus WRP westward to the Piru Dry Gap, which is located in Ventura County, approximately 3 miles west of the western boundary of the Basin (see Figure 5-34). This study area was selected because it contains the portion of the Basin where there are exchanges between surface water and groundwater and because there are sensitive habitats in this section of the river. Upstream to the east, the river and tributaries are ephemeral, flowing only during high-flow storm events. GSI identified a number of alluvial wells located near the river channel and obtained historical water level data from SCV Water, FivePoint Holdings, LLC (the Newhall Land and Farming Company), and United Water Conservation District (UWCD). The following data sets were used in the hydrograph analysis:

- Depth to water data from various alluvial wells located within the study area
- Precipitation data, dating as far back as 1883, from the Newhall-Soledad FC32CE gage in Newhall (currently maintained by the LADPW) and (beginning in 1979) the Pine Street gage (currently maintained by SCV Water, and formerly established by its predecessor agency Newhall County Water District)
- Monthly discharge volume data from both the Saugus and Valencia WRPs, dating back to 1980
- Monthly release volume data from the Castaic Lagoon, dating back to 1980
- River bottom (thalweg) elevation data for the Santa Clara River, which was collected by Environmental Science Associates (ESA) in 2016 using Light Detection and Ranging (LiDAR) methods.

The observed fluctuation in groundwater levels observed in the hydrographs may be affected by a number of seasonal and annual factors including precipitation, seasonal climate, surface water flow, WRP discharges, and changes in pumping. In order to examine some of these effects, multiple hydrographs that had sufficient groundwater level data available during wet, dry, and normal hydrologic periods were created for each well. Each hydrograph has two data sets in common: groundwater elevation over time and channel bottom elevation (also referred to as the thalweg). Groundwater elevation data illustrate the historical trends and fluctuations in groundwater levels. GSI used reference point elevations at each wellhead estimated from Google Earth to convert depth-to-water measurements to groundwater elevations. The reference point elevation data are accurate to within approximately +/- 5 feet, which affects the amount of uncertainty that arises when comparing groundwater level elevations to the bottom of the river channel (thalweg) elevations which are obtained from the more accurate LiDAR data source.

The river thalweg is a single data point that represents the lowest point in the river channel nearest to the well. Using the LiDAR data in conjunction with ArcGIS, a cross section of the channel bottom was created perpendicular to the river and in line with the well. The lowest point in the cross section was used as the thalweg and it was assumed that this value has not changed significantly over the years.[22] This data point is portrayed as a horizontal line on each hydrograph. The significance of this line is that when the groundwater elevation is equal to or above the channel bottom elevation, groundwater has the potential to contribute to surface flow, assuming that the groundwater level is above the surface elevation of the river. Because information about the elevation of the river at each location (and how that has likely changed over time) is lacking, it is possible to say only that there is a potential for the river to be gaining at these locations. As

[22] LiDAR data are a snapshot in time, representing present conditions. The data include both the elevation of the channel invert and the location of the channel. However, the current channel conditions are not necessarily the same as they have been in the past. Channel characteristics change over time, particularly due to large flood events such as those that occurred in 1993, 1997–1998, and 2004–2005.

indicated by the hydrographs, water levels in several wells stop at the thalweg elevation, in which case GSI infers that groundwater must be flowing into the river. In contrast, when the groundwater elevation is below the channel bottom elevation, GSI infers that groundwater is not contributing to surface flow in the river (regardless of river elevation) because the water table is not high enough to reach the channel bottom—in which case, this area is identified as a losing reach, where a portion of the streamflow is seeping downward to the underlying water table in the alluvium.

For each well, the base hydrograph (showing groundwater elevation and thalweg) was duplicated and plotted with at least one other factor that may affect groundwater levels, such as WRP discharges and precipitation (the latter of which relates to stormwater flows). This enables a demonstration of how a certain factor correlates with groundwater levels, if at all. For example, if the hydrograph shows a trend of increasing precipitation and an increase in groundwater elevation during the same time frame, then it is likely that precipitation has a strong influence on groundwater levels in that area.

The raw form of precipitation data is daily and monthly rainfall in measurement units of inches. However, for evaluating longer-term correlations, precipitation data are better presented as a cumulative departure from the long-term average amount of rainfall on an annual basis. When plotted on a hydrograph, the slope of a cumulative departure curve is indicative of the climatic conditions during a given period of time. An increasing slope represents a period of above-average precipitation, and a decreasing slope represents a period of below-average precipitation.

Results from the calibrated groundwater flow model were used in some cases to examine certain reaches of the river where measured groundwater data at certain wells are suspect (e.g., not representative of static conditions) or inconclusive. In other cases, where water level data are lacking, the groundwater flow model was used to corroborate observations about where the Saugus Formation is discharging to the alluvium and then the river. Details of the model setup and calibration are presented in a separate document (GSI, 2021).

The data and results of this evaluation were synthesized to create three maps showing the elevation of groundwater relative to the thalweg at various locations along the river during wet, normal, and dry climatic conditions. Wet conditions are defined by periods of above-average precipitation during the past 40 years, normal conditions are defined by periods of average precipitation, and dry periods are defined by periods of drought, or below-average precipitation. The average annual precipitation at the Pine Street gage since its establishment in 1979 was 21.3 inches. For the purposes of evaluating groundwater/surface water exchanges, wet and dry conditions were defined as periods with approximately 50 percent differences in annual precipitation compared with the 1980–2019 average precipitation (i.e., 31.8 inches or more during wet years and 10.5 inches or less during dry years). The maps display locations where groundwater levels are as follows:

- Above the thalweg or no deeper than 1 foot below the thalweg (blue)
- 1 foot to 5 feet below the thalweg (green)
- 5 feet to 15 feet below the thalweg (yellow)
- 15 feet to 30 feet below the thalweg (orange)
- Greater than 30 feet below the thalweg (brown)

In addition to representing where the river has the potential to be gaining or losing, the maps provide an aid to assessing areas where groundwater levels are shallow and may be supporting GDEs.

5.2.3 Limitations

Interpretations made on the basis of the data presented in Section 5.2 have a number of important limitations. First, most of the alluvial wells used in this evaluation are relatively deep and have screens that are present over a depth interval ranging between 18 and 130 feet below ground surface. Shallow monitoring wells (not pumping wells) would be preferred for monitoring because they would be more sensitive to water level changes just beneath the river and are more representative of the shallow portions of the alluvium that are connected to the river. Some of the existing wells also are not located adjacent to the river channel, which means that the water level in the well may not be strongly connected to the river. In addition, there are long distances along the river where well data are lacking, which makes it necessary to infer and extrapolate an understanding of conditions between locations. Inspection of the water level data for all of the agricultural wells in the region suggests that a large number of measurements that are reported to be static water levels are not truly static, perhaps because the water levels were measured (1) while the well was still recovering from having been turned off prior to the measurement, or (2) while nearby wells were pumping, thereby lowering the water level in the measured well. For example, well NLF-B14 shows a reading in early 2015 that is 5 to 6 feet higher than most other static water level measurements in this well; nearby well NLF-B10 shows four readings that are 6 to 7 feet higher than other static water level readings; and well NLF-C10 shows a 10- to 20-foot decrease in its water levels after it was installed and began operating in 2008. Lastly, the reference point elevations on existing monitoring wells have been estimated using Google Earth, which limits the accuracy of the computed groundwater elevations at each well. The elevation of the river thalweg was estimated using LiDAR data from 2016 and not actual surveyed elevations. Each of these factors reduces the accuracy of the data and were considered when interpreting the data.

5.2.4 Results

5.2.4.1 Hydrograph Analysis

Hydrographs were created for wells completed within the Alluvial Aquifer and located near the river, from the vicinity of the Saugus WRP downstream to just past the western boundary of the Basin. Hydrographs for eight wells (see Figures 5-36 through 5-51) are embedded in the text of this section. These wells were selected based on the location and value of the data (e.g., a sufficiently long period of record over multiple climatic conditions). The following wells are listed in order by location, from the easternmost well (VWD-S7) to the westernmost well (4N18W27B). Refer to Figure 5-34 for well locations.

Groundwater elevations observed in Well VWD-S7 do not appear to be correlated with WRP discharges (see Figure 5-36) during early 2003 and early 2011. Rather, the abrupt increase in elevations during 2005 and the gradual decrease beginning in 2011 correspond well with precipitation data (see Figure 5-37). These results appear to indicate that groundwater in the alluvium along this reach of the river between the Saugus WRP and Valencia WRP is weakly influenced by WRP effluent and strongly influenced by precipitation. However, this alluvial well is located approximately 150 feet from the river and may not be sensitive to WRP discharges. Water levels measured during the last drought were more than 30 feet below the river thalweg but started to show moderate increases in 2019 as precipitation increased.

It is noteworthy that groundwater levels in VWD-S7 show a strong seasonal response to precipitation and perhaps a response to pumping at two nearby municipal production wells (VWD-S6 and VWD-S8). The high water levels in 2005 and 2006 are within a few feet of the thalweg, indicating that potentially gaining conditions only occur during the winter months, i.e., only seasonally. Large changes in groundwater levels have also been observed seasonally in other Alluvial Aquifer wells located on the east end of the Basin. As described later in this section, groundwater levels in wells located on the west end of the Basin show significantly less seasonal variation because they are affected by WRP discharges, Castaic Reservoir releases, and discharge of Saugus Formation groundwater into the Alluvial Aquifer.

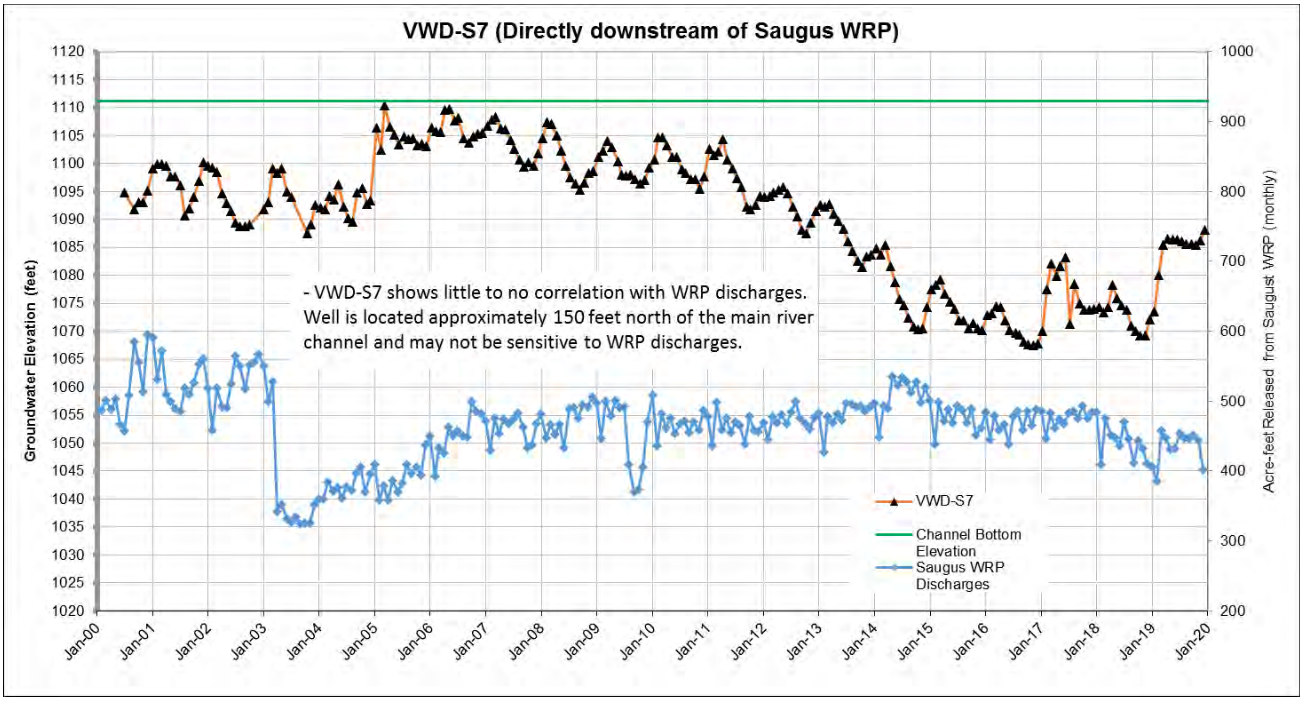

Figure 5-36. Well VWCD-S7 Groundwater Elevation and Saugus Water Reclamation Plant Discharges

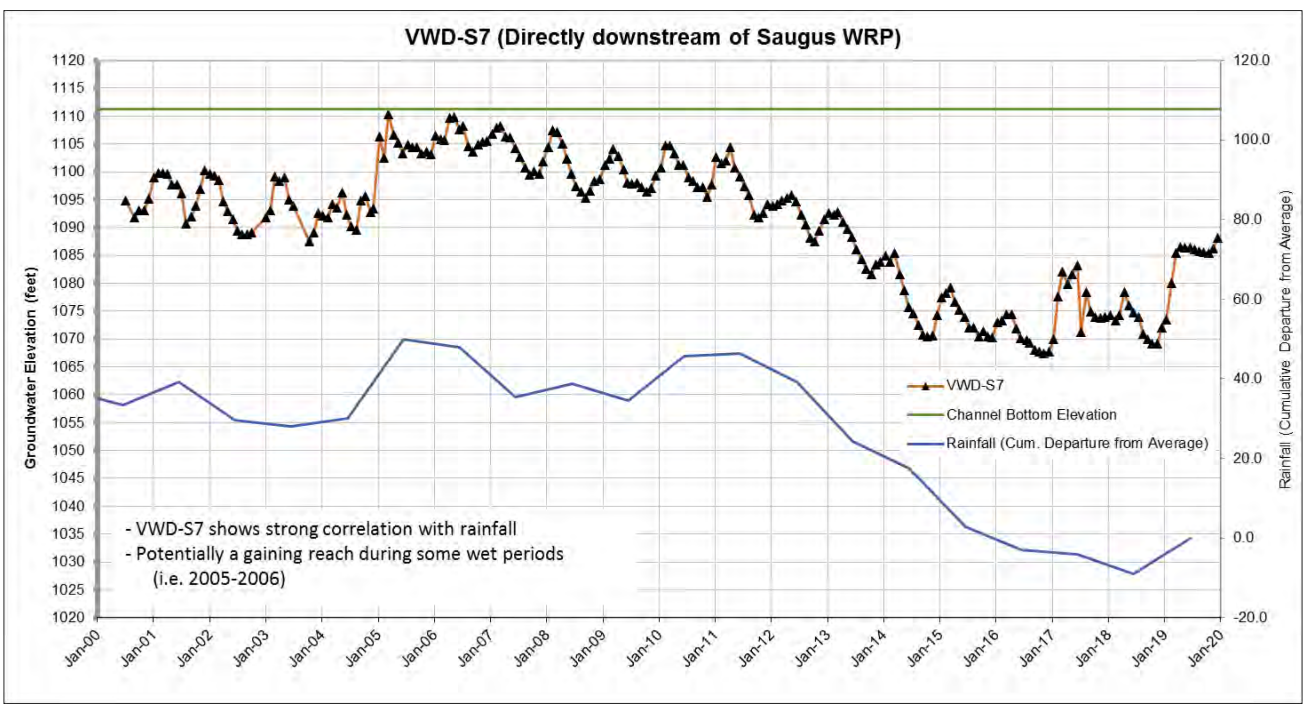

Figure 5-37. Well VWD-S7 Groundwater Elevation and Cumulative Departure from Average Rainfall

Groundwater elevations in Well NLF-G3 correlate well with Castaic Reservoir releases (see Figure 5-38) and with the precipitation trend (see Figure 5-39). The groundwater levels appear to be above the channel bottom (thalweg) in this area, indicative of potentially gaining conditions. The river appears to have been gaining in this area until the onset of drought conditions in 2013, when the groundwater levels dropped below the thalweg. Groundwater levels have nearly fully recovered in this well following the recent drought and the groundwater levels since 2017 are above the thalweg, indicating that the river may be gaining again at this location. The lowest measured historical groundwater level has been less than 5 feet below the thalweg.

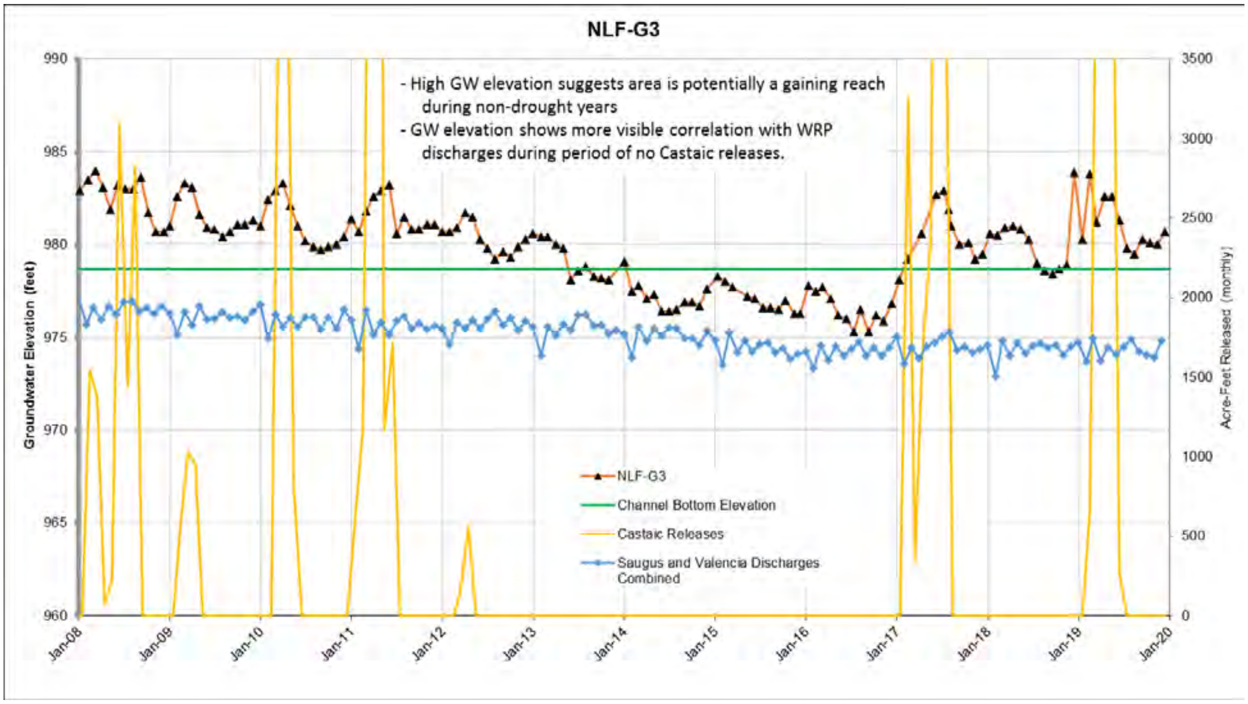

Figure 5-38. Well NLF-G3 Groundwater Elevation, Combined Water Reclamation Plant Discharges, and Castaic Reservoir Releases

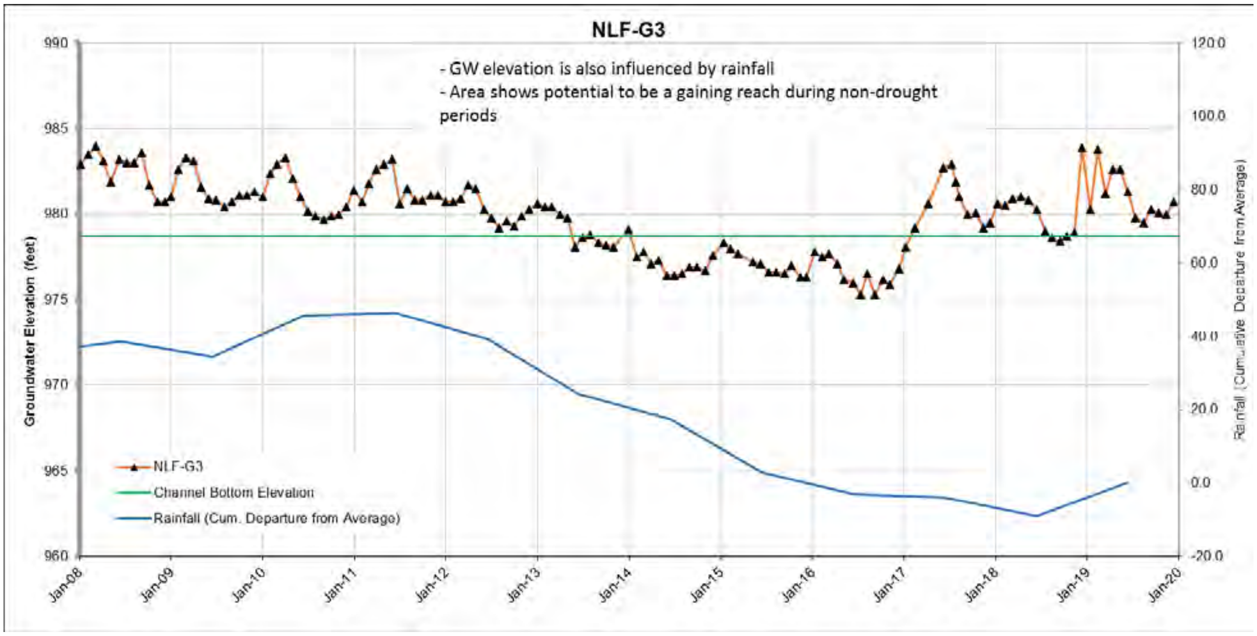

Figure 5-39. Well NLF-G3 Groundwater Elevation and Cumulative Departure from Average Rainfall

Groundwater elevations in Well NLF-C4, located along Castaic Creek just north of its confluence with the Santa Clara River, correlate strongly with Castaic releases as expected; however, it is not clear whether there is any correlation with WRP discharges (see Figure 5-40). Groundwater elevations appear to be less dependent on precipitation trends (see Figure 5-41), as demonstrated by the stable groundwater levels persisting through the drought conditions that occurred between 2011 and 2017. The available data at Well NLF-C4 suggest that this is a losing reach at all times; however, the authors believe that the reported water level elevations are too deep, based on (1) indications that another well in this wellfield (Well NLF-C10) has static water levels that are greatly affected by pumping in nearby wells and (2) simulation results from the groundwater model. Given that Castaic Creek receives a significant amount of recharge from reservoir releases, it seems likely that groundwater levels would be higher at Well NLF-C4 and the Santa Clara River would be gaining downstream of the confluence with Castaic Creek. The groundwater model shows a close correlation of the Well NLF-C4 groundwater levels with the northern-most well in the NLF-C wellfield (Well NLF-C6, which was not been pumped since 2004 and thereby is providing truly static water level data), but more difficulty matching the reportedly “static” water levels in the interior of this wellfield (e.g., Well NLF C-4), which is a further sign that the water levels in wells such as Well NLF-C4 (which is used each year to meet agricultural water demands) may not be truly static water levels, as discussed previously in Section 5.2.3. Based on this well’s location along the Santa Clara River, water levels observed at other wells, observations of conditions along the river, and the conceptual understanding of the river at this location, the river is potentially gaining at this location, in contrast to what groundwater levels indicate at Well NLF-C4. The reference elevations and channel bottom (thalweg) elevations will need to be checked and a better understanding of the role of local pumping influences on groundwater levels must be developed before too many conclusions can be drawn at this location.

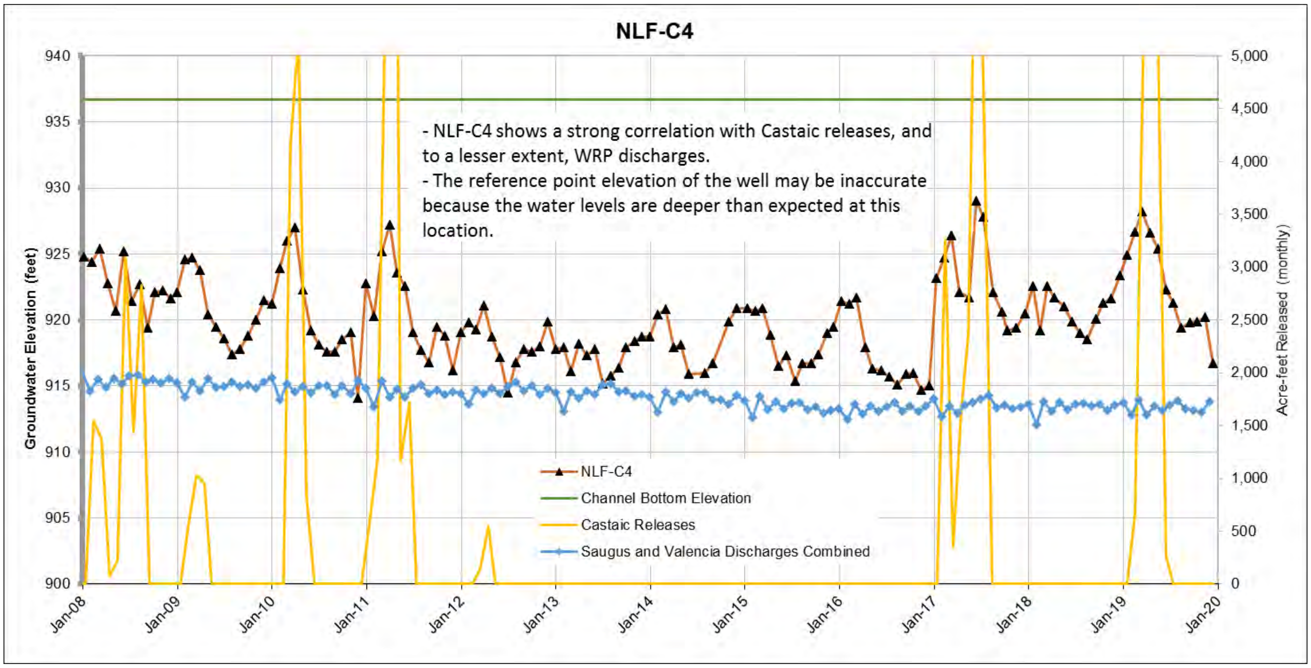

Figure 5-40. Well NLF-C4 Groundwater Elevation, Combined Water Reclamation Plant Discharges, and Castaic Reservoir Releases

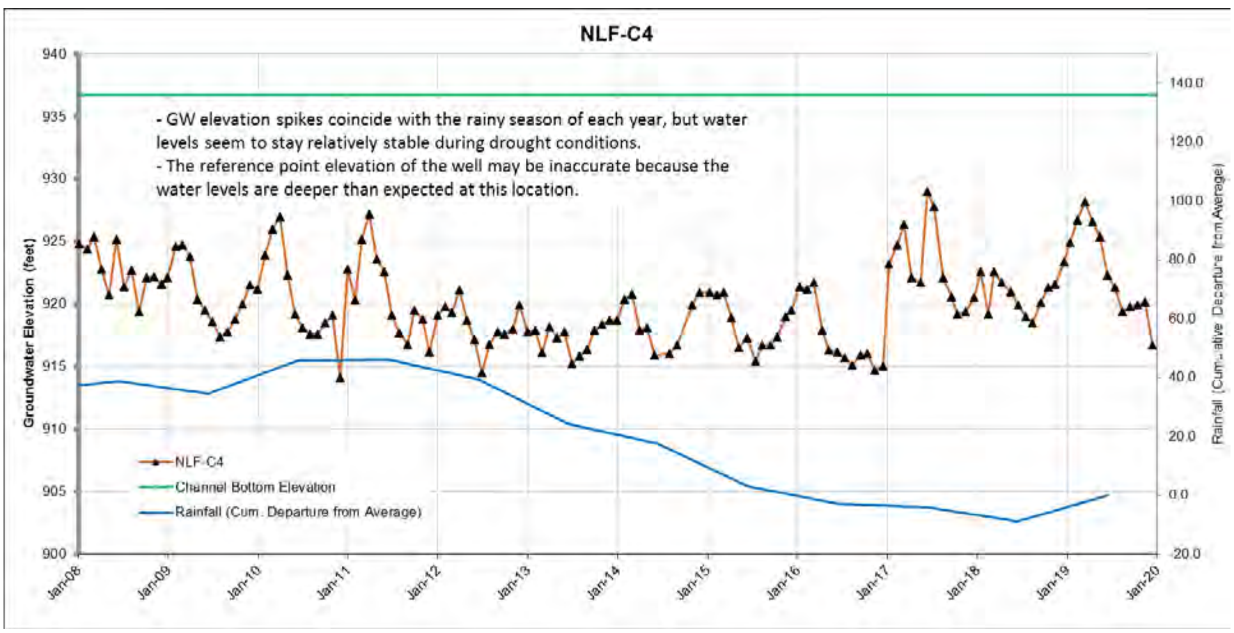

Figure 5-41. Well NLF-C4 GWE and Cumulative Departure from Average Rainfall

At Well NLF-B14, located 1.5 miles downstream from Well NLF-C4, the groundwater elevation data cannot be easily correlated with either (1) WRP discharges (due to the lack of variability in WRP discharges as shown in Figure 5-42) or (2) precipitation trends (as shown in Figure 5-43). This data-derived observation is consistent with observations that have been made during the process of calibrating the numerical groundwater flow model for the basin. Groundwater levels have remained constant through the drought (unlike wells located to the east). The hydrograph for Well NLF-B14 shows groundwater levels are relatively stable and are at or above the channel bottom (thalweg) elevation during most periods, and the groundwater model shows this part of the river is gaining. Accordingly, the authors infer this area to be primarily a gaining reach. However, other nearby wells with shallower screen depths (i.e., Wells NLF-B10 and NLF-B20; see Figures 5-44 through 5-47) show groundwater levels between 2 and 5 feet below the thalweg, indicating potentially losing conditions while the groundwater model shows that this part of the river is gaining. This inconsistency may be because the wells are screened at different depths or may be the result of uncertainties in the water level data set (such as elevation survey control and/or pumping influences on water level measurements). From extensive experience studying this area, the authors believe discharge from the Saugus Formation into the alluvium is the biggest reason for the observed stability. It is important to note too that the Saugus groundwater elevations tend to change more slowly than the groundwater elevations in the Alluvial Aquifer. That is, flow out of the Saugus Formation is only slightly affected (if at all) by hydrologic cycles and is virtually (if not completely) unaffected by WRP flow contributions into the river. Additionally, both the measured data sets and the groundwater model show long-term stability in groundwater levels (e.g., no apparent long-term trends). Based on the location of Well NLF-B14 along the river, the water levels observed at this well, the well's proximity to where the Saugus Formation pinches out against the low permeability Pico Formation, and the conceptual model understanding (which is supported by numerical modeling), the authors infer that the river in this area is primarily a gaining reach.

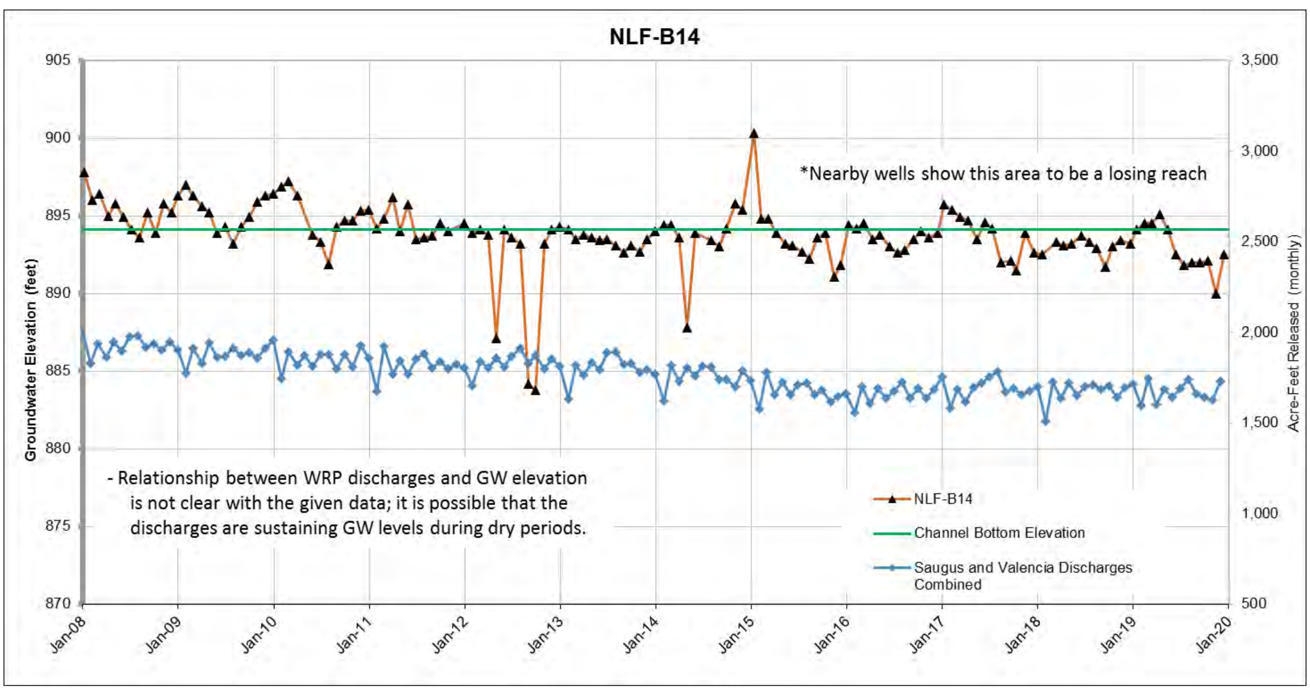

Figure 5-42. Well NLF-B14 Groundwater Elevation and Combined Water Reclamation Plant Discharges

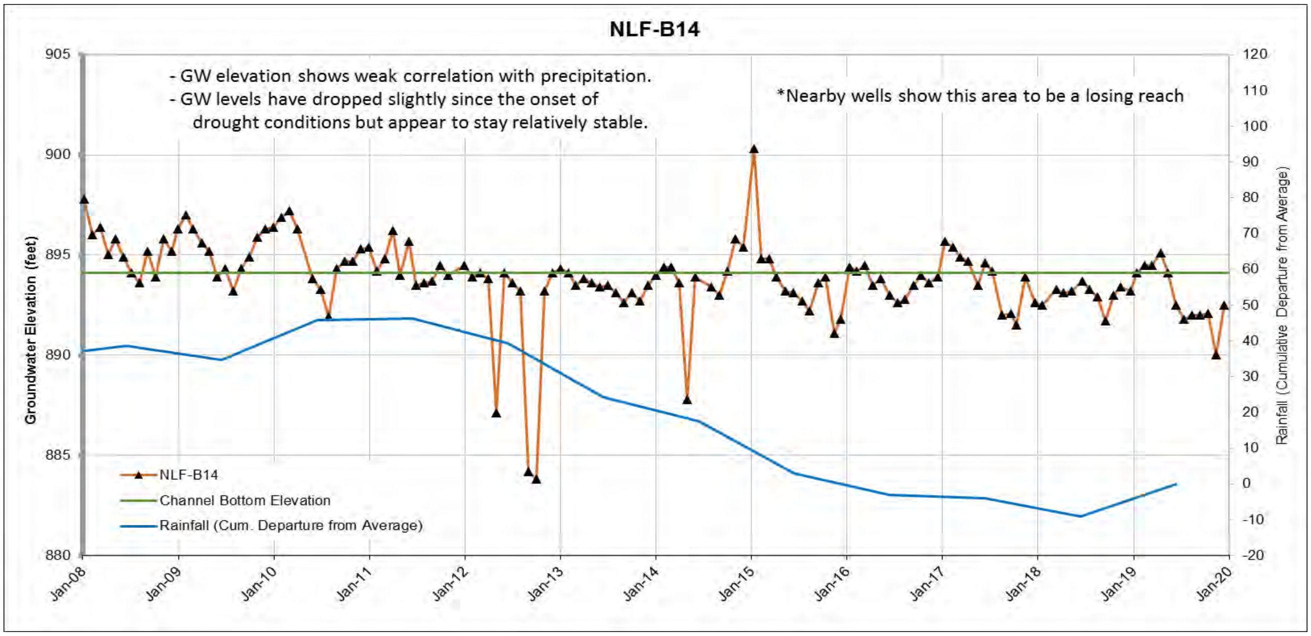

Figure 5-43. Well NLF-B14 Groundwater Elevation and Cumulative Departure from Average Rainfall

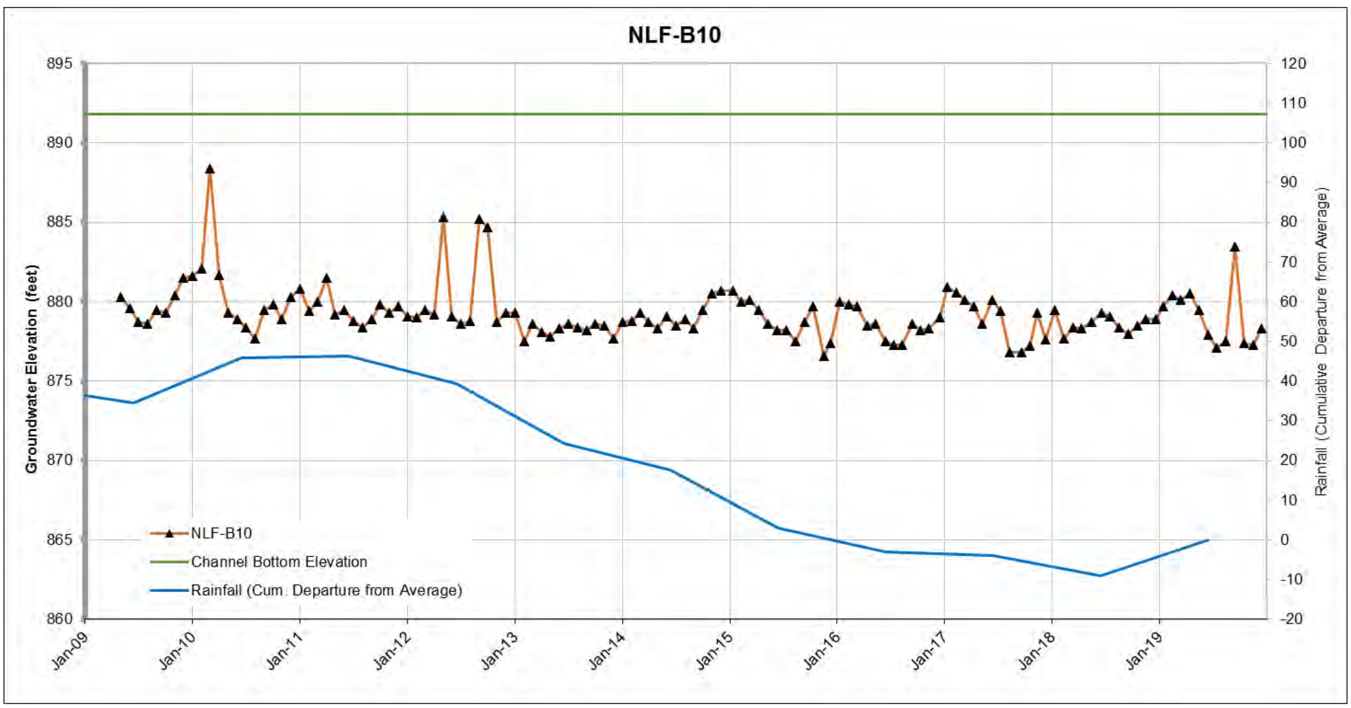

Figure 5-44. Well NLF-B10 Groundwater Elevation and Saugus Water Reclamation Plant Discharges

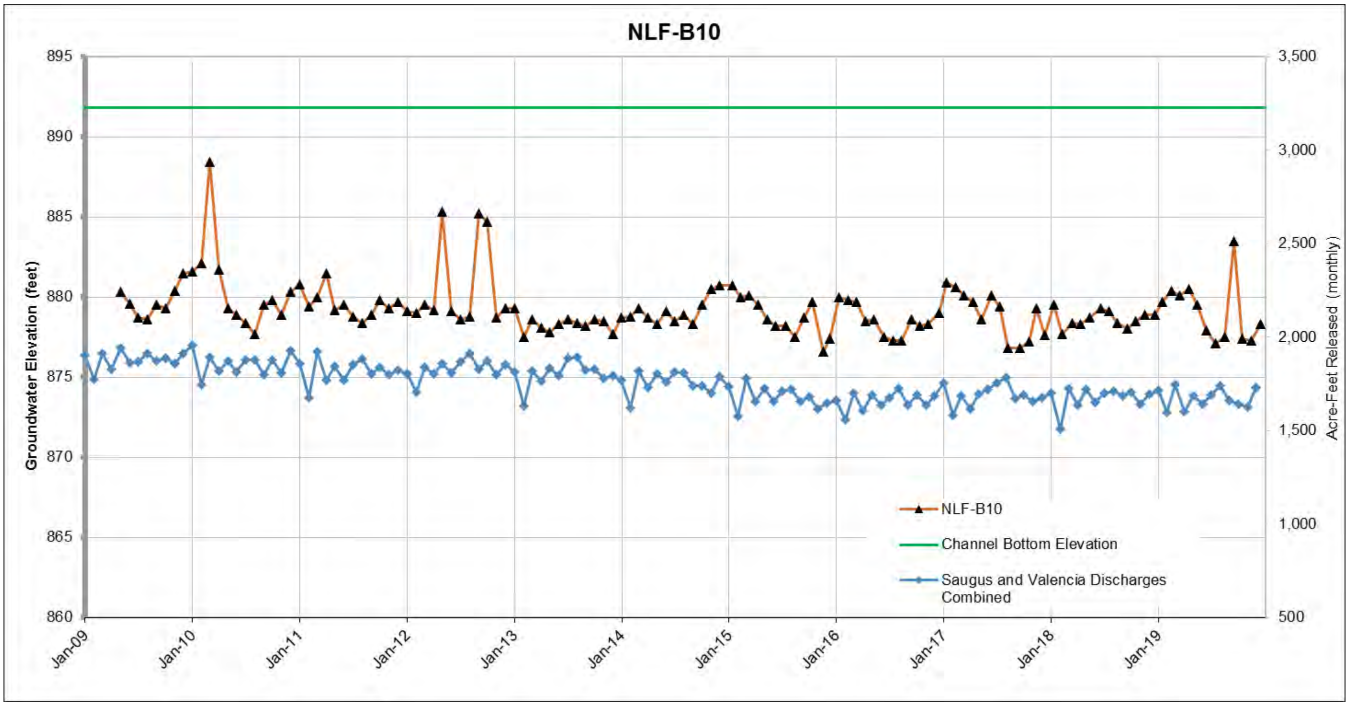

Figure 5-45. Well NLF-B10 Groundwater Elevation and Cumulative Departure from Average Rainfall

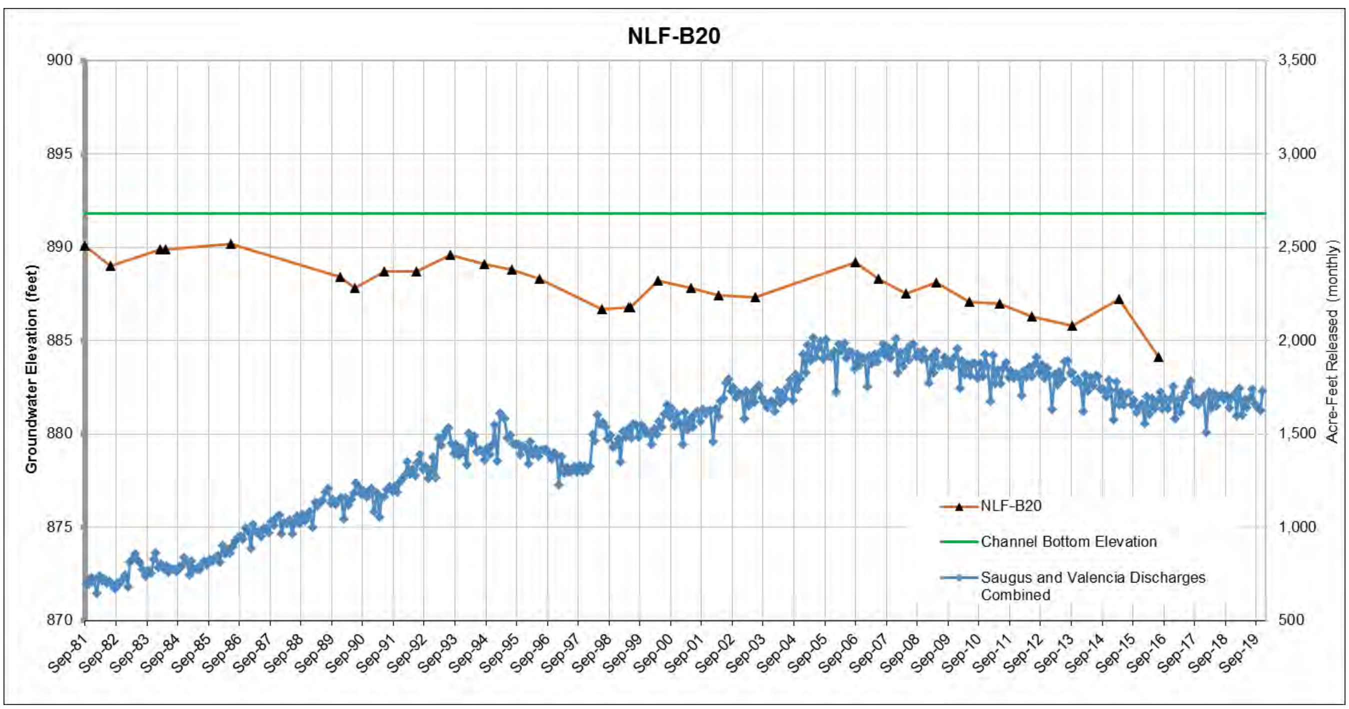

Figure 5-46. Well NLF-B20 Groundwater Elevation and Saugus Water Reclamation Plant Discharges

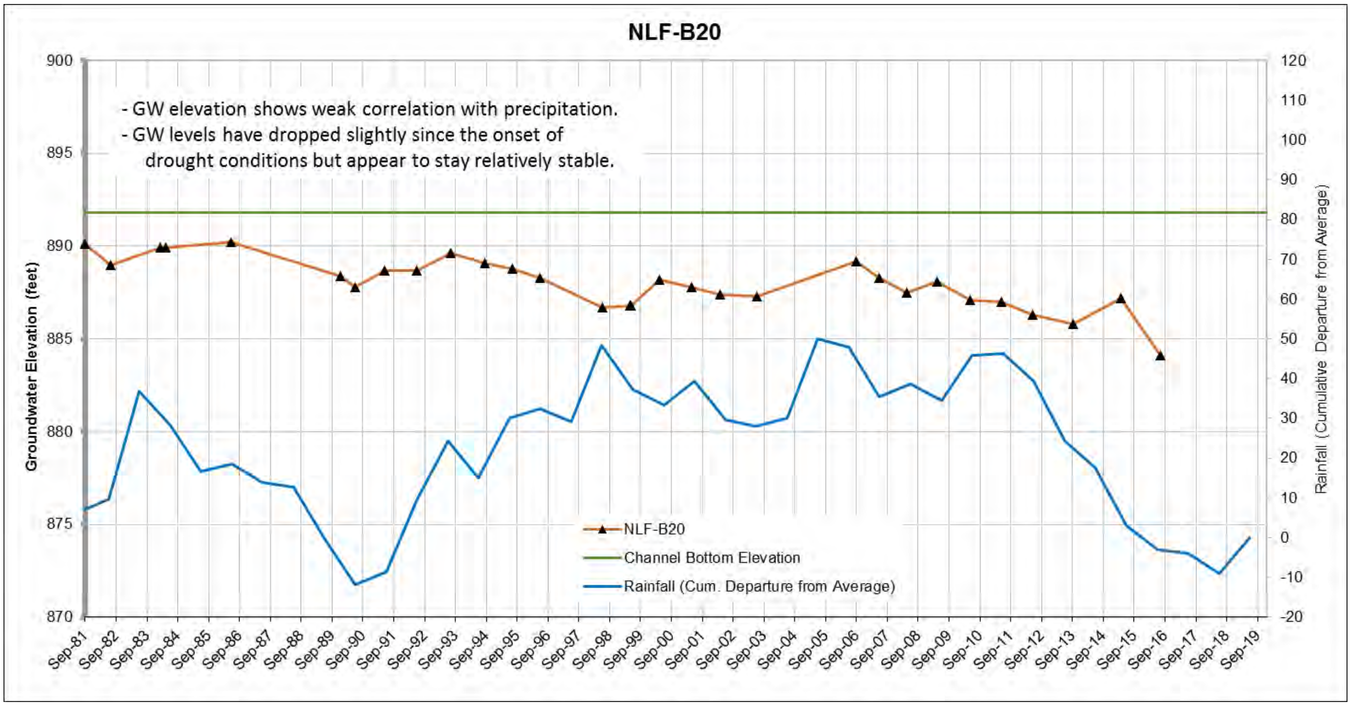

Figure 5-47. Well NLF-B20 Groundwater Elevation and Cumulative Departure from Average Rainfall

Groundwater elevations in Well NLF-B11/11A, located between the mouth of Potrero Canyon, and Well NLF-B14, do not correlate well with WRP discharges (see Figure 5-48) or precipitation (see Figure 5-49). There are indications that some readings are either affected by nearby pumping or that the water level measurement was not truly representing static conditions (see 1998 and 2005). The annual groundwater elevation readings do not show much detail, but it appears that groundwater levels have remained very stable during the period of record in this location. The authors believe this is because the Saugus Formation discharges significant quantities of groundwater to the alluvium upstream of Well NLF-B11/11A, thereby stabilizing groundwater levels in much of the western end of the groundwater basin. Downstream of this well, the alluvium is underlain by the low-permeability Pico Formation, which is considered to be non-water bearing for the purposes of agricultural and municipal water supply development. As a result, there is no additional upward flow coming from the Saugus Formation west of Well NLF-B11/B11A, and groundwater resides within the alluvium or discharges to the river depending upon whether climatic conditions are wet, dry, or normal. The deepest historically measured groundwater levels at Well NLF-B11/B11A were often no more than 5 feet below the channel bottom (thalweg) elevation, and often within 1 foot of the thalweg in this area. The authors believe that the river is transitioning from generally gaining to generally losing in this general area.

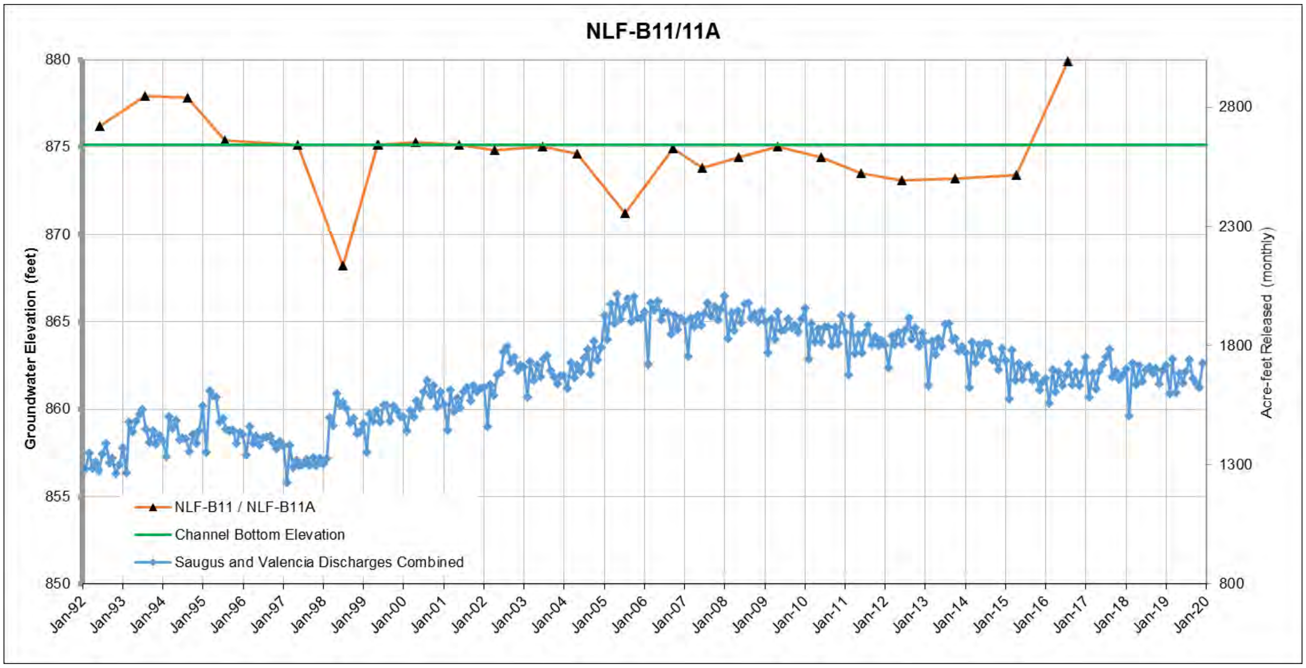

Figure 5-48. Well NLF-B11/11A Groundwater Elevation and Combined Water Reclamation Plant Discharges

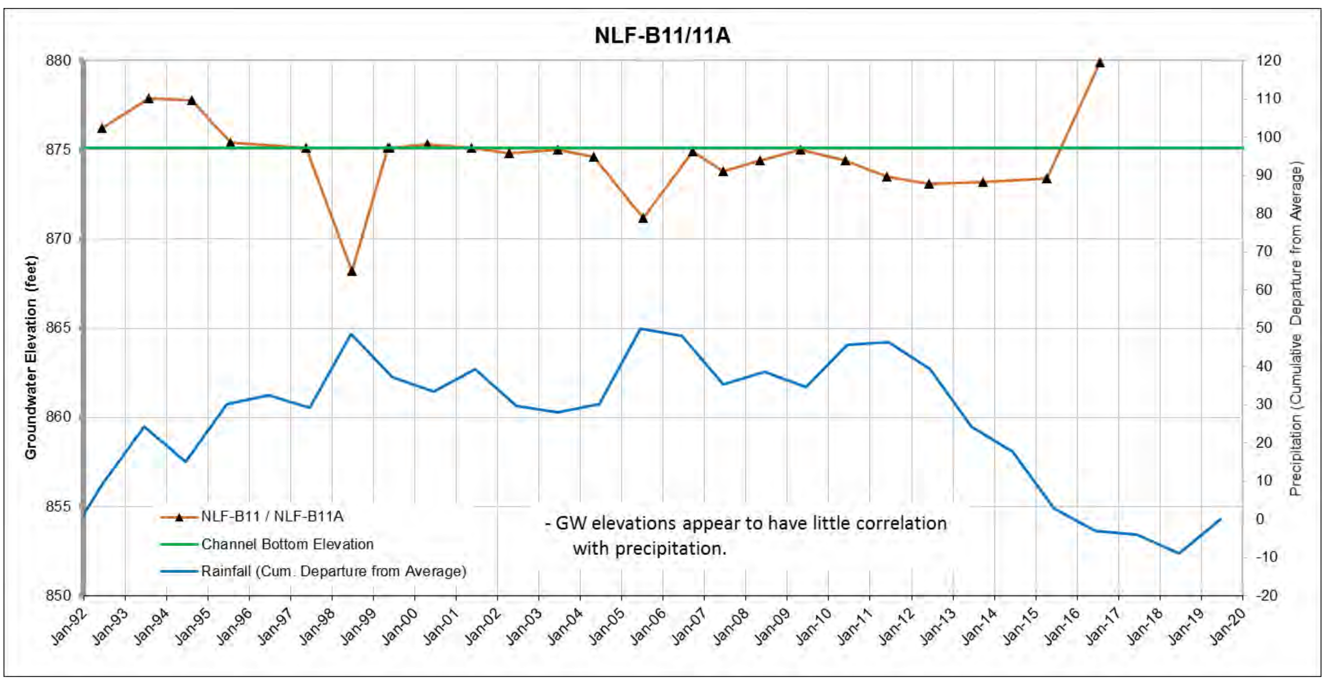

Figure 5-49. Well NLF-B11/11A Groundwater Elevation and Cumulative Departure from Average Rainfall

Well 4N18W27B, located west of the Basin and just west of the Piru Dry Gap, is the westernmost and furthest downstream well in the study area. Groundwater elevations at Well 4N18W27B correlate very well with precipitation trends since the late 1970s but appear to differ from precipitation trends from the mid-1960s through the mid to late 1970s (see Figure 5-51). Low groundwater levels observed in the Piru Subbasin during the 1960s (see Figure 5-50) are likely a result of a prolonged drought that began in the mid-1940s and continued through the mid-1960s. Water levels recover to near the channel bottom (thalweg) elevation beginning in the late 1960s as a result of (1) discharges from the Saugus and Valencia WRPs upstream and (2) the end of the drought period after the mid-1960s (as seen by the lack of a downward slope in the rainfall cumulative departure curve). Water levels in Well 4N18W27B declined significantly during the most recent drought beginning in 2011. Water levels have recovered substantially since the end of the drought in 2016, but not quite to pre-drought levels. As shown in Figure 5-51, it is likely that importation of water upstream and discharges from the WRPs have caused average groundwater elevations in this area to rise significantly since the late 1960s.

Well 4N18W27B appears to be located at a point that is likely where the alluvium has just started to thicken substantially (i.e., the well is just downstream of the transition from the narrow alluvial valley at Blue Cut to the wider alluvial valley that is present where the Piru Dry Gap begins). The river at this location appears to be losing during the summer and during drought conditions, partly because the alluvium is thickening as expected (which is why there is a dry gap).

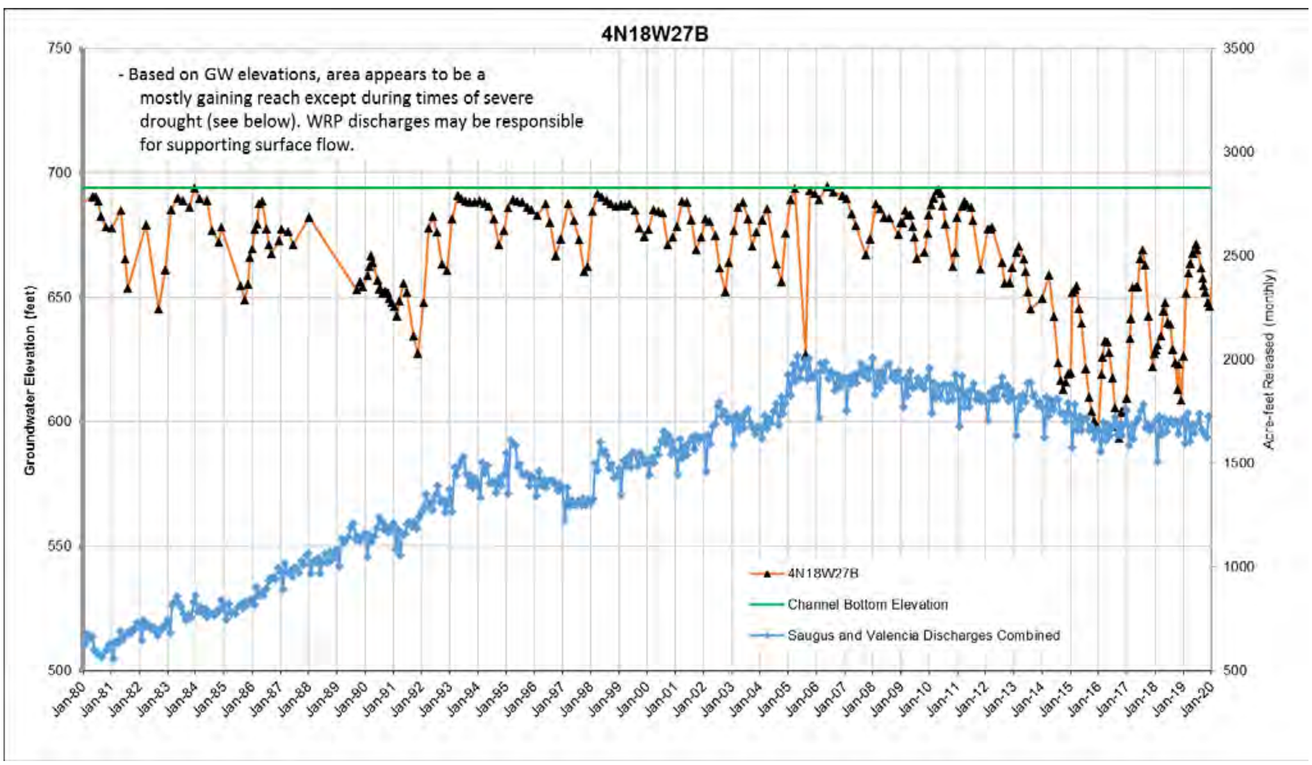

Figure 5-50. Well 4N18W27B Groundwater Elevation and Combined Water Reclamation Plant Effluent

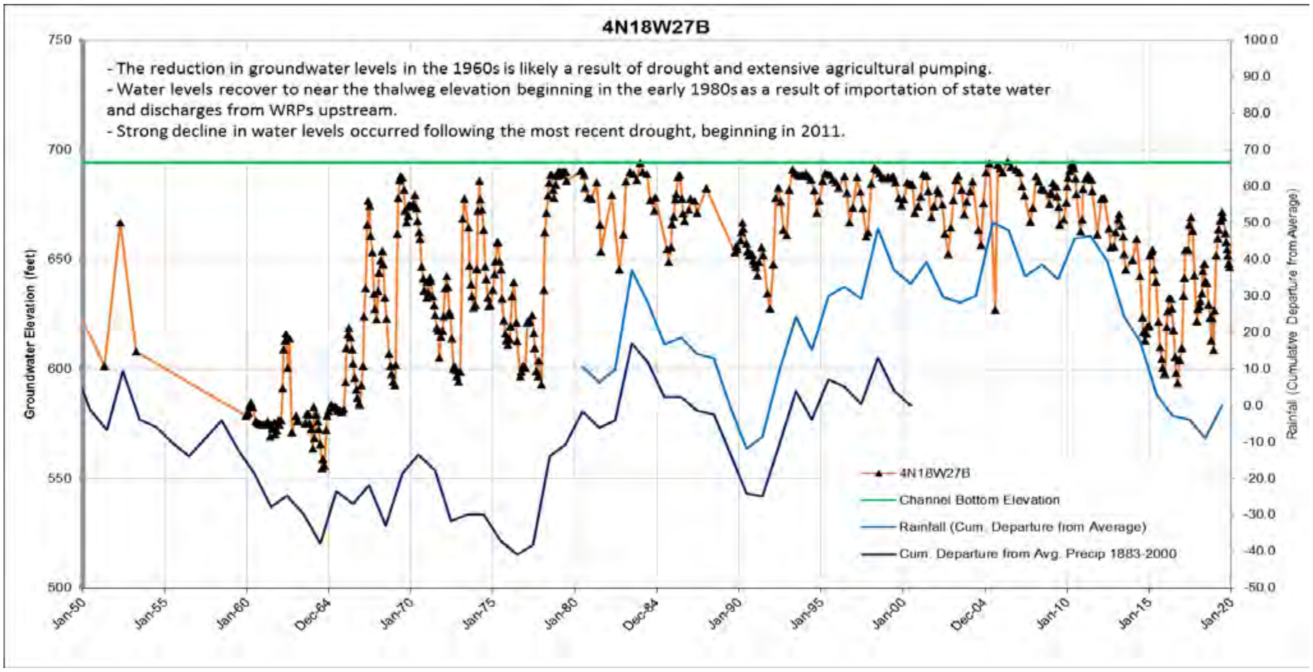

Figure 5-51. Well 4N18W27B Groundwater and Cumulative Departure from Average Rainfall

Effects of Precipitation, WRP Discharges, and Basin Pumping on River Flows

On the basis of available river gage data, it is believed that the WRP flows and the groundwater discharges from the Alluvial Aquifer to the river in the Basin are providing a base flow to the river as it moves through and out of the Basin and into the eastern portion of the Piru Subbasin. As shown on Figures 5-52, 5-53, and 5-54, surface water flow measurements at the former County Line gage and the existing Piru gage during non-storm events have steadily increased since the late 1970s. This increase appears to be unrelated to rainfall trends (see Figure 5-52) and more likely related to increased urbanization in the Basin that has resulted in importation of state water and discharge of treated water from the WRPs into the river (see Figure 5-53). As shown in Figure 5-54, pumping of the Alluvial and Saugus Aquifers in the Basin appears to have had little effect on river flows.

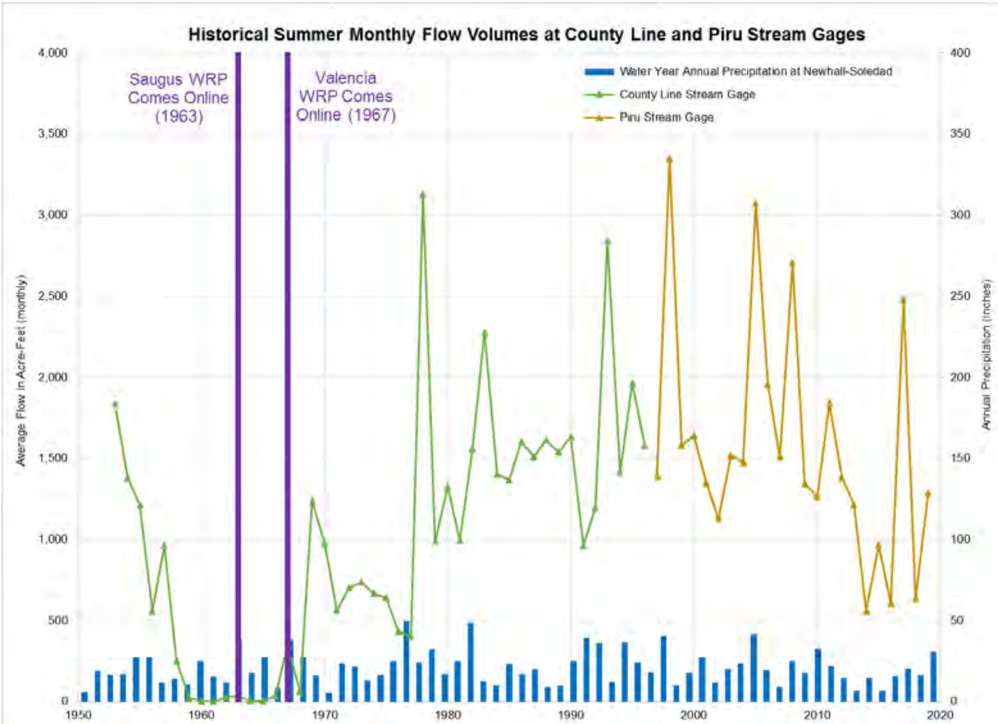

Figure 5-52. Santa Clara River Flow near the Western Basin Boundary County Line Gage and Precipitation in the Basin

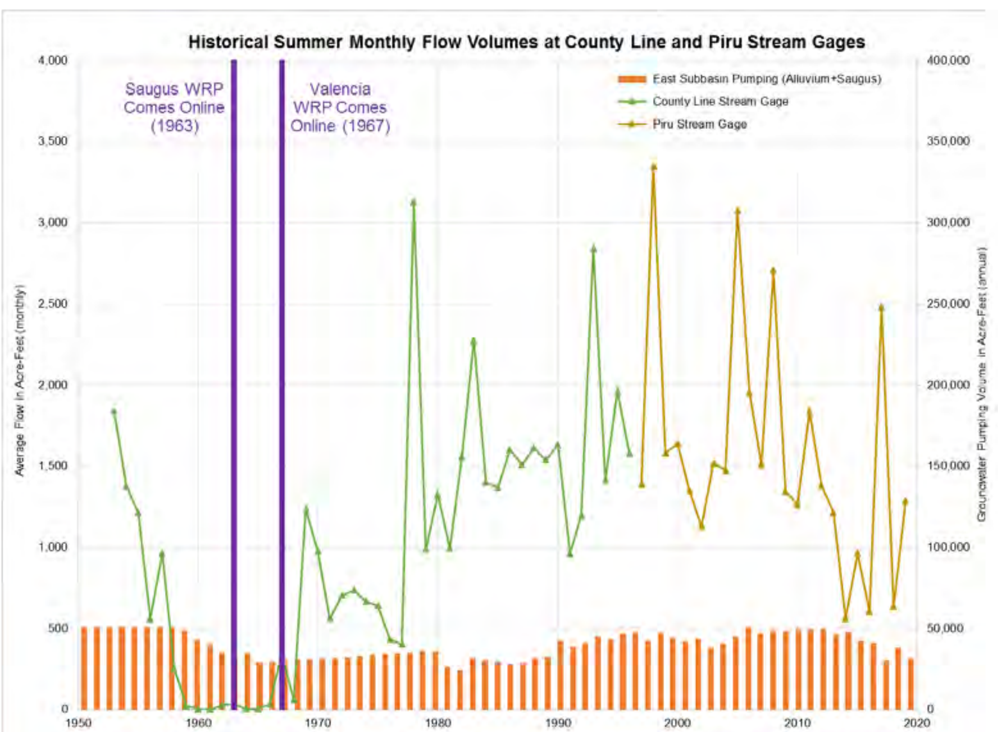

Figure 5-53. Santa Clara River Flow near the Western Basin Boundary and Water Reclamation Plant Discharges in the Basin

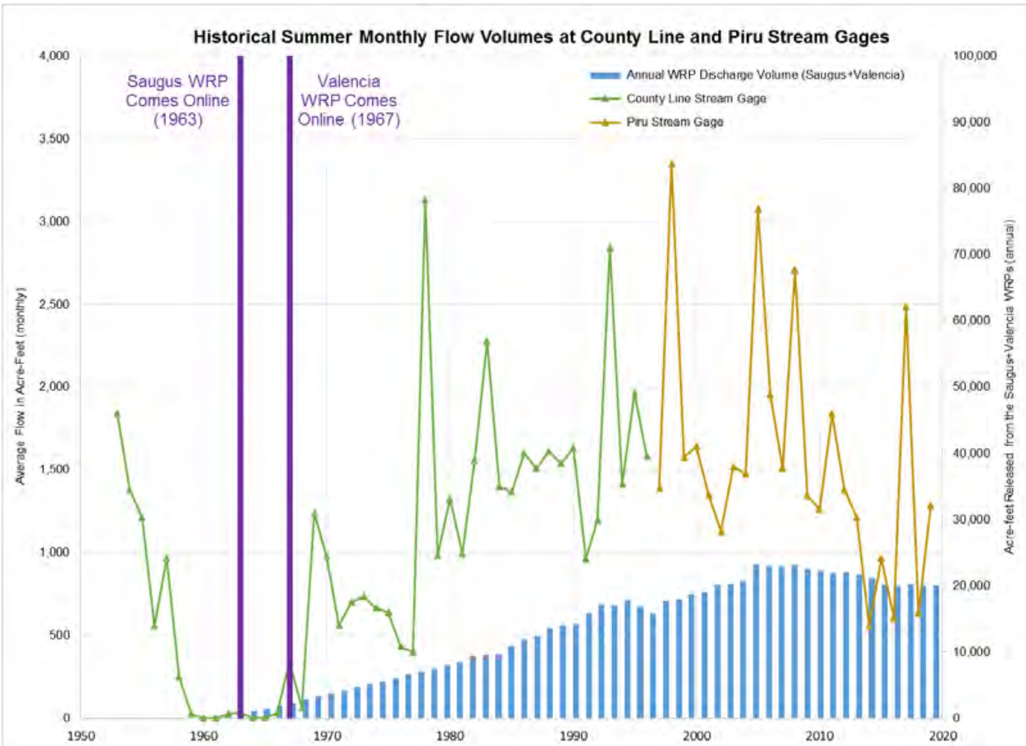

Figure 5-54. Santa Clara River Flow near the Western Basin Boundary and Total Groundwater Pumping in the Basin

The effect of increased urbanization and accordant discharges of treated water from WRPs into the Santa Clara River (see Figure 5-53) is consistent with the prior understanding of river flows before the onset of urbanization in the Basin. CH2M HILL (2004) inspected the summer-season flow records at the former County Line stream gage (located 0.75 miles west of the western boundary of the Basin) and found that prior to the activation of the Valencia WRP in 1967, the river flow volume during the lowest-flow month of any given year was (1) less than 100 AF per month and (2) being recorded as zero at the gage during the driest month in four different years (1960, 1961, 1964, and 1965). This observation is consistent with a report by Mann (1959), who provided water budgets for the adjoining downstream groundwater subbasins (Piru, Fillmore, and Santa Paula) for the period 1936–1957, which preceded urbanization and WRP discharges in the Basin. As discussed by UWCD (2020), Mann identified flood inflows to the Piru Subbasin separately from "rising water" inflows and did not quantify the latter, indicating that Mann considered the "rising water" inflows to the Piru Subbasin to be negligible. Mann quantified groundwater underflow into the Piru Subbasin as being small (averaging 240 AFY) compared to flood flows and imported water (averaging 75,180 AFY and 2,580 AFY, respectively). Mann's quantification of a small groundwater underflow term and the absence of an average value of dry-weather streamflow in his water budget for the Piru Subbasin suggests that dry-weather surface flows from the Basin into the Piru Subbasin were negligible during the summer season prior to the onset of urbanization in the Basin.

Extent of Gaining and Losing Reaches

Findings from the hydrograph analysis were used to create three separate maps that indicate the nature of surface water and groundwater exchanges along the Santa Clara River during wet, normal, and dry climatic conditions. Each map identifies six unique river reaches (stream segments) in the study area and shows where groundwater levels are vertically positioned relative to the nearby river channel bottom (thalweg) elevation during a given climatic condition. Reaches were defined by a combination of factors including the water level response in nearby wells, geological conditions such as thinning of the surficial alluvium, visual observations, and preliminary results from the groundwater model. This information can be used to provide an indication of where the river is potentially gaining or losing and how this might change over time depending on local rainfall cycles. It is important to note that there are limitations associated with the data sets used in this analysis (refer to Section 5.2.3); interpretation of the results considered those limitations.

Wet Conditions

Figure 5-55 illustrates the potentially gaining and losing reaches of the river during periods of increased precipitation (wet conditions), using data from 1991 to 1993, 2005, and 2017 to 2019. Though some wells do not have groundwater elevation data during these intervals, groundwater levels may be estimated based on the elevation trends during other periods.

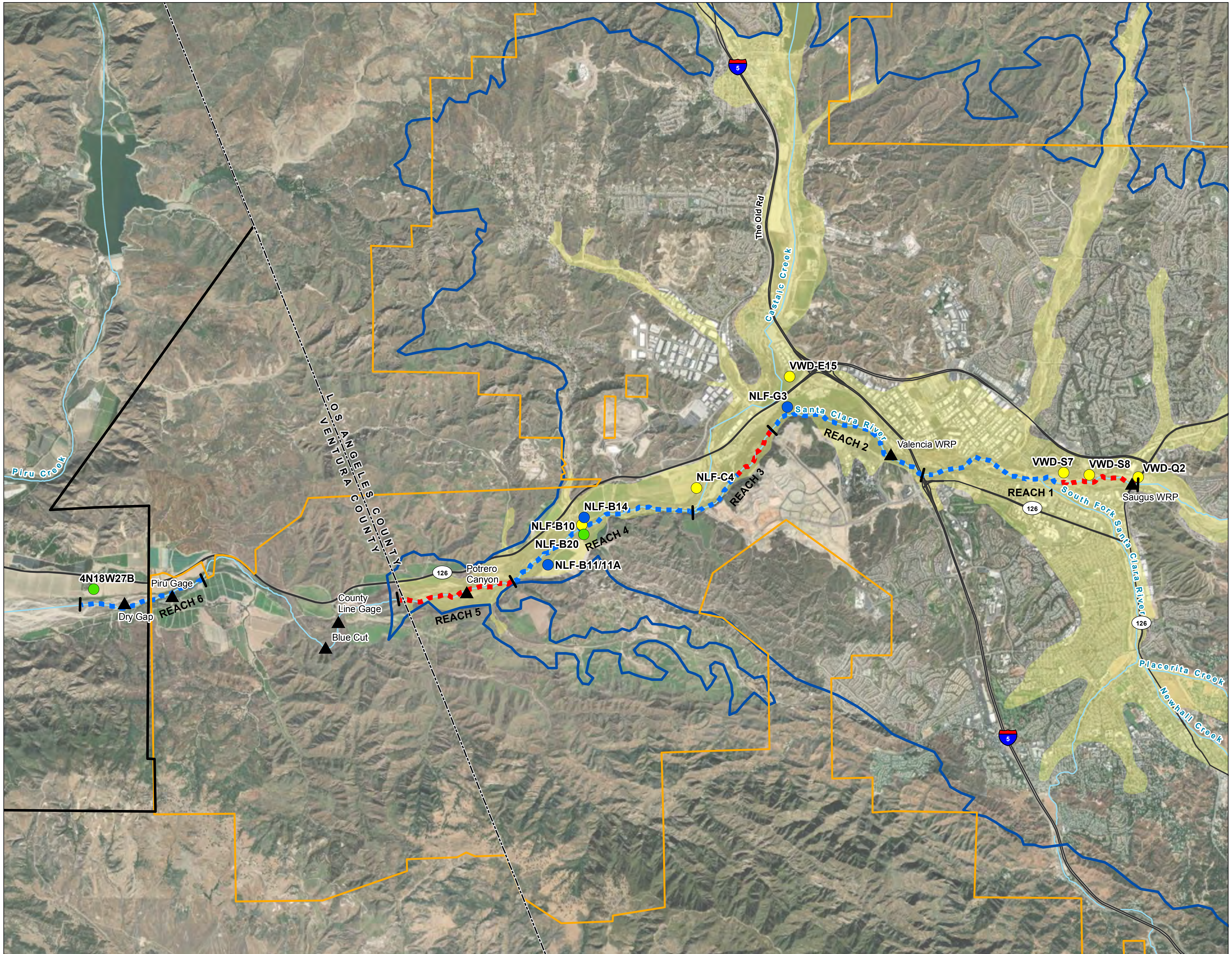

FIGURE 5-55

Gaining and Losing Reaches of the Santa Clara River During Wet Conditions

Santa Clara River Valley East Groundwater Subbasin Groundwater Sustainability Plan

LEGEND

- Potentially Gaining Reach
- Potentially Losing Reach

Key Well Depth to Water (ft)

- 0 - 1
- 1 - 5
- 5 - 15
- 15 - 30
- > 30

All Other Features

- Point of Interest
- Alluvial Aquifer
- Service Area Boundary for SCV Water
- UWCD Boundary
- Santa Clara River Valley Groundwater Basin, East Subbasin
- County Boundary
- Major Road
- Watercourse

NOTES

SCV Water: Santa Clarita Valley Water Agency
UWCD: United Water Conservation District

N

0 3,000 6,000 9,000
Feet

GSI Water Solutions, Inc.

Date: December 9, 2021
Data Sources: USGS, Maxar Imagery (2019), DWR Bulletin 118

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Reach 1 **Potentially Gaining** – Increased precipitation brought seasonal groundwater levels to near the thalweg during wet periods. Gaining conditions in this reach would likely only occur during the winter months of wet years, except for the short section of river east of the I-5 bridge, where groundwater upwelling has been observed even in drought conditions (see Section 5.2.1.4). This upwelling appears to be a result of thinning of the alluvium at this location. Groundwater elevation data also suggest that the far eastern end of this reach might be losing during wet years but transitioning to gaining conditions at or just upstream of the mouth of San Francisquito Canyon.

Reach 2 **Potentially Gaining** – Groundwater levels were consistently above the thalweg until 2 years after the onset of the drought in 2011, as indicated by groundwater level data at Well NLF-G3.

Reach 3 **Potentially Gaining** – Groundwater levels downstream of the confluence with Castaic Creek are likely close to the thalweg; however, there is a lack of reliable data in this reach. Groundwater modeling analyses suggest the eastern portion of this reach may be losing.

Reach 4 **Potentially Gaining** – The water level data in this reach are too uncertain to provide a clear indication of gaining or losing conditions. However, each well in this area (including Wells NFL-B11 and NLF-B14) shows relatively steady groundwater levels throughout the decades, with little difference in wet to normal to dry years. This stability is unlike what is observed east of I-5 or in the Castaic Valley north of the river corridor. The groundwater flow model indicates this remarkable stability in river flow rates is likely reflective of WRP flow contributions to the river from upstream plus the discharge of groundwater from the underlying Saugus Formation into the alluvium (which then discharges this water into the river throughout this reach).

Reach 5 **Potentially Losing** – There is a lack of long-term groundwater elevation data in this reach; however, in 2007, geophysical surveys and exploratory borings at the mouth of Potrero Canyon and at the county line indicated that the water table is near ground surface at the mouth of Potrero Canyon but approximately 20 feet deep at the county line, suggesting that the river could be gaining upstream of Potrero Canyon and likely losing downstream of Potrero Canyon (in the lower half of Reach 5). Results from the groundwater model (which includes thinning of the alluvium and streamflow records at the former County Line stream gage) also support this interpretation. In this reach, the alluvium overlies the low-permeability Pico Formation, which does not contain a significant groundwater resource and therefore does not substantially recharge the alluvium or the river, as occurs further upstream where the Saugus Formation is present beneath the alluvium.

Reach 6 **Potentially Gaining** – Beginning in the late 1960s, periods of heavy precipitation coupled with WRP discharges to the river upstream have raised the groundwater elevation in Well 4N18W27B nearly to the thalweg during wet periods. On occasion, the data suggest that groundwater levels might even briefly rise above the thalweg elevation. The river corridor widens and becomes devoid of riparian vegetation just downstream of Well 4N18W27B; therefore, it is highly likely that a much more prevalent losing reach begins just west of this well.

Normal Conditions

Figure 5-56 illustrates the gaining and losing reaches of the river during periods of average precipitation (normal conditions), using data from 2008 to 2011.

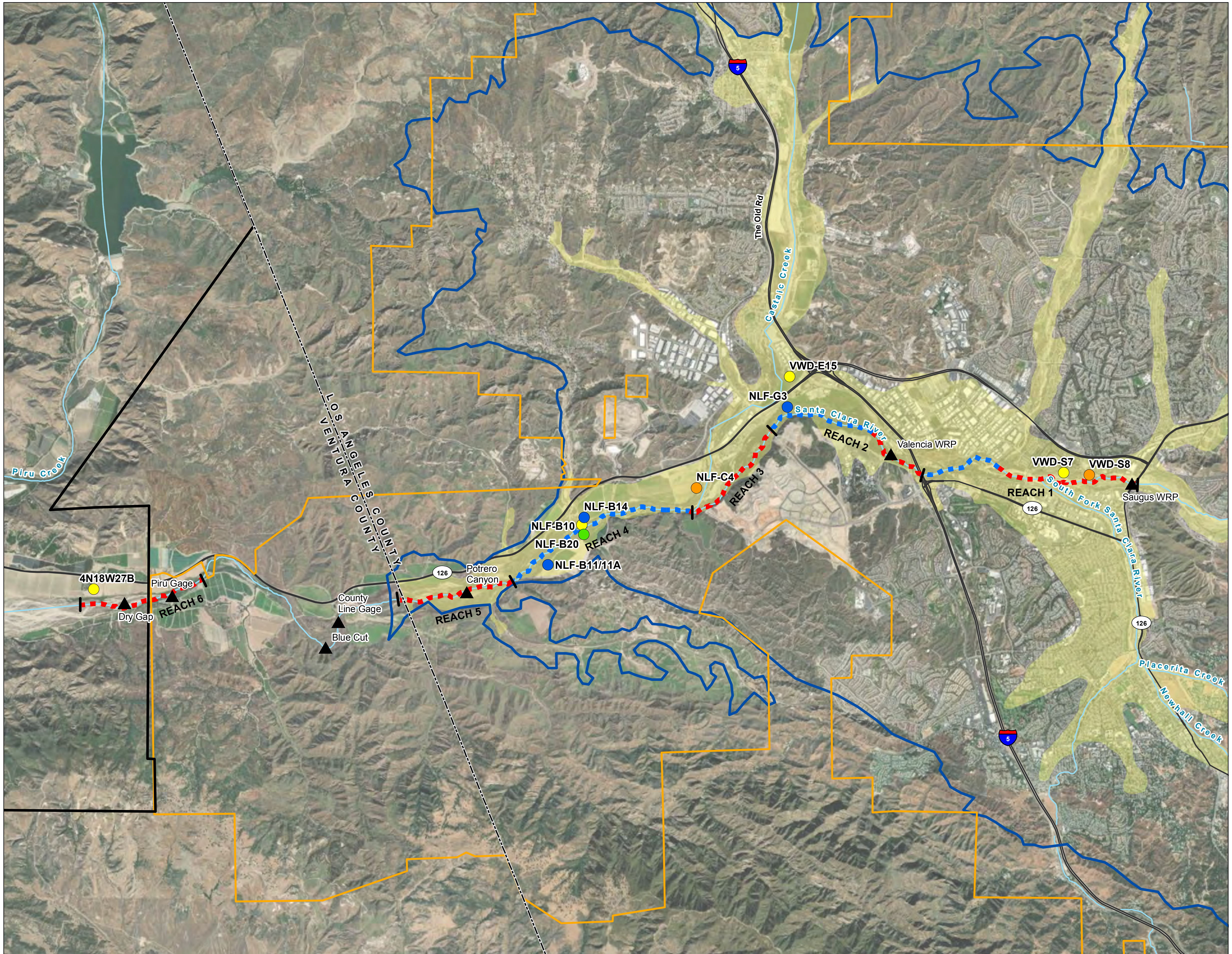

FIGURE 5-56

Gaining and Losing Reaches of the Santa Clara River During Normal Conditions

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

LEGEND

Potentially Gaining Reach
Potentially Losing Reach

Key Well Depth to Water (ft)

0 - 1
1 - 5
5 - 15
15 - 30
> 30

All Other Features

Point of Interest
Alluvial Aquifer
Service Area Boundary for SCV Water
UWCD Boundary
Santa Clara River Valley Groundwater Basin, East Subbasin
County Boundary
Major Road
Watercourse

NOTES

SCV Water: Santa Clarita Valley Water Agency
UWCD: United Water Conservation District

N

0 3,000 6,000 9,000
Feet

GSI Water Solutions, Inc.

Date: December 9, 2021
Data Sources: USGS, Maxar Imagery (2019), DWR Bulletin 118

Reach 1 **Potentially Losing / Potentially Gaining** – Groundwater levels are consistently below the channel bottom, except in the section of river just east of the I-5 bridge, where groundwater upwelling has been visually observed even in drought conditions.

Reach 2 **Potentially Losing / Potentially Gaining** – Groundwater levels in Well NLF-G3 are consistently above the bottom if the river channel until 2 years after the onset of the drought in 2011, indicating potentially gaining conditions in the western portion of Reach 2. Preliminary groundwater modeling results indicate that the eastern portion of Reach 2 is potentially losing, until a point downstream of the Valencia WRP where the river turns westward. This may be a result of changing aquifer thickness. Groundwater levels in Well NLF-G3 are consistently above the channel bottom until 2 years after the onset of the drought in 2011, indicating potentially gaining conditions in the western portion of Reach 2.

Reach 3 **Potentially Losing** – Groundwater levels in Well NLF-C4 are well below the nearby thalweg elevation in the river; however, the authors believe that the reference level elevation is not accurate at this location. The river is assumed to be potentially losing upstream of the confluence with Castaic Creek.

Reach 4 **Potentially Gaining** – The portion of the river directly downstream of the confluence with Castaic Creek would likely be gaining. Further downstream, the hydrographs for multiple wells in this area do not consistently show this reach to be gaining; however, Well NLF-B14 shows groundwater levels are at or above the thalweg. The wells in this area have differing screen depths and the thickness of the alluvium in this area may vary, causing local highs or lows in groundwater levels. The reference point elevations of the wellheads may also be erroneous. Well NLF-B14 shows relatively steady groundwater levels at or above the channel bottom elevation at all times that likely reflect discharge of Saugus groundwater into the alluvium in this reach.

Reach 5 **Potentially Losing**– See the discussion in Section 5.2.4.1.2 (Wet Conditions) for wet years, which identifies that the river is likely losing in the lower half of Reach 5 but may be either gaining or losing in the upper half of Reach 5. Groundwater modeling results and the field-observed stability of groundwater elevations at the well furthest downstream (Well NLF-B11) suggest that the gaining/losing characteristics of the river during wet years are likely also occurring during years of normal rainfall. The river resides in a relatively thin layer of alluvium that overlies the low-permeability Pico Formation; therefore, it is likely that this region is losing.

Reach 6 **Potentially Losing** – Beginning in the late 1960s, periods of heavy precipitation coupled with WRP discharges to the river upstream of Reach 6 have raised the groundwater elevation in Well 4N18W27B nearly to the river's thalweg elevation for prolonged periods of time. On occasion, the data suggest that groundwater levels might even briefly rise above the thalweg elevation. The river corridor widens and becomes devoid of riparian vegetation just downstream of Well 4N18W27B, so it is highly likely that a much more prevalent losing reach begins just west of this well.

Dry Conditions

Figure 5-57 illustrates the gaining and losing reaches of the river during periods of below-average precipitation (dry conditions), using data from 2012 to 2016.

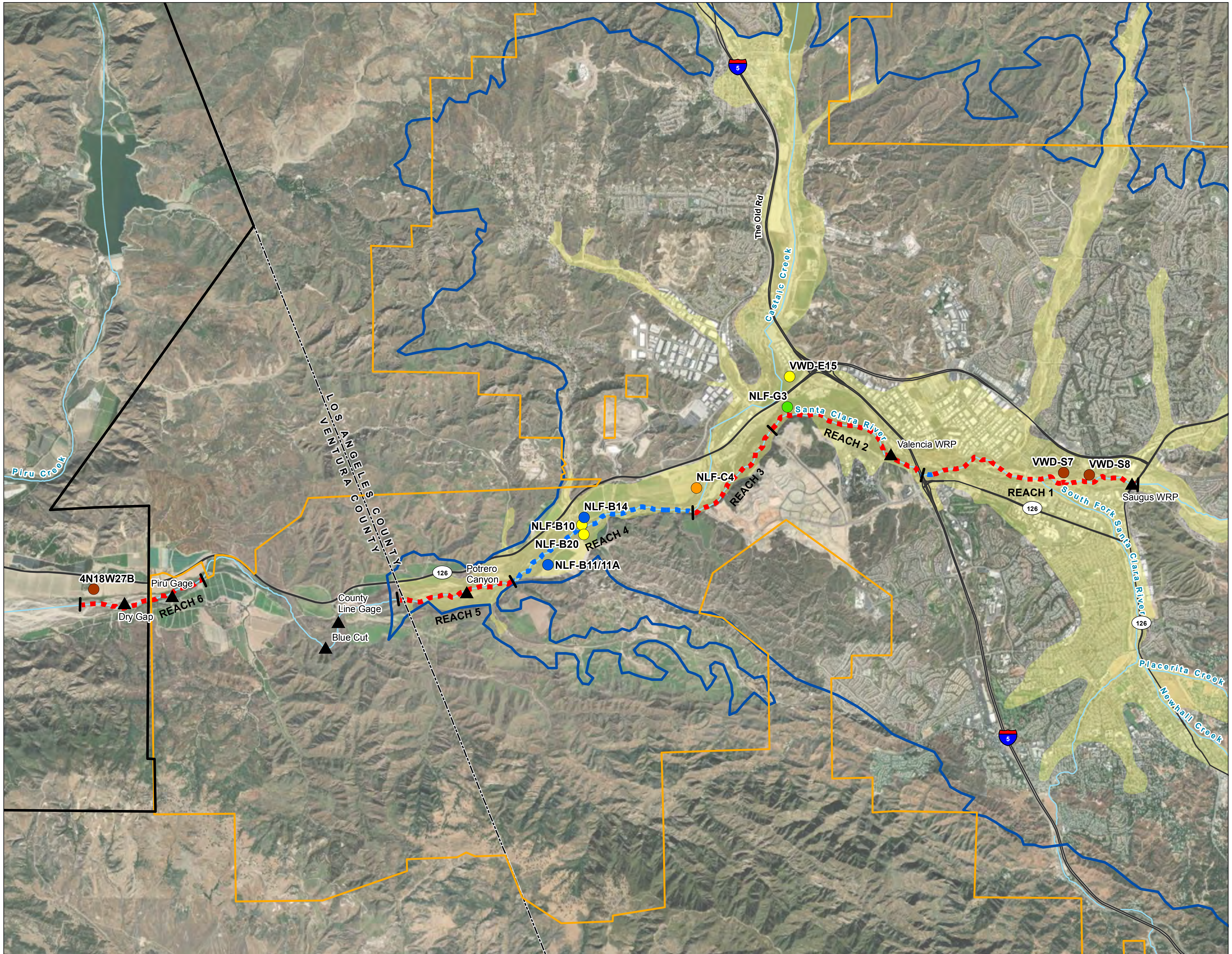

FIGURE 5-57

Gaining and Losing Reaches of the Santa Clara River During Dry Conditions

Santa Clara River Valley
East Groundwater Subbasin
Groundwater Sustainability Plan

LEGEND

- Potentially Gaining Reach
- Potentially Losing Reach

Key Well Depth to Water (ft)

- 0 - 1
- 1 - 5
- 5 - 15
- 15 - 30
- > 30

All Other Features

- Point of Interest
- Alluvial Aquifer
- Service Area Boundary for SCV Water
- UWCD Boundary
- Santa Clara River Valley Groundwater Basin, East Subbasin
- County Boundary
- Major Road
- Watercourse

NOTES

SCV Water: Santa Clarita Valley Water Agency
UWCD: United Water Conservation District

N

0 3,000 6,000 9,000
Feet

Date: December 9, 2021
Data Sources: USGS, Maxar Imagery (2019), DWR Bulletin 118

GSI Water Solutions, Inc.

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Reach 1 **Potentially Losing** – Groundwater levels are consistently below the channel bottom. However, in 2016, during the recent drought, lateral seepage of alluvial groundwater (springs) were observed to still be present beneath the I-5 bridge in the western portion of this reach, creating small pools at the base of steeply sloping ground surface topography and coinciding with an area where the alluvium is very thin (along the south side of Round Mountain). These pools were observed to transition into a small, distinct flowing channel starting at the nearby Old Road Bridge.

Reach 2 **Potentially Losing** – Groundwater levels slowly declined as the drought conditions which began in 2011 progressed, causing the groundwater levels to eventually fall below the channel bottom elevation in the summer of 2013. Prolonged drought is likely to render this length of river a losing reach, even with regular discharges from the WRPs.

Reach 3 **Potentially Losing**– The river appears to be losing throughout this reach. During the last drought, there were fewer releases from Castaic Reservoir and as a result, groundwater levels declined in Well NLF-C4 by 5 feet to 10 feet.

Reach 4 **Potentially Gaining** – The hydrographs for multiple wells in this area do not consistently show this reach to be gaining; however, Well NLF-B14 shows groundwater levels at or above the thalweg during the last drought from 2011 to 2016. The wells in this area have differing screen depths and the thickness of the alluvium in this area may vary, causing local highs or lows in groundwater level. The estimated reference point elevations of the wellheads may also be erroneous. Well NLF-B14 shows relatively steady groundwater levels at or above the channel bottom elevation during drought conditions that likely reflects discharge of Saugus groundwater into the alluvium in this reach.

Reach 5 **Potentially Losing** –Because of a lack of data in this reach, it is not known whether the river is gaining or losing; however, the river resides in a relatively thin layer of alluvium that overlies the low-permeability Pico Formation; therefore, it is likely that during low rainfall periods, this region of the river is losing.

Reach 6 **Potentially Losing** – Water levels in Well 4N18W27B have fallen steadily and dramatically below the thalweg since the onset of the drought in 2011, to depths of as much as 100 feet below ground surface during 2015. Other below-average rainfall periods also show this reach to be potentially losing.

5.2.5 Field Data Collection Work Plan

Based on the results of the evaluation of groundwater-surface water interaction presented previously, a number of data gaps and uncertainties were identified that should be further investigated in order to gain a better understanding of the interaction between groundwater and surface water. A field data collection work plan has been prepared that identifies possible locations for installing piezometers and temperature probes (see Appendix F). The piezometers and temperature probes will be used to measure water levels and temperature in the alluvium near the river. Temperature sensors placed within or above the water table will be able to detect the temperature signature of the underlying groundwater; thus, temperature will be used as a tracer for surface water influence. Because temperature probes will be installed to a depth of 10 feet bgs, they will be located below the effects of diurnal air temperature fluctuations and so they will reflect groundwater temperatures, even though they may not be submerged below the water table. Temperature will also be measured directly in the river. Temperature monitoring will allow identification of locations and time periods where warmer river water (heated by the sun and discharge from wastewater treatment plants) is recharging shallow groundwater and places where cooler groundwater is discharging to the river. The timing and direction of this exchange (gaining or losing stream) may change depending on the time of year and whether it is a dry versus wet year. Changes in temperature in the river, shallow temperature probes, and shallow groundwater will be correlated with river flow and groundwater levels to assess groundwater and surface water interactions over time. Access for installation of the piezometers and temperature probes is still being negotiated with property owners and so the locations for the installations are subject to change.

5.3 Groundwater Dependent Ecosystems (GDEs)

SGMA requires Groundwater Sustainability Agencies (GSAs) to identify and consider GDEs within their GSPs. 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” (23 California Code of Regulations § 351(m)). GDE types include seeps and springs; wetlands and lakes; terrestrial vegetation connected to shallow groundwater; and rivers, streams and estuaries.

To assist in the identification of GDEs, The Nature Conservancy (TNC) has developed a methodology and guidance document to assist in a structured and uniform process for defining and identifying GDEs that may be applied throughout the State. Section 5.3.2 describes the full TNC methodology. This section of the GSP accomplishes a portion of the TNC methodology to identify and map potential GDEs within the Basin.

Although the TNC guidance recommends using depth to groundwater as a means of identifying GDEs. Groundwater depths vary substantially seasonally and year-over-year in this watershed. This analysis identifies and maps habitats within the natural watershed that require intermittent or perennial water and characterizes these areas as “potential GDEs.” This provides for an initial conservative accounting of all areas that may or may not be groundwater dependent. Subsequent analysis using depth to groundwater data is discussed later in this document eliminates some areas identified as potential GDEs.

5.3.1 Environmental Setting

DWR maintains and updates Bulletin 118 that identifies the occurrence and nature of groundwater within the state (DWR, 2016), including the establishment and naming of groundwater basin boundaries, the status of pumping and overdraft for each basin, and the identification of priority basins experiencing critical overdraft.

California’s 515 groundwater basins are classified into one of four categories: high, medium, low, or very low priority based on components identified in the California Water Code Section 10933(b). Basin priority determines which provisions of California Statewide Groundwater Elevation Monitoring (CASGEM) Program and the SGMA apply in a basin. DWR prioritized groundwater basins through the CASGEM Program in 2014. In 2015, SGMA went into effect and required DWR to prioritize basins. Consequently, DWR used the 2014 CASGEM Basin Prioritization as the initial SGMA basin prioritization, which identified the Santa Clara River Valley East Groundwater Subbasin as a high priority basin (DWR, 2019a).

5.3.1.1 Santa Clara River Watershed

The Santa Clara River is the largest river system in Southern California remaining in a relatively natural state. The Santa Clara River originates in the northern slope of the San Gabriel Mountains in LA County and flows in a westerly direction for approximately 84 miles through Tie Canyon, Aliso Canyon, Soledad Canyon, the Santa Clarita Valley, the Santa Clara River Valley, and the Oxnard Plain before discharging to the Pacific Ocean near the Ventura Harbor (see Figure 5-58).

The Santa Clara River and tributary system covers about 1,634 square miles. Major tributaries include Castaic Creek, Bouquet Canyon Creek, and San Francisquito Creek in LA County, and the Sespe, Piru, and

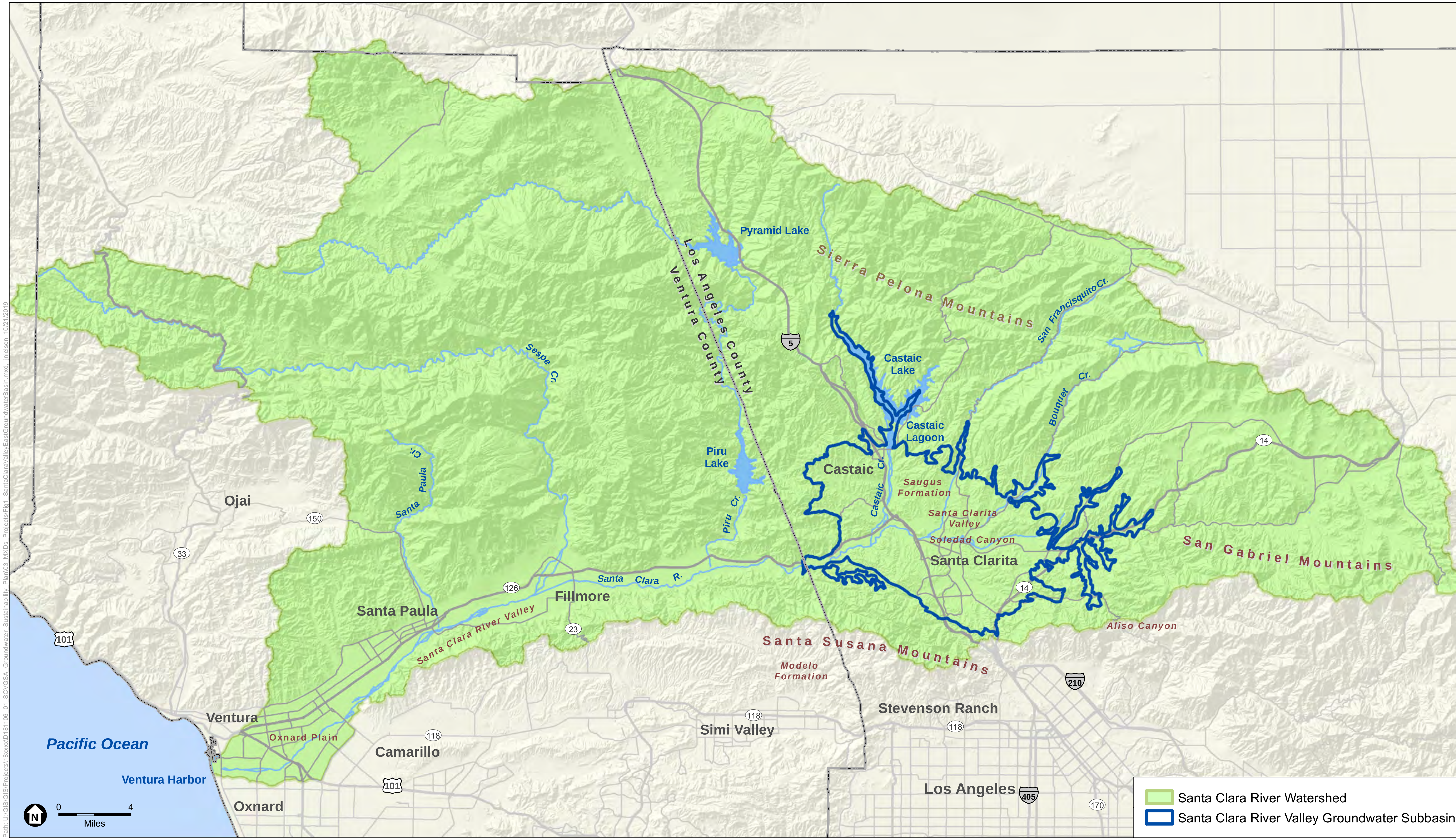
Santa Paula Creeks in Ventura County. Approximately 40 percent of the watershed is located in LA County and 60 percent is in Ventura County (Watersheds Coalition of Ventura County, 2017). Land use within the watershed is predominately open space, with primarily residential, agriculture, and some industrial uses along the mainstem of the river. High quality riparian patches occur along the river and its tributaries (Water Boards, 2019).

5.3.1.2 Santa Clara River Valley East Groundwater Subbasin

The Basin is located in the central- western portion of LA County. The Basin is bound on the north by the Sierra Pelona Mountains, on the east and southeast by the San Gabriel Mountains, and on the south by the Santa Susana Mountains (see Figure 5-58). It is bound on the west by the Modelo Formation, the Saugus Formation, and a thinning of the alluvium near the Piru Subbasin (DWR, 2018). This includes nearly the entirety of the City of Santa Clarita as well as unincorporated LA County communities and census-designated areas such as Castaic and Stevenson Ranch.

5.3.1.3 Riparian Habitat

In general, riparian habitat in the Upper Santa Clara River Basin support several special status avian species including the least Bell's vireo and southwestern willow flycatcher. These species are found in the willow and riparian mixed hardwood forests along the length of the river. Riparian habitat requires a reliable water source. Willow forests occur in areas where groundwater is available year-round. Willow root zones occur most prominently within 1 to 5 feet below the surface but may reach depths of up to 8 feet (TNC, 2018a). Root depths of mature cottonwood trees may reach over 16 feet (Taylor, 2000). The TNC Guidelines suggest that habitats where underlying groundwater depths are 30 feet or more can be assumed to be disconnected from groundwater (TNC, 2018b). Table 5-4 characterizes GDEs in the watershed, focusing on discrete segments of the Santa Clara River below Bouquet Canyon. The GDE resources sustained in these reaches rely on a combination of surface flow and groundwater upwelling.



SOURCE: ESRI, 2019; ESA, 2019.

SCVGSA Groundwater Sustainability Plan

Figure 5-58
Santa Clara Valley East Groundwater Subbasin and Santa Clara River Watershed

ESA

Table 5-4. Characteristics of GDEs along Santa Clara River Corridor

Segment Description	Dry Year Gaining/Losing	GDE Resource
Upper Reaches and Interim Reaches of Santa Clara River	Mostly dry in dry season, Losing	GDEs are present in certain areas of the watershed outside of the Santa Clara River mainstem. These areas include oak woodlands that are supported from hillside seepage and riparian habitat where groundwater is shallow or at the surface intermittently.
Santa Clara River from Bouquet Canyon to I-5 Bridge	Losing/Gaining	This reach stretches from the confluence of the Bouquet Canyon to the I-5 Bridge. Much of the reach is perennially dry, exhibiting Riversidean scrub. The Saugus WRP discharges an average of 5 MGD to the river in this reach that supports a ribbon of riparian vegetation that dissipates as the surface flow infiltrates. Riparian vegetation begins to reemerge below this area that is otherwise a sandy dry wash. Riparian vegetation becomes more established at the confluence of the San Francisquito Creek to the I-5 Bridge. Beginning at the I-5 Bridge for a few 100 feet downstream, perennial surface flows have been recorded resulting from rising groundwater. This perennial flow represents an essential aquatic habitat for sensitive native aquatic species.
Santa Clara River from I-5 Bridge to one mile downstream of the VWRP point of discharge	Losing/Gaining	This reach stretches from just below the I-5 bridge to approximately 1 mile below the Valencia WRP discharge. A few 100 feet downstream of the I-5 bridge, the river narrows and becomes a losing reach. However, at this point the Valencia WRP discharges an average of approximately 15 MGD to the river. The river corridor from the I-5 bridge to one mile downstream of the Valencia WRP exhibits a dense cottonwood and willow forest. The river widens in places and vegetation covers the entire flood plain. The dense riparian forest and perennial aquatic habitat exists in this reach supported in part by Valencia WRP surface flow discharges.
Santa Clara River from one mile to Castaic Creek	Losing	This reach stretches from approximately 1 mile downstream from the Valencia WRP to just above the confluence with Castaic Creek. This is a losing reach with groundwater levels dropping below 25 feet during the driest months. The riparian forest becomes less dense and wide dry sand bars with scrub habitat are evident. Surface water flows are perennial in this reach supporting a ribbon of riparian habitat on one side of the floodplain.
Santa Clara River from Castaic Creek for two miles	Gaining	This reach stretches from just above Castaic Creek for approximately 2 miles downstream. Groundwater upwelling contributes surface flow to this segment even in the driest months of the driest years. The channel begins to narrow, and the riparian forest becomes denser, covering the entire floodplain in many places. Surface water flows are perennial.

Segment Description	Dry Year Gaining/Losing	GDE Resource
Santa Clara River from approximately two miles below Castaic Creek to Ventura County border	Losing/Gaining	This reach stretches for another mile to the end of the Upper Santa Clara Basin near the Ventura County border. The channel narrows and the riparian forest is dense in this segment although groundwater levels may drop below 25 feet during the driest months of dry years. Surface water flows are perennial.

Notes

GDE = groundwater dependent ecosystem

MGD = million gallons per day

I-5 = Interstate 5

WRP= water reclamation plan

5.3.1.4 Aquatic Habitat

Aquatic habitat in the Basin may support several special status species including the arroyo toad, native fishes, and unarmored three-spined stickleback (UTS). The UTS have been found in only a few locations within the watershed upstream of the Valencia WRP. Recently, the UTS has not been located below the Valencia WRP discharges, making the short upstream segment near the I-5 bridge a particularly important location. The Valencia WRP discharges of approximately 15 million gallons per day (MGD) create perennial surface flows. The aquatic habitat is also supported by groundwater upwelling. The cooler groundwater may cool the WRP discharges presenting preferable water quality conditions for special status species such as UTS. As a result, groundwater upwelling in areas that historically have been gaining reaches improves aquatic habitat quality.

5.3.2 The Nature Conservancy Guidance for Identifying GDEs

TNC developed a guidance document based on best available science to assist agencies, consultants, and stakeholders to efficiently incorporate GDEs into GSPs. In the guidance, five steps were outlined to inform the GSP process (TNC, 2018b):

Step 1: Identify 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; and

Step 5: Identify Projects and Management Actions to Maintain or Improve GDEs.

There are two objectives within Step 1 which are to map (Step 1.1) and characterize (Step 1.2) GDEs in the Basin. Step 1.1 is the focus of this section.

5.3.2.1 Step 1.1: Map GDEs

The mapping process in Step 1.1 begins with the publicly available statewide GDE indicators (iGDE) database that was developed by the TNC in partnership with the California Department of Fish and Wildlife (CDFW) and the DWR using the best available statewide data on vegetation, springs and seeps, wetlands, and riparian mapping. This statewide database identifies areas (polygons) where GDEs may be potentially present. These polygons may be refined further using local information and site-specific data to ensure the map accurately reflects local conditions.

Aerial photos and local knowledge may be used to refine the data specific to local regions, resulting in addition, removal, and modifications to polygons. To confirm whether the GDE polygons are connected to groundwater, local hydrologic information may be used to confirm a groundwater connection to the potential GDE. For hydrologic data that is missing or insufficient, TNC guidance provides a list of questions to assess whether iGDE polygons are connected to groundwater. These questions include the following from Worksheet 1 of the guidance:

1. Is the iGDE 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 iGDE less than 30 feet?
3. Is the iGDE 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.

Once a hydrologic connection between each iGDE polygon and groundwater is confirmed, the polygons can be designated as actual GDEs (TNC, 2018b). As a part of the process, some GDE polygons are removed and other GDE polygons added, where appropriate. TNC recommends that iGDEs with insufficient hydrologic data also be considered GDEs but should be flagged for further investigation.

TNC further recommends grouping and consolidating GDE polygons based on their proximity to each other, GDE type (seeps and springs; wetlands and lakes; terrestrial vegetation; and rivers, streams, and estuaries), and association to the same aquifer. Based on DWR's Bulletin 118 and local geologic information, it is recommended to group proximate GDE polygons in the Basin by aquifer.

5.3.2.2 Step 1.2: Characterize GDE Condition

Once GDEs are mapped, they are then characterized in Step 1.2 by their hydrologic and ecological conditions. Although mapping of potential GDEs is the focus of this section, additional characterization of potential GDEs is an anticipated next step (see Section 5.3.5).

To assess the ecological condition of each GDE, the TNC guidance recommends that data sets be reviewed including the iGDE database, U.S. Fish and Wildlife Service's Environmental Conservation Online System, CDFW's California Natural Diversity Database, California Protected Areas Data Portal, Areas of Conservation Emphasis, Regional Water Quality Control Board's beneficial use designations, and local plans or studies such as habitat conservation plans and natural resource management plans.

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 (TNC, 2018b). 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.

This step has not been conducted for all the potential GDEs, although field data sheets have been prepared for a representative sampling of the GDE polygons. The identification of riparian habitat in this watershed is considered to represent high ecological values that could potentially support sensitive species. Any further refinement of habitat condition could result in a reduction of assessed ecological values associated with specific GDE polygons (see Section 5.3.5).

5.3.3 Methods Used to Identify Potential GDEs

5.3.3.1 Data Compilation and Aerial Imagery Analysis Methods

Both vegetation and wetland layers of the Natural Communities Commonly Associated with Groundwater (NCCAG) data set (DWR, 2019a) were used as the baseline mapping for the locations of potential GDEs. The NCCAG data set is the same data set as the statewide GDE indicators (iGDE) database referred to in the TNC guidance (TNC 2018b). The publicly available data compiled into the iGDE database includes several large-scale vegetation and wetland mapping efforts that conform to established State or federal mapping standards. The NCCAG (i.e., iGDE) can be accessed using the NC Data set Viewer which is a web-based mapping program that allows for the viewing and download of vegetation and wetland layers contained in the NCCAG data set (DWR, 2019b). As further detailed in Appendix D, the *Mapping of Potential Groundwater Dependent Ecosystems within the Santa Clara River Valley East Groundwater Basin* (Appendix A of that report), the data sources used to compile the iGDE database include the following:

1. VEGCAMP – The Vegetation Classification and Mapping Program, CDFW
2. CALVEG – Classification and Assessment with Landsat of Visible Ecological Groupings, USDA Forest Service
3. NWI V 2.0. – National Wetlands Inventory (Version 2.0.), U.S. Fish and Wildlife Service
4. FVEG – California Department of Forestry and Fire Protection, Fire and Resources Assessment Program (CALFIRE FRAP).
5. United States Geologic Survey (USGS) National Hydrography Data set (NHD)
6. Mojave Desert Springs and Waterholes (Mojave Desert Spring Survey)

Although the iGDE database lists the National Wetland Inventory (NWI) as one of its data sources, it was noted that the entirety of the NWI data was not accurately depicted. Therefore, NWI data were taken from its original U.S. Fish and Wildlife source to identify areas not included in the iGDE database but which contained riverine channels, riparian, or wetland vegetation. Spatial data were assembled in Keyhole Markup Language (KML) files, that were zipped (i.e., saved as KMZs). The KMZs were prepared using the most current aerial imagery available. The original iGDE database was used to create KMZ 1 (Original iGDE Database).

The Basin boundary defined in Bulletin 118, as viewed on the NC Data set Viewer (DWR, 2019b), was used as the area within which potential GDEs are to be identified (DWR, 2016).

Using aerial imagery (Google, 2019), the next step was to keep, add, or remove potential GDE polygons in accordance with Step 1.1 of the TNC guidance based on an assessment and interpretation of vegetative cover and/or land use. Added polygons included vegetation communities that were already mapped as potential GDE polygons in the original iGDE database but needed to be revised or added based on the vegetative cover shown on the aerial imagery (i.e., unmapped sections of river channels). These added polygons were assigned one of the vegetation or wetland classifications of an adjacent polygon or an existing classification as used in the iGDE data set, for consistency (KMZ 2). The added potential GDE polygons were included with the original iGDE database to create a working iGDE database [(KMZ 2 (iGDE Database + Added GDEs)]. Areas that were difficult to assess using aerial imagery were noted as needing a field assessment to confirm the vegetation present, as discussed below.

5.3.3.2 Field Assessment Methods

To verify polygons of the working iGDE database reflected in KMZ 2, and to gather species and habitat information, representative potential GDE polygons were selected for a field assessment. These areas included the following:

1. At least one of each habitat type reflected in the original iGDE database
2. Areas where vegetation type or hydrology was unclear based on the aerial imagery analysis (i.e., isolated tree clusters with no obvious connection to a water source)

Prior to the field assessment, a field data sheet was developed that incorporated species and habitat information, and environmental beneficial uses established by the LARWQCB (LARWQCB, 2016), consistent with TNC guidance for determining the ecological condition of a potential GDE. Additional information on the field data sheet included, but was not limited to, dominant plant species observed within the tree, shrub, and herbaceous layers; wildlife species observed; hydrology information such as the presence of surface flows or ponded water and the source of water; and soil type. The data sheet was completed for each of the potential GDE polygons selected for a field assessment that were accessible.

The field assessment was conducted by ESA biologists on September 5 and 6, 2019. The survey was conducted on foot within accessible portions of the representative potential GDE polygons, which comprised 335 acres. Aerial photography and tablets using ArcGIS Collector were used to accurately locate each polygon. Vegetation communities were characterized and mapped in the field in accordance with the vegetation classifications from the original iGDE database. In areas that were not accessible at the time of the survey, visual observations were made from the nearest accessible locations. Inaccessible locations typically occurred on private or gated property, and trespassing was avoided. Areas where the polygon could not be visually assessed from a distance or with binoculars were not analyzed and were noted as being inaccessible. Inaccessible polygons accounted for a total of 12 distinct polygons totaling 30 acres (or an estimated 8 percent of the total survey area). Inaccessible polygons were kept as potential GDE polygons with the original vegetation classification. Datasheets prepared during the field assessment are included in Appendix D, the *Mapping of Potential Groundwater Dependent Ecosystems within the Santa Clara River Valley East Groundwater Basin* (Appendix B of that report).

5.3.3.3 Refinement of GDE Mapping

Removal of Potential GDE Polygons

After the field assessment, it became evident that some habitat types do not meet the definition of GDEs as defined under SGMA. These areas include the following:

1. Upland habitats that were planted or landscaped, and/or are currently supported by irrigation
2. Human-made features[23] maintained by management of surface flows (i.e., intakes/outlets) such as golf course ponds, detention basins, concrete-lined channels, open water reservoir/lakes and associated riparian/wetland vegetation (i.e., Castaic Lake)
3. Barren[24] segments of river channels
4. Riversidean scrub habitats. Vegetation classified within the original iGDE database as Riversidean Alluvial Scrub, Riverwash Scrub, or Scalebroom were removed from the potential GDEs, as these

[23] Human-made features exclude historical drainage features that were later surrounded by development.

[24] Barren habitat is defined by the absence of vegetation. Any habitat with <2% total vegetation cover by herbaceous,desert, or nonwildland species and <10% cover by tree or shrub species is defined this way (CDFG 1988).

habitats are established in river floodplains where they are dependent on (limited) flood events (Beller et al., 2011), and are generally not known to be groundwater dependent

The remaining potential GDE polygons were compiled into KMZ 3 (iGDE Database + Added GDEs - Removed GDEs).

Remapping and Reclassification of Potential GDE Polygons

A review of all confirmations or modifications of the field assessed potential GDEs made during the field assessment was conducted in coordination with ESA's Geospatial Services' staff. Based on the field assessment, a handful of polygons originally classified as Coast Live Oak, Riparian Mixed Hardwood, Riversidean Alluvial Scrub, Scalebroom or Willow (Shrub) were reclassified and remapped from KMZ 3 as necessary and kept as potential GDEs.

The vegetation communities of the potential GDEs from KMZ 3 were then reclassified according to *A Manual of California Vegetation, Second Edition* (Sawyer et al., 2009) based on the dominant plant species observed during the field assessment. In addition, in accordance with TNC guidance, the potential GDE polygons were also grouped by potential GDE type (seeps and springs; wetlands and lakes; terrestrial vegetation; and rivers, streams and estuaries). The potential GDE polygons reflective of this step were compiled into KMZ 4 (Final Potential GDE Mapping).

5.3.4 Results of Potential GDE Identification

5.3.4.1 Data Compilation and Aerial Imagery Analysis Methods

The iGDE database source data includes an estimated 6,926 acres of potential GDEs (KMZ 1) categorized by the NCCAG as wetlands and vegetation. These two categories are a combination of a number of different vegetation classifications systems. As such, the vegetation types within the NCCAG data set associated with these two categories included: Baccharis (Riparian), California Sycamore (*Platanus racemosa*), Coast Live Oak (*Quercus agrifolia*), Fremont Cottonwood (*Populus fremontii*), Arrowweed (*Pluchea sericea*), Riparian Mixed Hardwood, Riparian Mixed Shrub, Riversidean Alluvial Scrub, Riverwash Scrub, Narrowleaf Willow (*Salix exigua*), Scalebroom (*Lepidospartum squamatum*), Tule – Cattail (*Schoenoplectus* sp. – *Typha* sp.), Valley Oak (*Quercus lobata*), Wet Meadows, Willow, and Willow (Shrub). NWI data within the Basin contained the following classifications: Freshwater Emergent Wetland, Freshwater Forested/Shrub Wetland, Freshwater Pond, Lake, and Riverine.

After review of aerial imagery, a total of 1,533 acres of potential GDEs were added to the original iGDE database, totaling 8,459 acres of potential GDEs as reflected in KMZ 2. These added potential GDE polygons included the following vegetation communities: Coast Live Oak, Riparian Mixed Hardwood, Riparian Mixed Scrub, and Willow (Shrub). Several of the less common communities that occurred within the NCCAG data set were consolidated into the surrounding communities if the analysis of aerial imagery was not conclusive to that specific type of community. This included Baccharis, California Sycamore, Riverwash Scrub, Narrowleaf Willow, Tule-Cattail, and Valley oak. One detention basin and four ponds were also noted as potential GDEs based on the data compilation and aerial imagery analysis, as they are features located along natural drainages.

5.3.4.2 Field Assessment

During the field assessment, some areas originally mapped in the iGDE database as Riversidean Alluvial Scrub or Willow (Shrub) were confirmed to be riparian woodland communities (Riparian Mixed Hardwood or Coast Live Oak) along the Santa Clara River mainstem, Castaic Creek, and Bouquet Canyon. Several willow species including Goodding's willow (*Salix gooddingii*), red willow (*Salix laevigata*), arroyo willow (*Salix* *lasiolepis*) and narrowleaf willow occurred within much of the Riparian Mixed Hardwood community. Upland habitats surveyed in the field that were planted or landscaped, and/or are currently supported by irrigation, included pine and eucalyptus trees.

It should be noted that not all polygons identified as potential GDEs were visited during the field assessment. Several areas identified for field assessment (such as Potrero Canyon, detention basins, and four ponds) were not accessible due to a number of factors including the presence of private property, locked gates, fences or other factors which prevented entry. Inaccessible areas totaled 30 acres, and vegetation communities or land uses within these inaccessible areas were classified solely based on the aerial imagery analysis.

5.3.4.3 Refinement of Potential GDE Mapping

Further refinement of the potential GDEs was conducted to remove habitat types identified in aerial imagery and confirmed in the field visit that do not meet the definition of GDEs as defined under SGMA. Riversidean Alluvial Scrub, Riverwash Scrub, and Scalebroom habitats were removed from the potential GDE database. In addition, habitat types associated with man-made features such as wet meadows on the shores of Castaic Lake, planted/irrigated areas, detention basins, golf course ponds, ponds, barren channels, and other man-made features were also removed from the potential GDE database. A total of 6,567 acres were removed from the potential GDE database (KMZ 3).

The remaining potential GDEs were then reclassified in accordance with *A Manual of California Vegetation, Second Edition* (Sawyer et al., 2009) where applicable, based on observations from the field assessment. Table 5-5 lists and Figure 5-59 displays the potential GDEs reflected in KMZ 4, totaling an estimated 1,890 acres. The primary vegetation types include Fremont cottonwood forest and coast live oak woodland along the Santa Clara River and its tributaries.

Table 5-5. Summary of Potential Groundwater Dependent Ecosystems within the Santa Clara River Valley East Groundwater Subbasin

Waterway/Tributary	Tributary ID Number	Vegetation Classification Based on Aerial Imagery Analysis[1]	Revised Vegetation Classification[2]	Area (acres)
Santa Clara River	SCR	Riparian mixed hardwood	Fremont cottonwood forest	698.33
Unnamed tributary to Santa Clara River (Fairfield Way)	SCRTRIB3	Riparian mixed hardwood	Fremont cottonwood forest	1.65
Unnamed tributary to Santa Clara River (Turn Leaf Court)	SCRTRIB2b	Riparian mixed hardwood	Fremont cottonwood forest	1.10
Unnamed tributary to Santa Clara River (Golden Valley Road)	SCRTRIB2a	Coast live oak	Coast live oak woodland	2.33
Unnamed tributary to Santa Clara River (Keaton Street)	SCRTRIB1	Riparian mixed hardwood	Fremont cottonwood forest	5.29

Waterway/Tributary	Tributary ID Number	Vegetation Classification Based on Aerial Imagery Analysis[1]	Revised Vegetation Classification[2]	Area (acres)
Unnamed tributary to Santa Clara River (Sierra Highway, south of Soledad Canyon Road)	SCRTRIB4	Riparian mixed hardwood	Fremont cottonwood forest	1.01
Unnamed tributaries to Santa Clara River (Sierra Highway, north of Soledad Canyon Road)	SCRTRIB5	Coast live oak	Coast live oak woodland	2.34
		Riparian mixed hardwood	Fremont cottonwood forest	1.84
		Pond	Open water	0.50
Unnamed tributary to Santa Clara River (Sand Canyon Road)	SCRTRIB6	*Coast live oak	Coast live oak woodland	41.95
		*Pond	Open water	1.12
Unnamed tributary to Santa Clara River (west of I-5, South of Santa Clara River)	SCRTRIB7	Coast live oak	Coast live oak woodland	12.64
Unnamed tributary to Santa Clara River (west of I-5, Borton Street, Val Verde)	SCRTRIB8	*Coast live oak	Coast live oak woodland	7.69
		*Riparian mixed hardwood	Fremont cottonwood forest	1.66
Unnamed tributaries of Santa Clara River (far western GWB, Del Valle)	SCRTRIB9	Riparian mixed hardwood	Fremont cottonwood forest	0.9
		*Riparian mixed scrub	Mulefat thickets	3.57
South Fork Santa Clara River	SCRTRIB10	Riparian mixed hardwood	Fremont cottonwood forest	67.37
		Riparian mixed scrub	Mulefat thickets	2.33
Unnamed tributary to South Fork Santa Clara River (La Salle Canyon Road)	SCRTRIB11	*Coast live oak	Coast live oak woodland	5.19
		Riparian mixed hardwood	Fremont's cottonwood forest	0.65
		*Detention basin	Detention basin	0.59
Unnamed tributary to South Fork Santa Clara River (The Old Road)	SCRTRIB12	Coast live oak	Coast live oak woodland	44.93
Bouquet Creek	SCRTRIB13	Riparian mixed hardwood	Fremont cottonwood forest	13.07

Waterway/Tributary	Tributary ID Number	Vegetation Classification Based on Aerial Imagery Analysis[1]	Revised Vegetation Classification[2]	Area (acres)
Unnamed tributary to Bouquet Creek (Forest Route 6N18)	SCRTRIB14	Coast live oak	Coast live oak woodland	1.35
		Riparian mixed scrub	Mulefat thickets	1.29
Castaic Creek	SCRTRIB15	Riparian mixed hardwood	Fremont cottonwood forest	201.10
Unnamed tributary to Castaic Creek (Tapia Canyon Road)	SCRTRIB16	Coast live oak	Coast live oak woodland	24.09
Unnamed tributaries to tributary of Castaic Creek (Hasley Canyon Road)	SCRTRIB17	Coast live oak	Coast live oak woodland	4.25
		Riparian mixed hardwood	Fremont cottonwood forest	2.77
San Francisquito Creek	SCRTRIB18	Riparian mixed hardwood	Fremont cottonwood forest	91.22
Placerita Creek	SCRTRIB19	Riparian mixed hardwood	Fremont cottonwood forest	17.58
		Coast live oak	Coast live oak woodland	2.77
Unnamed tributary to Placerita Creek (Oro Fino Mountainway)	SCRTRIB20	Coast live oak	Coast live oak woodland	25.74
Newhall Creek	SCRTRIB21	Riparian mixed hardwood	Fremont cottonwood forest	15.47
Unnamed tributary to Newhall Creek (Pine Street)	SCRTRIB22	Coast live oak	Coast live oak woodland	43.75
Potrero Canyon	SCRTRIB23	*Coast live oak	Coast live oak woodland	3.43
		*Riparian mixed hardwood	Fremont cottonwood forest	35.95

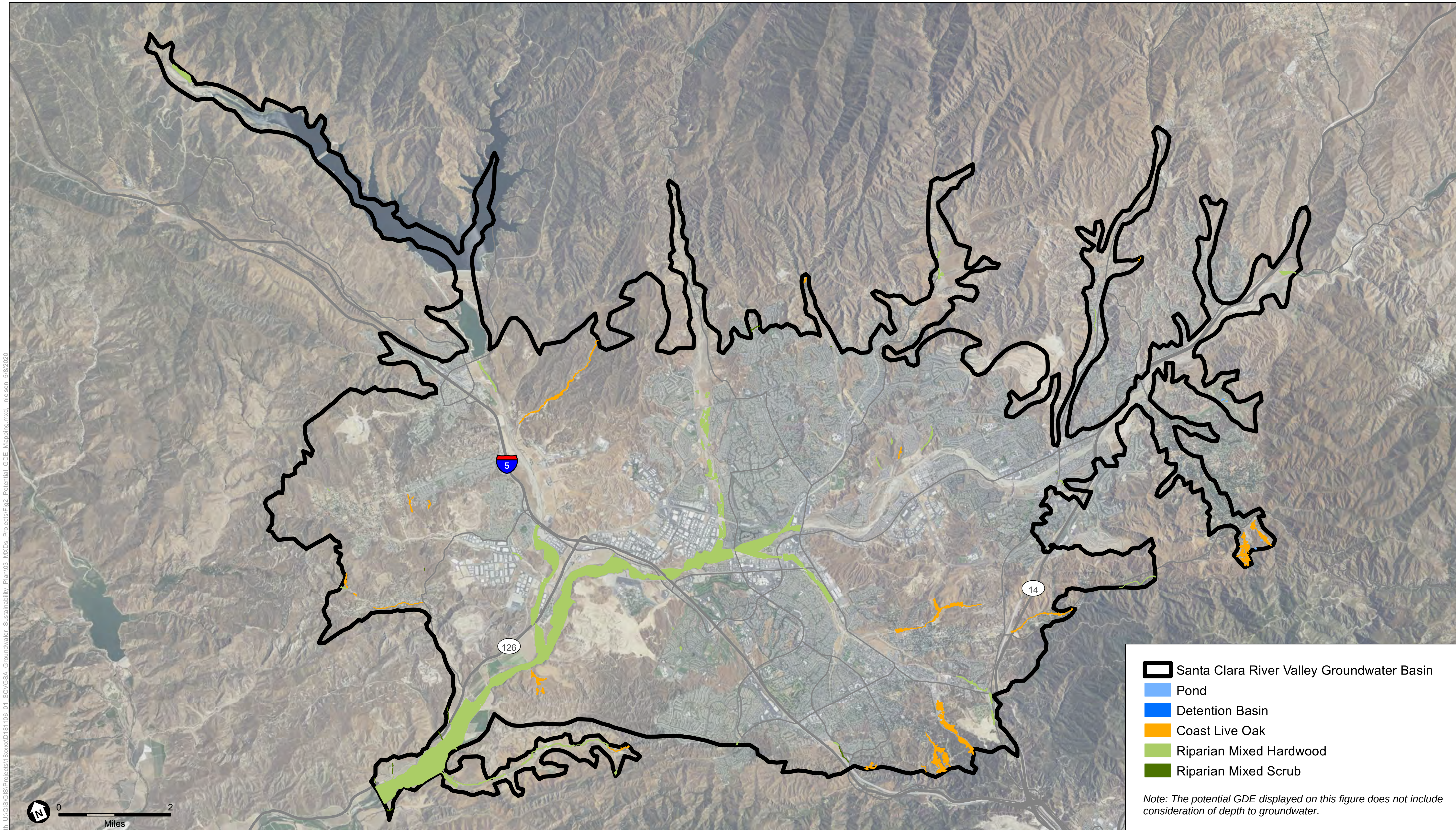
Waterway/Tributary	Tributary ID Number	Vegetation Classification Based on Aerial Imagery Analysis[1]	Revised Vegetation Classification[2]	Area (acres)
Features Associated with Sand Canyon Golf Course	SCRTRIB24	*Pond	Open water	1.13
		*Riparian mixed hardwood	Fremont cottonwood forest	1.14
		*Riparian mixed scrub	Mulefat thickets	0.12
Total				1,889.96

Notes

[1] Based on KMZ 2.

[2] Vegetation communities classified using *A Manual of California Vegetation, Second Edition* (Sawyer et al., 2009).

* Inaccessible during the field assessment.



SOURCE: ESA, 2020; NWI, 2019; NCCAG, 2019.

Figure 5-59
Potential GDE Mapping

ESA

5.3.4.4 Discussion of Potential GDE Mapping

Following the TNC suggested methodology, an estimated 1,890 acres of potential GDE have been documented within the Basin boundaries. The KMZ 4 database provides the geographic location for each distinct potential GDE. The potential GDEs are comprised primarily of riparian corridors. Much of the acreage associated with the potential GDEs occurs in the main stem of the Santa Clara River. However, many smaller potential GDEs are identified within the tributaries reaching into the higher elevations. Some potential GDEs in the higher elevations may be fed from higher elevation seepage disconnected from the shallow groundwater basin.

In accordance with Step 1.1 of the TNC guidance, potential GDEs with a depth to groundwater of greater than 30 feet may indicate that no connection to groundwater is possible to support vegetation. Groundwater levels vary with seasons, hydrologic year types, and alluvial aquifer pumping. The analysis of potential GDEs presented herein inventories all habitats observed within the semi-arid watershed that require intermittent or perennial access to water, subtracting only the man-made water features and irrigated landscapes (including agricultural land). Section 5.4 discusses further refinement of the distribution of GDEs using a 30-foot depth to groundwater criterion.

Step 1.2 of the TNC guidance that recommends characterizing the ecological value of each GDE unit to assist with GDE prioritization was not conducted. Rather than refine the relative value of each GDE polygon, documentation is provided regarding the existence of habitat that may be suitable to support sensitive species. Relative quality of the habitat in each stretch of the river may depend on occupation by sensitive species, the season, consistency of water availability, invasive species, nuisance surface flows, urban runoff water quality including trash, and in stream human use including homeless encampments. Additional field verification and/or other study is needed to fully implement Step 1.2 of the TNC guidance for the potential GDE polygons. However, in this semi-arid environment, the current existence of riparian, aquatic, and woodland habitats represent important ecological values that have the potential to support sensitive species; therefore, additional characterization of ecological value is not recommended. A discussion of riparian and aquatic habitats is presented below.

5.3.5 Refinement of GDE Distribution Based Upon Groundwater Levels

The TNC guidelines suggest that when groundwater is consistently greater than 30 feet bgs, it can be concluded that the vegetation is not reliant on a groundwater aquifer. Figure 5-60 presents a revised map of GDEs within the Upper Santa Clara River Basin considering this 30-foot depth to groundwater criterion. Since groundwater fluctuates over the year and between years, the 30-foot criterion data is taken conservatively from modeled groundwater depths throughout the Basin in the late dry season (September) during a wet year (2011). As illustrated in Figure 5-60, some of the vegetated areas in the eastern portion of the basin and in the upper canyons have been removed from the GDE category. However, the majority of potential GDEs identified in Section 5.3.3 are confirmed, particularly the areas within the Santa Clara River corridor extending from the confluence with San Francisquito Creek to the western Basin boundary.

SOURCE: ESA, 2020; NWI, 2019; NCCAG, 2019.

GDE Considerations Assessment

Figure 5-60
Wet Year - September, 2011, GDE Mapping

ESA

5.3.6 Historical Range in Groundwater Levels

Groundwater levels tend to decline in the late summer and recover in the winter responding to natural recharge and reduced pumping in the winter months, and groundwater levels also reflect multi-year drought with progressively lower levels each year, followed by recovery in wetter periods. The existing GDEs have been sustained through a recent drought (2012–2016) that resulted in historically low groundwater levels. Table 5-6 summarizes the historical lows recorded in several representative locations along the river corridor. Figure 5-61 identifies these locations. When groundwater levels are above these recorded temporary historical lows, it can be inferred that GDEs are not significantly and unreasonably affected. As a result, these existing wells may be used to monitor future groundwater elevations to ensure that GDEs are sufficiently maintained throughout the upper Santa Clara River.

Table 5-6. GDE Monitoring Locations and Historical Low Groundwater Levels

Location Description	Well Name	Historical Low Depth to Groundwater below River Thalweg (feet bgs)[1]	Historical Low Groundwater Elevation (feet NAVD 88)[2]
San Francisquito Canyon	NLF-W5[3]	42	1,108
Santa Clara River Below Mouth of Bouquet Canyon	GDE-A[3]	42	1,087
Santa Clara River at I-5 Bridge	GDE-B	-5	1,060
Santa Clara River Near Valencia WRP	GDE-C	8	1,027
Santa Clara River 1 Mile Downstream of Valencia WRP	NLF-G3	5	975
Castaic Creek in Lower Castaic Valley	NLF-E	40	981
Santa Clara River Below Mouth of Castaic Creek	GDE-D	3	932
Santa Clara River at Mouth of Potrero Canyon	GDE-E	0	860

Notes:

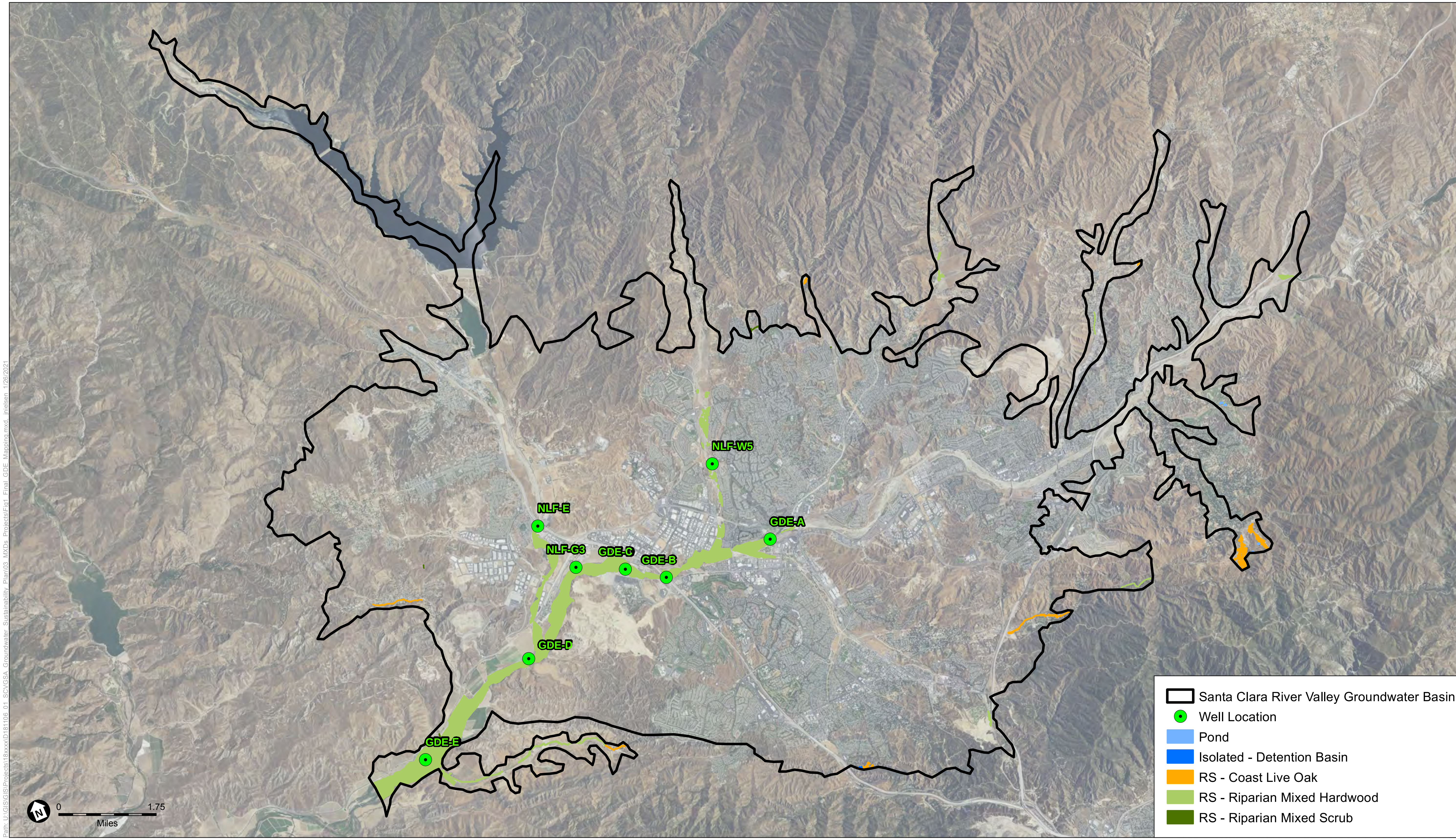
[1] Subject to change in monitoring plan

[2] Historical groundwater elevations are from simulations conducted using the calibrated groundwater flow model.

[3] Might not be within an actual GDE area.

bgs = below ground surface GDE = groundwater-dependent ecosystem

NAVD88 = North American Vertical Datum of 1988 WRP = water reclamation plant



SOURCE: ESA, 2020; NWI, 2019; NCCAG, 2019.

GDE Considerations Assessment

Figure 5-61
Potential Monitoring Locations

ESA

Groundwater levels in the alluvium respond to higher rates of pumping in the summer generally reaching their deepest levels around September (early fall) and recovering entirely in the winter. During prolonged periods of drought, the recovery may not be complete, and a lowering of groundwater levels occurs year-over-year until a single or multiple wet seasons completely recover levels, maintaining an historical average baseline level. Figure 5-62 depicts this pattern based on a conceptual hydrograph provided in the TNC guidelines. As shown in the figure, the historical annual cycle has created conditions that support habitat over time.

The historical hydrographs of older wells show that groundwater was pumped in large amounts for a short period in the 1950s. Alluvial groundwater levels dropped over 30 feet in some areas for a period of one or 2 years and then immediately recovered back to previous levels. This sudden major temporary decline has not occurred since the 1950s because urbanization has reduced the amount of agricultural pumping and because importation of state water and discharges of treated wastewater to the river from the WRPs has increased the flow in the river overall. The hydrographs illustrate that alluvial groundwater levels can recover from significant declines in a matter of one or 2 wet years.

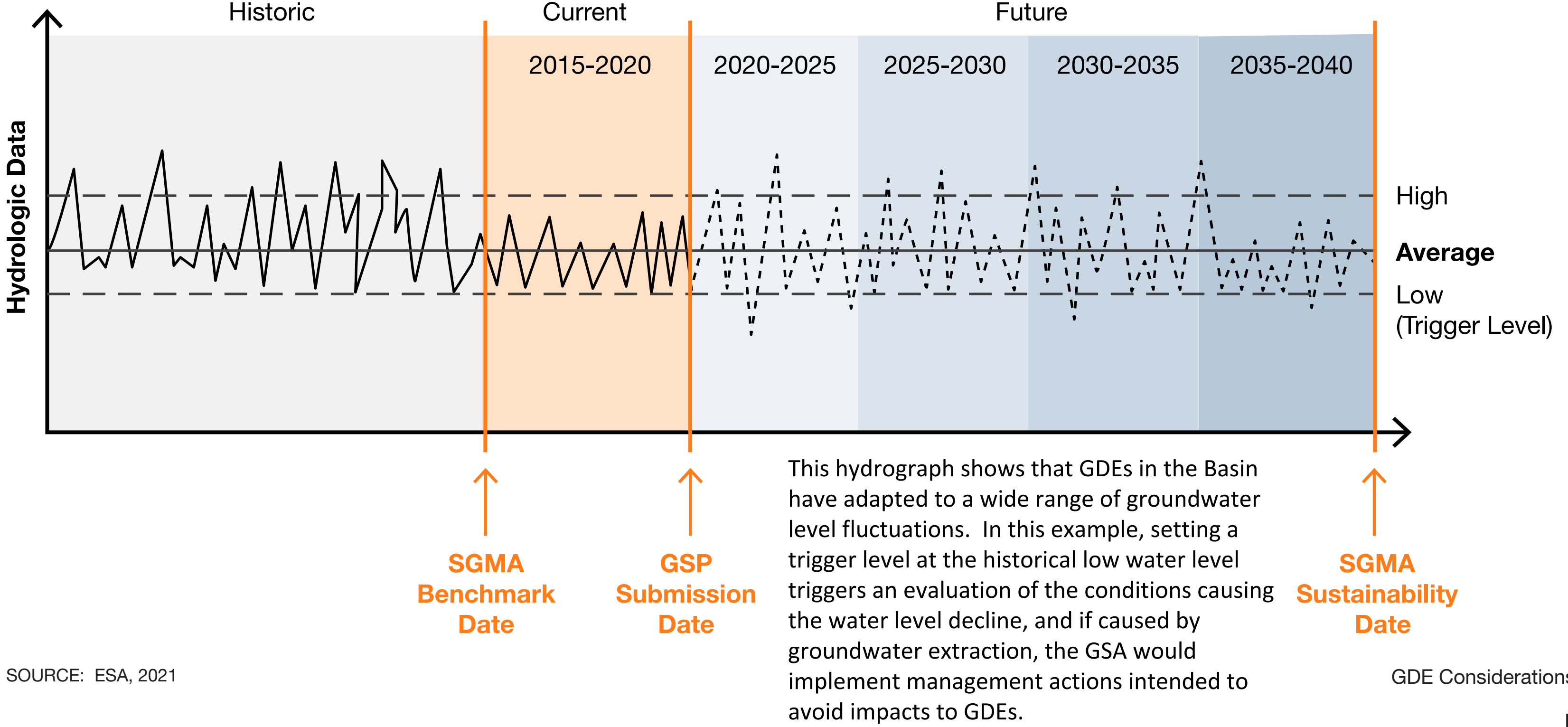
5.3.7 Resilience of Existing Habitat

The existing vegetation within the GDE area has survived a pattern of annually lowering levels with even greater declines in drought years. This pattern affects different parts of the river channel differently. Figures 5-63, 5-64, and 5-65 schematically depict this seasonal variability within different river segments. The river channel widens and narrows providing varying density of riparian habitat corresponding to river width, proximity to surface water, and groundwater depth.

Discharges from the Valencia WRP provide approximately 15 MGD of surface water just downstream from the I-5 bridge. This surface water supports riparian habitat. A green ribbon of vegetation can be seen following surface water where shallow groundwater may not be reliably present. In some of these areas, the remaining channel is a dry sand bank. In other areas, riparian vegetation occurs sporadically across the channel, supported either by high soil moisture from lateral movement of perennial surface water or from shallow groundwater. The more sparsely vegetated areas may represent areas where groundwater drops sufficiently often to stress vegetation during normal and dry years.

In these losing reaches and particularly in the eastern portion of the watershed where depth to groundwater is already below the thalweg (bottom of the river channel), groundwater becomes progressively lower as the summer progresses. Vegetation that relies on moisture within the first 1 to 5 feet exclusively may not survive or even exist in areas where groundwater routinely declines by 10 feet. Rather, vegetation that exists in this condition is likely seasonal in nature. However, some vegetation such as larger trees may develop root systems that can accommodate this variability. In some areas, riparian habitat may experience high degrees of stress during prolonged drought conditions. If the drought lasts long enough, vegetation may be temporarily impacted. However, when wet conditions return, these areas may re-establish themselves with emergent riparian vegetation. Furthermore, high flows change the channel morphology periodically, transporting sediment and altering the low flow channel location that may result in vegetation conversions or habitat value fluctuations in these areas.

Figure 5-66 presents an aerial photograph of the Santa Clara River in 1947 showing river segments with thick vegetation and other drier segments corresponding to reliable groundwater availability prior to surface discharges from the WRPs. The historical aerial photograph illustrates that vegetation has persisted in the river channel since the last mid-century similar to the existing condition.



SOURCE: ESA, 2021

GDE Considerations Assessment

Figure 5-62
Conceptual Groundwater Hydrograph

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